PRACTICAL

# ELECTRONICS

SEPTEMBER 1974

25p

## PE CCTV MONOCHROME CAMERA

LOW COST INSTRUMENT FOR USE WITH 625 LINE TV RECEIVERS
. . . STARTING THIS MONTH

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These letters – and there are many more on file at Aldermaston Court – speak of the rewards that come to the man who has given himself the specialised know-how employers seek. There's no surer way of getting ahead or of opening up new opportunities for yourself. It will cost you a stamp to find out how we can help *you*. **Write to B.I.E.T. Dept. BEE80, Aldermaston Court, Reading RG7 4PF.**

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# PRACTICAL ELECTRONICS

VOLUME 10 No. 9 SEPTEMBER 1974

## CONSTRUCTIONAL PROJECTS



## GENERAL FEATURES



## NEWS AND COMMENT



**Because of prevailing production problems, no firm publishing date can be announced for the October issue. Readers are advised to check regularly with their local supplier from mid-September onwards.**

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# Henry's

**DON'T RELY ON YOUR MEMORY BUY NOW AT BARGAIN PRICES**
*Hi Fi and Transistors – Up to date Brochures on request*

**HENRY'S CATALOGUE**
Due to rapid price changes, shortages of paper and raw materials, all prices in the existing catalogues no longer apply. Call or phone for latest prices. A new catalogue will be available for Aug/Sept. 1974.

**UK's LARGEST RANGE OF KITS & GADGETS**

## TEST EQUIPMENT MULTIMETERS

(carr. etc. 30p)
ITI-2 20K/Volt Slimline £5·95
M210 (Case £1·25) 20K/Volt Slimline deluxe £6·75
TLH33D 2K/Volt Robust £7·50
U4323 (+1F 8AF OSC) £7·00
AF105 (Case £1·90) 50K/Volt 12·50
U4313 20K/Volt AC current. Steel case 10·50
U4341 Plus Built-in transistor tester 10·50
Model 500 (Case £2·25). 30K/Volt 11·75

## OTHER EQUIPMENT

SE250B Pocket Signal Injector 2·25 carr. 15p
TE15 Grid Dip meter 440kHz 280mHz 16·50 carr. 30p
TE40 AC Millivoltmeter 1·2mHz 19·75 carr. 35p
TE65 28 Range valve voltmeter 22·50 carr. 40p
TE20D 120kHz-500mHz RF Gen. 18·95 carr. 40p
TE22D 20Hz-200kHz Audio Gen. 19·95 carr. 40p
SE350A Deluxe Signal Tracer 12·95 carr. 20p
SE400 Volts/ohms/R-C sub./RF field/RF gen. 15·50 carr. 20p

## New Revolutionary Supertester 680R

680R Multi-tester £18·50

**Accessories**
Transistor tester 11·00
Electronic voltmeter 18·00
Ampclamp 11·95
Temperature probe 11·95
Gauss meter 11·95
Signal injector 5·95
Phase Sequence 5·95
EHT Probe 5·95
Shunts 25/50/100A 4·50

## A SELECTION OF INTERESTING ITEMS

C3025 Compact transistor tester 6·95 p & p 15p
Q4002 Photoelectric System £13·70
E1310 Stereo mag. cart. preamp. 4·80 p & p 25p
Easiphone D1201 telephone amp 7·50 p & p 25p
D1203 Teleamp. with PU coil 4·95 p & p 20p
LL1 Door Intercomm. and chime 8·40 p & p 25p
9" Twin spring unit For 3·30 p & p 15p
16" Twin spring unit Reverbs 6·85 p & p 25p
US50 Ultrasonic Switch Trans/Rec £12·75
C3041 1-250mHz £4·25
C3043 SCH 1-300mHz £5·75
VHF 105 Aircraft Band Convertor 4·50 p & p 15p
B2005 4 Ch. mic. mixer 4·20 p & p 15p
B2004 2 ch. Stereo mixer 6·75 p & p 15p
PK3 Kit £1·95 p & p 20p

## EXCLUSIVE: SPECIAL OFFERS

MW/LW CAR RADIO + or − Earth with speaker and fixings. £6·50 c/p 30p. 8 TRACK CAR STEREO (− Earth) with speakers in Pods and fixings £12·50 c/p 40p. Portable Batt/Cass Tape Player £7·25. Car Lighter Plug and adaptor for all cassette and radio 6/7½/9 V output (state width) £1·95 each. Rotel Stereophones RH630 £6·80, RH700 £10·25, RH430 £4·14. Rotel RA310 15+15 watt Stereo Amplifier (List £52·00) £34·52. Wem W500 Battery/Mains Cassette Recorder £12·75.

PORTABLE CASSETTE TAPE PLAYER—for car or carry around. £7·25 c/p. 20p. HANIMAX BC808 POCKET CALCULATOR WITH % KEY. £28·95. HANIMAX BC811M MEMORY VERSION £33·75 *BC807 % key £22·95 *BCM850 % key + memory £33·95. *MAINS UNIT £3·25 EXTRA. HANIMAX H101 STEREO COMPACT RECORD PLAYER 2 7 watts. Complete with Speakers (List £54·50) Price £39·95 Plus free pair of stereo phones.

## BUILD THIS RADIO

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

## FIBRE OPTICS

0·01 diam. Mono Filament £5·50 per 100 metre reel
0·13 diam. 64 Fibres Sheathed £1·00 per metre.
SPRAYS 15mm diam. (Mare's Tail Spray £10·50.)

## SPECIAL PURCHASES

### UHF TV TUNERS CHANNELS 21 TO 64

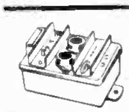
Brand new transistorised geared tuners for 625 Line Receiver IF output. £2·50. Post 20p.

**PUSHBUTTON UHF TV Tuner**
New purchase of 4 button transistorised UHF tuners, £3·50, post 20p.

## EASY TO BUILD KITS BY AMTRON— EVERYTHING SUPPLIED

| Model No. | | £ p |
|---|---|---|
| 310 | Radio control receiver | 3·29 |
| 300 | 4-channel R/C transmitter | 6·61 |
| 345 | Superhet R/C receiver | 6·61 |
| 65 | Simple transistor tester | 1·66 |
| 115 | 8 watt Amplifier | 4·50 |
| 120 | 12 watt amplifier | 4·73 |
| 125 | Stereo control unit | 6·01 |
| 130 | Mono control unit | 4·16 |
| 605 | Power supply for 115 | 5·31 |
| 610 | Power supply for 120 | 5·31 |
| 615 | Power supply for 2 × 120 | 6·64 |
| 230 | AM/FM aerial amplifier | 3·29 |
| 240 | Auto packing light | 6·90 |
| 275 | Mic. preamplifier | 6·98 |
| 570S | LF generator 10Hz-1mHz | 21·45 |
| 575S | Sq. wave generator 20Hz-20Hkz | 19·77 |
| 590 | SWR meter | 9·47 |
| 630 | STAB Power supply 6-12V 0·25-0·1A | 9·24 |
| 690 | DC motor speed Gov. | 3·31 |
| 700 | Electronic Chaffinch | 7·92 |

| Model No. | | £ p |
|---|---|---|
| 760 | Acoustic switch | 12·57 |
| 780 | Metal Detector (electronics only) | 10·91 |
| 790 | Capacitive Burglar alarm | 7·92 |
| 835 | Guitar preamp. | 4·99 |
| 840 | Delay car alarm | 6·99 |
| 875 | CAP Discharge ignition (for car engine (—Ve Earth)) | 13·99 |
| 80 | Scope Calibrator | 2·65 |
| 255 | Level Indicator | 6·98 |
| 525 | 120-160mHz VHF timer | 11·31 |
| 715 | Photo cell switch | 8·97 |
| 795 | Electronic continuity tester | 4·97 |
| 860 | Photo timer | 15·51 |
| 235 | Acoustic Alarm for driver | 8·61 |
| 465 | Quartz XTAL checker | 9·90 |
| 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
**Prices correct at time of preparation. Subject to change without notice.**

## BUILD THIS TUNER ML3

MW/LW Radio Tuner to use with any amplifier. Features Mullard RF/IF module Ferrite aerial, built in battery. Excellent results. Size 7" 2½" × 3½". All parts £5·25, carr. 15p.

**MULLARD FM MODULES**
LP1186 Tuning Heart Module
LP1185 IF Module complete with data Price £9·00 pair

**FM TUNER MODULE**
FM 5231 12v FM Tuner £7·95
SD4912 Stereo Decoder £7·95
SF62H 6v Stereo FM Tuner £14·95

**TBA800 5 WATT I.C.**
Suitable alternative to SL 403D. 5/30 volt operated. 8/16 ohm 5 watt output. **With circuits and data** £1·50
**Kit with printed circuit panel** £2·70
All kits available from stock.

**STROBE TUBE**
ZFT4A Suitable for Dec. '73 Pract. Electronics. £3·50
ST2 (D32) DIAC 25p
CRS1/40 SCR 45p
ZFT4 £3·50
ZFT8 £4·00

**SINCLAIR SPECIAL OFFER**
Stereo 60 Pre-amplifier —for use with most small amplifiers. Exclusive offer £6·75

**PP9 ELIMINATOR KIT**
Complete module kit 9v 100mA output £1·95 p & p 25p

**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.**

## U.K.'s LARGEST RANGE OF TRANSISTORS & DEVICES

**JUST A SELECTION**
•TBA800 5W IC £1·50
•Sinclair IC12 6W IC £2·00
•ZN414IC Radio £1·20
•Ultrasonic Transducers £5·90 pr.
•3015F 7SEG Indicator £1·70
TIL 209 LED 24p each 22p each per 10
•With circuits/data sheet.

## OVER 1,500 DIFFERENT SEMI-CONDUCTOR DEVICES IN STOCK

Free stock list—latest edition (Ref. 36) on request. Includes radio valves, I.C.'s, rectifiers, triacs, SCR's, LED's, etc. More types—better prices—discounts for quantity small or large.

## GARRARD BATTERY TAPE DECK

GARRARD 2 speed 9 volt tape decks. Fitted record/play and oscillator/erase heads. Wind and rewind controls. Takes up to 4" 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** 5K, 10K, 22K, 50K, 100K, 250K, 500K, 1 Meg. 45p each.
**Ganged Log and Lin** 10K, 22K, 50K, 100K, 250K, 65p each.
(Quantity discounts available)
Complete with knobs.

**MARRIOT TAPE HEADS**
4 TRACK MONO or 2 TRACK STEREO
"17" High Impedance £2·50
"18" Med. Impedance £3·50
"36" Med. Impedance £5·00
R730/E73 2 track mono Record/Erase low imp. 75p pair.
Erase Heads for "17" "18" and "36" £1·00
"63" 2 track mono, High Imp. £1·75
"43" Erase Head for "63" 75p
(Post, etc. 15p any quantity).

## SINCLAIR MINIATURE AMPLIFIERS & TUNER/DECODER

**AMPLIFIERS** (carr., etc. 20p)
4-300, 0·3 w 9 volt 1·75
104, 1 watt 9 volt 3·10
304, 3 watt 9 volt 3·95
555, 3 watt 12 volt 4·10
E1208, 5 w 12 volt 5·10
608, 10 w 24 volt 4·95
410, 10 w 28 volt 4·45
E1206, 30 w 45 volt 9·95
E1210, 2½ + 2½ watts 12 volt 8·25
RE500, 5 watt IC mains operated Amplifier with controls 6·30
SAC14, 7 + 7 watt Stereo with controls 11·75
SAC13, 15 + 15 w Stereo with controls 14·95
SP40-5 2Z40/ Stereo 80/PZ5 25·00
SP40-6 2Z40/ Stereo 80/PZ6 27·75
SP60 2Z60/ Stereo 80/PZ8 30·45
Transformer PZ8 3·95

**POWER SUPPLIES FOR EVERY PURPOSE**

(All cased unless stated chassis)
470C 6/7½/9 volt 300 MA (includes Multi-Adaptor for Tape Recorders, etc.) 2·25 post 20p
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SC202 3/6/7½/9 volt 400mA 4·25 carr. 30p
HC244R Stabilised version 5·50 carr. 30p
P500 9 volt 500mA 3·20 post 20p
P11 24 volt 500mA (chassis) 2·90 post 20p
P15 26/28 volt 1 amp (chassis) 2·90 post 20p
P1080 12V 1 amp (chassis) 4·70 post 20p
P1081 45V 0·9 amp (chassis) 7·80 post 20p
P12 4½–12 volt 0·4–1 amp 7·15 post 30p
SE101A 3/6/9/12 volt 1 amp (Stab.) 12·75 post 25p
RP164 6/7½/9/12 1 amp (Stab.) 13·45 post 30p

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All mail to 303 Edgware Road, London W2 1BW
*All stores open 9 am to 6 pm six days a week*
*Hi-Fi—Tape Equipment Discount Stock List Free at all stores*

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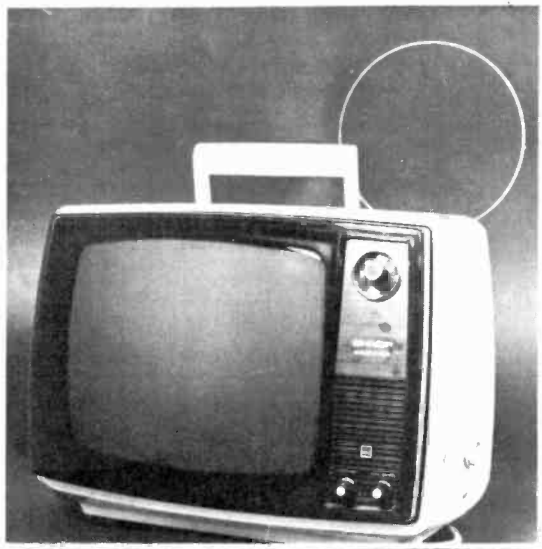
## THE ARISTOCRAT OF PORTABLE TELEVISIONS



- ★ FROM THE INTERNATIONALLY FAMOUS SHARP AUDIO & ELECTRONICS CORPORATION
- ★ INSTANTLY TUNABLE IN ALL U.K. AREAS
- ★ MAINS OR 12V BATTERY
- ★ ALL SOLID STATE CIRCUITRY FOR RELIABILITY AND INSTANT WARM-UP
- ★ REMOVABLE SUN SHIELD
- ★ IMPECCABLY STYLED CASE IN OFF-WHITE HIGH IMPACT ACRYLIC WITH FOLDAWAY HANDLE
- ★ COMPLETE WITH MAINS LEAD, PERSONAL EAR PHONE AND UHF AERIAL
- ★ GUARANTEED FOR 1 YEAR
- ★ RECOMMENDED RETAIL PRICE £75·95 (INC. of V.A.T.)

OUR PRICE **£43·95**

# NEW BASF CASSETTE RECORDER

- ★ THE LATEST HIGH QUALITY PRODUCT FROM THE RENOWNED GERMAN BASF COMPANY
- ★ STYLISH, COMPACT MAINS OR BATTERY OPERATION
- ★ SUPERB TONE AND PROVISION FOR EXTERNAL LOUDSPEAKER
- ★ BUILT-IN HIGH SENSITIVITY CONDENSER MICROPHONE AND PROVISION FOR EXTERNAL MICROPHONE
- ★ PIANO KEY CONTROLS, RECORD METER AND AUTOMATIC RECORD LEVEL CONTROL
- ★ SUPPLIED WITH CARRYING CASE, MAINS LEAD AND 3 PIN DIN-DIN LEAD
- ★ RECOMMENDED RETAIL PRICE £36·35 (Exclusive of V.A.T.)

OUR PRICE **£29·95**

# BASF CASSETTES (TYPE LH IN SNAP-PACK)

| | C30 | C60 | C90 | C120 |
|---|---|---|---|---|
| PRICE EACH: | **47p** | **55p** | **76p** | **£1·13** |

# PHIER ¼ & ½ WATT CARBON FILM RESISTORS

**E12** ¼ watt 10Ω — 1M
½ watt 10Ω — 10M

- ★ MINIMUM ORDER 100 RESISTORS
- ★ MINIMUM PER VALVE 25

**75p/100**

IF EXACT VALVE IS OUT OF STOCK THEN NEAREST WILL BE SUPPLIED

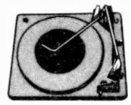
**TERMS** (TRADE AND BULK ENQUIRIES WELCOME)
- ★ PRICES DO NOT INCLUDE V.A.T.
- ★ PAYMENT WITH ORDER ONLY
- ★ TOTAL PAYMENT = COST OF GOODS + P/P + 10% V.A.T.

**POSTAGE AND PACKING**
TELEVISION—£1·25
CASSETTE RECORDER—£1
CASSETTES/RESISTORS—35p

**MOTEC** P.O. BOX 14 · ABINGDON · OXON

# ALL OUR PRICES INCLUDE V.A.T.

## BSR HI-FI AUTOCHANGER
### STEREO & MONO



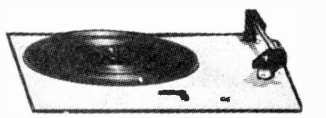
Plays 12", 10" or 7" records. Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. AC 200/250V. Size 13¾ × 11¼in. Above motor board 3¼in. Below motor board 2¾in.
with STEREO and MONO XTAL **£6·75** Post 45p.

### PORTABLE PLAYER CABINET

Modern design. Black rexine covered. Silver front grille. Padded Lid. Chrome fittings. Size 17in × 15in × 7in. Few only in red rexine. Motor board cut for BSR deck **£4·50** Post 50p

### 4 Transistor Mono Amplifier

Powerful 3 watt output. 15 ohm. AC mains operated with transformer. 3-Controls, volume, treble, bass and On/Off switch with knobs. Ready made on printed circuit board. Fused inputs and outputs. Famous make.
Size 8in wide × 4in deep × 3in high. **£5·95** Post 25p
Suitable 7in × 4in speaker, £1.



## R.C.S. DISCO DECK SINGLE RECORD PLAYER

Fitted with auto stop. Acos stereo/mono cartridge. Baseplate. Size 11in × 8½in. Turntable. Size 7in diameter. A/C mains. 200/250V motor has a separate winding 14 volt to power a small amplifier. Three speeds. Plays all records.

**£5·50** Post 25p

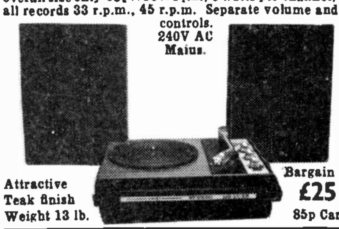
### METAL PLINTH AND PLASTIC COVER

Cut out for most Garrard or B.S.R. Most will play with cover in position. 12¾ × 14¾ × 7¼in. Covered in black leatherette. **£4·95** Post 45p

ALSO AVAILABLE IN SOLID NATURAL MAHOGANY WAX POLISHED FINISH—£5·95

## COMPACT PORTABLE STEREO HI-FI

Two full size loudspeakers 13½ × 10 × 3½in. Player unit clips to loudspeakers making it extremely compact, overall size only 13½ × 10 × 8½in., 3 watts per channel, plays all records 33 r.p.m., 45 r.p.m. Separate volume and tone controls. 240V AC Mains.



Attractive Teak finish Weight 13 lb.
Bargain Price **£25** 85p Carriage

## SPECIAL OFFER! SMITH'S CLOCKWORK 15 AMP TIME SWITCH 0 TO 60 MINUTES

Single pole two-way Surface mounting with fixing screws. Will replace existing wall switch to give light for return home, garage, automatic anti-burglar lights, etc. Variable knob. Turn on or off at full or intermediate settings. Fully insulated. Makers' last list price £4·50. Brand new and fully guaranteed.
OUR PRICE **£1·95** Post 25p

BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2½in sides 6 × 4in 45p; 8 × 6in 53p; 10 × 7in 65p; 12 × 8in 85p; 14 × 9in 90p; 16 × 6in 90p; 12 × 3in 50p; 16 × 10in £1.
ALUMINIUM BOXES 3 × 3 × 3in 60p; 4 × 4 × 4in 70p; 6 × 4 × 4in 80p; 9 × 4 × 4in £1; 12 × 4 × 4in £1·30.
ALUMINIUM PANELS 18 s.w.g. 6 × 4in 12p; 8 × 6in 19p; 14 × 3in 20p; 10 × 7in 24p; 12 × 5in 25p; 12 × 8in 34p; 16 × 6in 34p; 14 × 9in 40p; 12 × 12in 47p; 16 × 10in 60p.
PAXOLIN PANEL 10 × 8in 20p.
1¼ inch DIAMETER WAVECHANGE SWITCHES, 45p ea.
2 p. 2-way, or 2 p. 6-way, or 3 p. 4-way.
1 p.l. 2-way, or 4 p. 2-way, or 4 p. 3-way.
TOGGLE SWITCHES, sp. 20p; dp. 25p; dp. dt. 30p.
Sub-miniature, sp. 33p; dp. dt. 50p.

### BRITISH FM/VHF TUNING HEART

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

### R.C.S. STABILISED POWER PACK KITS

All parts and instructions with Zener Diode, Printed Circuit, Bridge Rectifiers and Double Wound Mains Transformer input 200/240V a.c. Output voltages available 6 or 9 or 12 or 15 or 18 or 20V d.c. at 100mA or less
PLEASE STATE VOLTAGE REQUIRED. **£2·20** Post 20p
Details S.A.E. Size 3½ × 1½ × 1¼in.

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

Ideal for Mike, Tape, P.U., Guitar, etc. Can be used with Battery 9-12V or H.T. line 200-300V d.c. operation. Size: 1¾ × 1¼ × ½ in. Response 25 c/s to 25 kc/s. 26 dB gain. For use with valve or transistor equipment. Full instructions supplied. Details S.A.E. **99p** Post 10p

### R.C.S. POWER PACK KIT

12 VOLT, 750mA. Complete with printed circuit board and assembly instructions. **£2·95** Post 25p
12 VOLT 300mA KIT, £2·75. 9 VOLT 1 AMP KIT, £2·95.

| NEW TUBULAR ELECTROLYTICS | | | | CAN TYPES | |
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| 2/350V | 14p | 250/25V | 14p | 50+50/300V | 50p |
| 4/350V | 14p | 500/25V | 20p | 60+100/350V | 85p |
| 8/450V | 18p | 1000/25V | 35p | 32+32/250V | 20p |
| 16/450V | 22p | 1000/50V | 47p | 32+32/450V | 60p |
| 32/500V | 50p | 8+8/450V | 22p | 350+50/325V | 55p |
| 25/25V | 10p | 8+16/450V | 25p | 16+16+16/275V | 45p |
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LOW VOLTAGE ELECTROLYTICS.
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TWIN GANG. "0-0" 208pF+176pF, 75p.
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Primary 0-110-240V. Secondary 0-240V 3 amps 720 watts. Insulated terminals. Varnish impregnated. Fully enclosed in steel case with fixing feet. Famous make (Value £19) OUR PRICE **£10** Carr. 50p
Can be used as 800 watt auto transformers 240-110V.

### SET OF 3 MOTORS FOR COLLARO STUDIO 115 VOLT TAPE DECK

**£2·50** Post 50p

### VOLUME CONTROLS

Long spindles. Midget Size 5 K. ohms to 2 Meg. LOG or LIN. L/S 20p. D.P. 35p. STEREO L/S 55p. D.P. 75p. Edge 5K. S.P. Transistor 25p.

### 80 ohm Coax 5p yd.

BRITISH AERIALITE AERAXIAL-AIR SPACED 40 yd £1·75; 60 yd £2·60.
FRINGE LOW LOSS **10p** per yd
Ideal 625 and colour.

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

## E.M.I. 13½ × 8in. SPEAKER SALE!

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

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

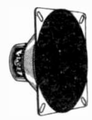
### LOUDSPEAKER FRONT GRILLES

Teakwood strips mounted on cloth backing, easily glued on to baffle to modernise cabinets. Size 18¼in × 10¼in. **75p**
Or size 10¼in × 7¼in. **45p**

### E.M.I. 6½in. HI-FI WOOFER

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

### ELAC CONE TWEETER



The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 c/s to 18,000 c/s. Size 3¾ × 3¾ × 2in deep. Rating 10W, 3 ohm.
Crossover £1·25 **£1·90** Post 20p.

### GOODMANS 8 in. WOOFER

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

### SPECIAL OFFER LOUDSPEAKERS
ALL BRAND NEW

3 ohm, 2½in; 2¾in; 3½in; 5in.
8 ohm, 2½in; 2¾in; 5in × 3in; 5in.
15 ohm, 3½in; 5in; 6 × 4in; 5 × 3in; 7 × 4in; 8 × 5in.
25 ohm, 2½in; 3in; 5 × 3in; 5in.
35 ohm, 2in; 3in; 5in.
80 ohm, 2½in; 2¾in. 120 ohm 3in. **£1** EACH

LOUDSPEAKERS P.M. 3 OHMS. 7 × 4in £1·25; 6½in £1·50; 8 × 5in £1·60; 8in £1·75; 10 × 6in £1·90; 10in £2·50
RICHARD ALLAN TWIN CONE LOUDSPEAKERS. 8in diameter 4W £2·50, 10 in diameter 5W £2·50; Post 25p. 12in diameter, 6W, £2·95; 3 or 8 or 15 ohm models.
SPEAKER COVERING MATERIALS. Samples Large S.A.E.
Horn Tweeters 2-16Kc/s. 8W 8 ohm or 15 ohm £2·20.
De Luxe Horn Tweeters 2-18Kc/s, 15W, 15 ohm £3·50.
TWO-WAY 3,000 c.p.s. CROSSOVERS 3, 8 or 15 ohm £1·25.

### 3 WAY CROSSOVER

Complete with 12 ft. twin lead fitted with din speaker plug. Ready assembled with leads for speakers, bass, mid and tweeter. Crossover frequencies—950 cps and 3,000 cps. **£1·95**

VALVE OUTPUT TRANSFORMER 40p.
MIKE TRANSFORMER MU metal 100-1 £1·25.
PUSH-PULL VALVE OUTPUT TRANSFORMERS.
50 watt............£12·50 100 watt ........ £15·00

### ELECTRO MAGNETIC PENDULUM MECHANISM

1·5V d.c. operation over 200 hours continuous on SP2 battery, fully adjustable swing and speed. Ideal displays, teaching electro magnetism or for metronome, strobe, etc. **95p** Post 20p

### R.C.S. RECORD PLAYER AMPLIFIER

2 stage triode pentode valve. 3 watts output. Volume on/off and tone controls. Printed circuit A.C. mains complete and tested. **£4·50** Post 25p
Complete with speaker.

COAXIAL PLUG 10p. PANEL SOCKETS 10p. LINE 18
OUTLET BOXES, SURFACE MOUNTING 25p.
BALANCED TWIN RIBBON FEEDER 300 ohms, 7p yd.
JACK SOCKET Std. open-circuit 14p. closed circuit 23p; Chrome Lead Socket 45p. Phono Plugs 7p. Phono Socket 7p
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## E.M.I. WOOFER AND TWEETER KIT

**£6·75** THE PAIR, Post 25p. (Available separately. Woofer £5·25; Tweeter £1·90)

Comprising a fine example of a Woofer 10¾ × 6½in with a massive Ceramic Magnet, 44oz Gauss 13,000 'lines. Aluminium Cone centre to improve middle and top response. Also the E.M.I. Tweeter 3½in square has a special lightweight paper cone and magnet flux 10,000 lines. Crossover condenser and full instructions supplied.

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

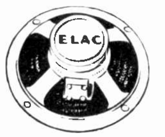
SUITABLE ENCLOSURE 20 × 13 × 9in. MODERN DESIGN. TEAK WOOD FINISH. **£10·50** Post 75p

## ANOTHER R.C.S. BARGAIN !

ELAC 9 × 5in. HI-FI SPEAKER TYPE 59RN

This famous unit now available, 10 watts, 8 ohm.

Price **£3·30** Post 25p

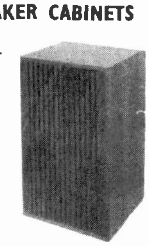


## 8" or 10" x 6" ELAC HI-FI SPEAKER

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

10in round £4·50.

## TEAK VENEER HI-FI SPEAKER CABINETS
### Fluted Wood Fronts



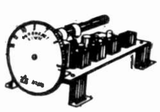
MODEL "A". 20 × 13 × 9in For 12 in. dia. or 10in speaker. **£10·50** Post 75p

MODEL "B". 16 × 10 × 9in For 13 × 8in. or 8 in. speaker **£6·60** Post 45p

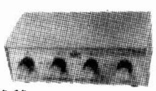
MODEL "B" 2 ditto. Triangular Corner Version.

MODEL "C". 16 × 8 × 6in. For 8 × 5in. speaker **£4·95** Post 35p

LOUDSPEAKER CABINET WADDING 18in wide, 20p ft.



BARGAIN AM TUNER. Medium Wave. Transistor Superhet Ferrite aerial. 9 volt. **£5·50**



BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt battery operated. **£4·50**

STEREO VERSION OF ABOVE £5·95.

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

THE "INSTANT" BULK TAPE ERASER & HEAD DEMAGNETISER. Suitable for cassettes, and all sizes of tape reels. A.C. mains 200/250V. Leaflet S.A.E. **£3·50** Post 20p

## WAFER THIN HEATING ELEMENTS

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

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

ONLY **40p** EACH (FOUR FOR £1·50)

ALL POST PAID—Discounts for quantity.

## BAKER MAJOR 12" £9·90

Post Free

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

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

Please state 3 or 8 or 15 ohms. Post free

## BAKER "BIG SOUND" SPEAKERS

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

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

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

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

50 watt 12in VERSION £16

## MAJOR 100 WATT ALL PURPOSE TRANSISTOR AMPLIFIER


All purpose transistorised. Ideal for Groups, Disco and P.A. 4 inputs speech and music. 4 way mixing. Output 8/15 ohm a.c. Mains. Separate treble and bass controls. Guaranteed. Details S.A.E. **£49** Carr. £1·00

CALLERS ONLY! DE-LUXE 100 WATT AMPLIFIER CHASSIS. 7 Valve version, 4 inputs, 10 wide range controls. For Mikes, Discos, Organs, Guitars, etc. 4, 8 and 15 ohm Loudspeaker matching. **£69**

## Q MAX CHASSIS CUTTERS
### A die, punch and Allen Screw

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|---|---|---|---|
| Sizes ⅜" | 74p | Sizes 1¾" | £1·70 |
| 7/16" | 83p | Key "B" for above | 10p |
| Key "T" for above | 6p | 2" | £2·25 |
| ½", 9/16", ⅝" | 90p | 2 3/32" | £2·50 |
| 11/16", ¾" | 92p | 2½" | £3·30 |
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| 15/16", 1", 1 1/16", 1⅛" | £1·00 | 2¾" | £5·75 |
| 1 3/16", 1 7/32", 1¼" | £1·15 | 3" | £9·00 |
| 1 5/16", 1⅜" | £1·20 | Key "E" for above | 20p |
| 1½" | £1·35 | 1" Square, with key | £2·10 |
| 1⅝" | £1·55 | | |

20 Watt 100 ohm Rheostat 2¼in dia. Ceramic former screw terminals ¼in dia. spindle. 95p. Post 25p.

## R.C.S. STEREO DECODER

British made. Ready aligned and tested. Complete with instructions. Size 3in × 2in. **£6·95**

## WEYRAD COILS

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| P50/2CC | 40p | RA2W | 85p |
| P50/3CC | 40p | OPT1 | 65p |
| PCA1 | 60p | LFDT4 | 65p |
| | | Twin gang | 75p |

## DELUXE 4 POLE MOTOR

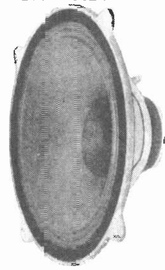
1,400 r.p.m. reversible 42 Watt, spindle 1⅛in × 7/32in, size 3¼in × 3in. As illustrated. 240V a.c. mains. **£2·25** Post 25p

## E.M.I. GRAM MOTOR

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

## BAKER HI-FI SPEAKERS
HIGH QUALITY—BRITISH MADE

## REGENT
### 12in. 15 watts



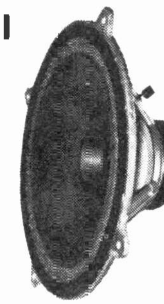
An inexpensive unit for the beginner in high fidelity and for general purposes. May be used to improve any Radio, Amplifier, Hi-Fi or Television receiver.

| | |
|---|---|
| Bass Resonance | 45cps |
| Flux Density | 12,000 gauss |
| Useful response | 45-13,000cps |

3 or 8 or 15 ohm models.

**£8·80** Post Free

## DE-LUXE Mk II
### 12in. 15 watts



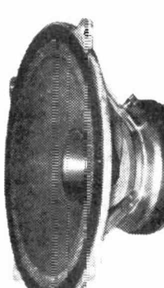
Especially designed to provide full range reproduction at an economical cost. Suitable for use with any high fidelity system. Built-in concentric tweeter cone.

| | |
|---|---|
| Bass Resonance | 30cps |
| Flux Density | 14,000 gauss |
| Useful response | 25-16,000cps |

8 or 15 ohms models.

**£11** Post Free

## SUPERB
### 12in. 20 watts



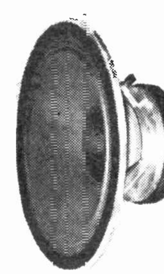
A high quality loudspeaker, its remarkable low cone resonance ensures clear reproduction of the deepest bass. Fitted with a special copper drive and concentric tweeter cone resulting in full range reproduction with remarkable efficiency in the upper register.

| | |
|---|---|
| Bass Resonance | 25cps |
| Flux Density | 16,500 gauss |
| Useful response | 20-17,000cps |

8 or 15 ohms models.

**£16·50** Post Free

## AUDITORIUM
### 12in. 25 watts



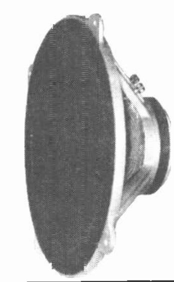
A full range reproducer for high power, Electric Guitars, public address, multi-speaker systems, electric organs, Ideal for Hi-Fi and Discotheques.

| | |
|---|---|
| Bass Resonance | 35cps |
| Flux Density | 15,000 gauss |
| Useful response | 25-16,000cps |

8 or 15 ohms models.

**£15·40** Post Free

## AUDITORIUM
### 15in 35 watts



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

| | |
|---|---|
| Bass Resonance | 35cps |
| Flux Density | 15,000 gauss |
| Useful response | 20-14,000cps |

8 or 15 ohms models.

**£22** Post Free

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

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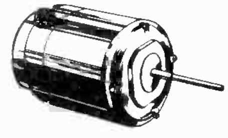
## "SLO-SYN" 3-LEAD SYNCHRONOUS STEPPING MOTOR



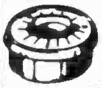
Type SS15. These fine motors are easily reversed, starting and stopping in less than 5° without electrical or mechanical braking. Simple relay circuit can be applied to give DC to winding for a maximum holding torque of 300oz/in with 35v at 0·35 amps through winding. For AC (synchronous) operation at 120v., 50Hz. Speed 60 rpm at 60Hz., 72 rpm. STEPPING. Holding torque at 50 steps per second—100 oz in. Can be wired to give 100 or 200 steps per revolution with accuracy of 0·1° per step non-cumulative. Torque characteristics can be modified by simple R.C. circuits. Dimensions dia 4", body length 4½", spindle length 2¼" × ⅛" dia. Weight 6½ lbs. BRAND NEW in maker's packing. Offered at less than ½ maker's price.

OUR PRICE ONLY £15

## NORPLEX

Fibre-glass copper-clad laminate. Finest quality epoxy resin base. Heat resistant. Ideal for P.C.s. Size 12" × 12", 24" × 12", 24" × 24". FULL SHEET 43" × 37" (11 sq. ft.). Single-sided Copper with thickness of 1/32", 3/64", 1/16". Also double-sided 1/32", 1/16", 1/8". £1 per sq. ft. Cut sizes (1–10 sq. ft.) 25p P. & P. Full Sheet £8 each. Carr £1 for 1st sheet plus 25p each additional sheet.

## SMITHS RINGER-TIMER

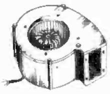


Reliable 15 minute times, spring wound (concurrent with time setting) 15 × 1min divisions, approximately ⅛" between divisions. Panel mounting with chrome bezel 3½" dia. £1·40. 15p P. & P.

## KNOWLE (U.S.A.) MINIATURE MICROPHONE CAPSULES

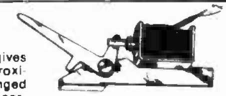
Impedance approx. 200Ω, output 60 or 80 DB at 1 Kc. As used in deaf aids, bugging device, etc. Size (60 DB) 1/32" × 1/16" × ⅛". (80 DB) ⅜" 1/16" ⅜". Ex-equipment, all tested. £1·20 each. P. & P. FREE.

## *Ultra* PRECISION CENTRIFUGAL BLOWER
### by Air Control Ltd.



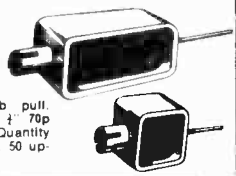
30 segments individually balanced in heavy cast alloy case. 2,300 r.p.m. 240 V a.c. Very powerful and silent running. 5½" dia. 3" inlet dia. Outlet flange 3" × 2½". Limited number only £8·95. P. & P. 40p.

## MAINS SOLENOID



This little unit gives vertical lift of approximately 1" through hinged "elbow". Bracket incorporates 2 fixing screws. Length of arm, 2½". 240V AC. Pull at coil is approximately 1lb. £1. FREE P. & P. Special quotes for quantities.

## SOLENOIDS by WESTOOL



240AC type MM6 3lb pull, 2½" × 1" × 1½". Travel 1". 90p. each. P. & P. 10p.
240AC type MM4, 2lb pull, 1¼" × 1¼" × 1". Travel ½". 70p each. P. & P. 10p. Quantity discounts, 10–50 10%, 50 upwards 25%.

## OPEN FRAME shaded pole GEARED MOTORS

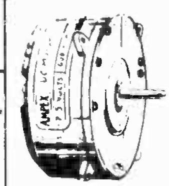
(Dural gear case) 240 AC., 28rpm NEW HIGH TORQUE, approx. overall size: 3¼" × 3¼" × 2½" + spindle ½" dia. as illustrated £2·70. P. & P. 30p.
Similar to above, 19rpm £2·70. P. & P. 30p.
110rpm with pressed steel gear case (similar to above but SLIGHTLY SMALLER). £2·70. P. & P. 30p.

## SILVANIA MAGNETIC SWITCH

*Now complete with reference magnet!*

A magnetically activated switch, vacuum sealed in a glass envelope. Silver contacts, normally closed. Rated 3amp at 120v, 1½amp at 240v. Size: (approx.) 1⅞" long × ⅛" dia. Ideal for burglar alarms, security systems etc., and wherever non-mechanical switching is required. 10 for £2·10; P. & P. 15p. 50 for £8; 100 for £15·50. FREE P. & P. over 10.

## AMPEX 7·5V. D.C. MOTOR



An ultra precision tape motor designed for use in the AG20 portable recorder. Torque 450GM/CM. Stall load at 500ma. Draws 60ma on run. 600rpm ± speed adjustment. Internal AF/RF suppression. ⅛" dia × 1" spindle, motor 3" dia. × 1½". Original cost £16·50. OUR PRICE £3·30. P. & P. 25p. Quantities available. Mu-metal enclosure available 75p each. FREE P. & P.

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## The Tourist II

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

Fine tuning push button mechanism is fully built and tested to mate with printed circuit board.

Technical specification:

(1) **Output** 4 watts R.M.S. output. For 12 volt operation on negative or positive earth.

(2) **Integrated circuit** output stage, pre-built three stage IF Module.

**Controls volume** manual tuning and five push buttons for station selection, illuminated tuning scale covering full, medium and long wave bands.

Size chassis 7" wide, 2" high and 4$\frac{5}{16}$" deep approx

**Car Radio Kit £7.70 + 55p. postage & packing**

**Speaker** including baffle and fixing strip **£1.65+23p. p&p.**

**Car Aerial** Recommended — fully retractable and locking **£1.37+20p. postage & packing**

**Tourist Mk.1** kit still available-price **£6.60+55p. p&p.**

See July issue for full specification

---

## STEREO 21

## QUALITY SOUND(*) FOR LESS THAN £19·00

Stereo 21 easy to assemble audio system kit, - no soldering required. Includes:—

**BSR 3 speed deck**, automatic, manual facilities together with ceramic cartridge.

**Two speakers** with cabinets.

**Amplifier module**. Ready built with control panel, speaker leads and full, easy to follow assembly instructions.

For the technically minded:—

**Specifications**:

Input sensitivity 600mV: Aux. input sensitivity 120mV: Power output 2.7 watts per channel: Output impedance 8–15 ohms. Stereo headphone socket with automatic speaker cutout. Provision for auxiliary inputs - radio, tape, etc., and outputs for taping discs. **Overall Dimensions**. Speakers approx. 15½" × 8" × 4". Complete deck and cover in closed position approx. 15½" × 12" × 6". Complete only **£18.95** +£1.60 p & p.

**Extras if required**.

Optional Diamond Styli **£1.37**

Specially selected pair of stereo headphones with individual level controls and padded earpieces to give optimum performance. **£3.85.**

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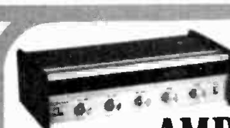

## DISCO AMPLIFIER

Reliant Mk IV Mono Amplifier, ideal for the small disco or house parties.

**Outputs** 20 watts R.M.S. into 8 ohms (suitable for 15 ohms).

**Inputs** *4 Electrically Mixed Inputs *3 Individual Mixing controls. *Separate bass and treble controls common to all 4 inputs *Mixer employing F.E.T. (Field Effect Transistors). *Solid State Circuitry. *Attractive Styling.

**INPUT SENSITIVITIES**

—Input—1.) Crystal mic. guitar or moving coil mic. 2. and 10 mV. (selector switch for desired sensitivity.—Inputs—2), 3), 4. Medium output equipment—ceramic cartridge, tuner, tape recorder, organs etc.

- all 250mV sensitivity.

AC Mains 240V. operation.

Size approx. 12½ ins × 6 ins × 3½ ins

**£15.00 + 60p. post & pack**

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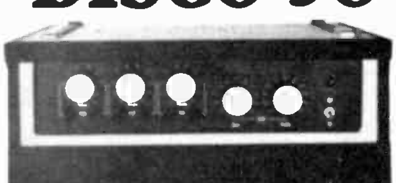
# DISCO 50



**45 WATT R.M.S. MONO DISCOTHEQUE AMPLIFIER**

Ideal for Disco Work. Output Power: 45 watts R.M.S. Frequency Response 3dB points 30Hz and 18KHz. Total Distortion: less than 2% at rated output. Signal to noise ratio: better than 60dB. Bass Control Range: 13dB at 60Hz. Treble Control Range: 12dB at 10KHz. Inputs: 4 inputs at 5mV into 470K. Each pair of inputs controlled by separate volume control. 2 inputs at 200mV into 470K. Size: 19¼ × 10½ × 8ins. approx. Amplifier **£27.50+£1.50 p. & p**

**Special Offer**: Disco 50 plus two 15" E.M.I. speakers type 14A/780 (as illustrated on opposite page). **Complete £57.00+£4.00 p&p.**

# COMPLETE(*) STEREO SYSTEM

## £51·00

**40 Watt Amplifier.**
**Viscount III – R102 now 20 watts per channel.**
**System I** includes,
**Viscount III amplifier** – volume, bass, treble and balance controls, plus switches for mono/stereo on/off function and bass and treble filters. Plus headphone socket.
**Specification**
20 watts per channel into 8 ohms.
Total distortion @ 10W @ 1kHz 0·1%. *P.U.1* (for ceramic cartridges) 150mV into 3 Meg. *P.U.2* (for magnetic cartridges) 4mV @ 1kHz into 47K. equalised within ± 1dB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power). Tape out facilities: headphone socket, power out 250mW per channel. *Tone controls and filter characteristics.* Bass: +12dB to −17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to −12dB @ 15kHz. Treble filter: 12dB per octave. *Signal to noise ratio*: (all controls at max.) −58dB.
Crosstalk better than 35dB on all inputs.
Overload characteristics better than 26dB on all inputs. Size approx. 13¾″ × 9″ × 3¾″.
**Garrard SP25 deck**, with magnetic cartridge, de luxe plinth and hinged cover.
**Two Duo Type II matched speakers** – Enclosure size approx. 17½″ × 10¾″ × 6″ in simulated teak. Drive unit 13″ × 8″ with parasitic tweeter 10 watts handling

**Complete System £51.00**

## £69·00

**System II**
**Viscount III amplifier** (As System I)
**Garrard SP. 25** (As System I)
**Two Duo Type IIIA matched speakers**— Enclosure size approx. 31″ × 13″ × 11½″. Finished in teak veneer. Drive units approx. 13½″ × 8¼″ with 3¼″ HF speaker. Max. power 20 watts, 8 ohms. Freq. range 20Hz to 20kHz.

**Complete System £69.00**

**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 with MAG. cartridge de luxe plinth and hinged cover | £21.00 | + £1.75 p & p. |
| total | £59.20 | |

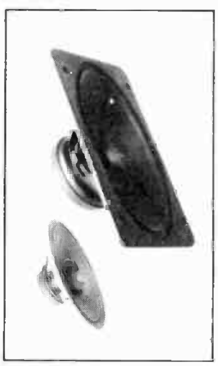
**Available complete for only £51.00 + £3·50 p. & p.**

**PRICES: SYSTEM 2**

| | | |
|---|---|---|
| Viscount R102 amplifier | £24·20 | + £1·00 p. & p. |
| 2 Duo Type IIIA speakers | £39·00 | + £4·00 p. & p. |
| Garrard SP25 with MAG cartridge de luxe plinth and hinged cover | £21·00 | + £1·75 p. & p. |
| total | £84·20 | |

**Available complete for only £69.00 + £4 p & p.**

# EMI SPEAKERS AT FANTASTIC REDUCTIONS



## 20 WATT SPEAKER SYSTEM

System consists of a 13″ × 8″ (approx) eliptical woofer unit with a 8″ × 5″ (approx.) mid range unit incorporating parasitic tweeter and crossover components.
**Technical Specification:**
Bass Unit
Flux density–100 K, speech coil–1½″, Cone, Triple laminated paper with P.V.C. surround.
Mid Range Unit
Flux density-33K, speech coil-1″ with parasitic tweeter.
Power Handling
20 watts R.M.S., impedance – 8 ohms, frequency response – 20 Hz to 18,000 Hz.

**OUR PRICE £6.60. Complete + 90p p & p.**

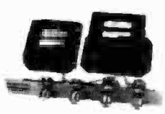
## 15″ 14A/780 BASS UNIT

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

**Recommended retail price £40·80.**
**OUR PRICE £18·70 + £1·50 p & p**

## 950 KIT

Five matched speakers and crossover unit for handling up to 45 watts, frequency response from 20 to 20,000 Hz.
Huge 19″ × 14″ (approx.) high efficiency Bass-Speaker with 16,500-gauss magnet built on a heavy diecast frame.
The four 10,000 gauss tweeters, each 3¼″ dia. approx., are fed by the crossover which critically adjusts signal for maximum fidelity. Impedance at 1 kHz is 8 ohms. Bass coil 2″, others 0·5″. Recommended list price £44·00. **OUR PRICE £19.50 + £1·50 p & p Special Offer.**



# BUILD YOUR OWN STEREO AMPLIFIER(*)

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**£7·64 + 55p. p&p**

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Elegant self selector push button player for use with your stereo system. Compatible with Viscount III system, Unisound module and the Stereo 21. Technical specification  Mains input. 240V, Output sensitivity 125mV
Comparable unit sold elsewhere at £24·00 approx.

**Yours for only £10.95 + 90p. p & p**

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### 33 RANGE POCKET MULTIMETER

- SENSITIVITY 20,000Ω/VOLT (D.C.), 4,000Ω/VOLT (A.C.).
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- ACCURACY—RESISTANCE, D.C. VOLTAGE AND CURRENT, 2·5%. A.C. VOLTAGE AND CURRENT 3·5%.
- RESISTANCE RANGES POWERED BY INTERNAL BATTERIES.
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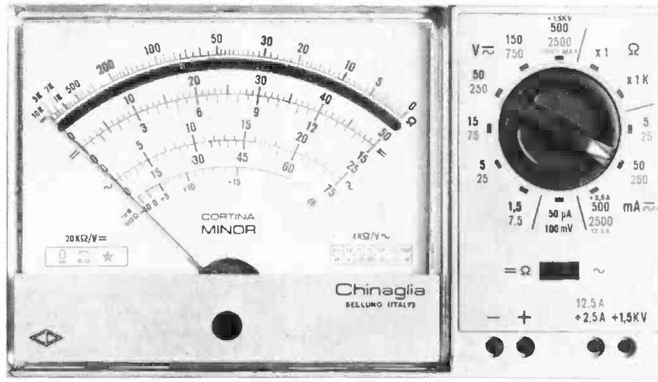


**METER PRICE £15·40 (p & p 80p) PROBE £8·80 inclusive of V.A.T.**

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½W Iskra high stability carbon film—very low noise—capless construction ¼W Mullard CR25 carbon film—very small body size 7·5 × 2·5mm. ½W 2% ELECTROSIL TR5

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| ⅛ | 5% | 4·7Ω–1MΩ | E12 | 1·3p | 1·1p |
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Quantity price applies for any selection. Ignore fractions on total order.

### DEVELOPMENT PACK

0·5 watt 5% Iskra resistors 5 off each value 4·7Ω to 1MΩ.
E12 pack 325 resistors **£2·40**. E24 pack 650 resistors **£4·70**.

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Carbon track 5kΩ to 2MΩ, log or linear (log ¼W, lin ½W).
Single, **14p**. Dual gang (stereo), **49p**. Single D.P. switch **28p**.

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Linear: 100, 250, 500Ω and decades to 5MΩ. Horizontal or vertical P.C. mounting (0·1 matrix).
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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. Detector GDI, **£2**.

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Mains operated with audible alarm, **£5·60**.
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**NOTE**—The battery operated kits incorporate our patented circuit to minimise battery drain. Typically 120mA for 12V. These kits contain all parts required with the exception of case. Suitable case. Mains operated kit, **£1·60**. Battery operated kits, **£5**.

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160V: 0·01µF, 0·015µF, 0·022µF, 0·033µF, 0·047µF, 0·068µF, 3p. 0·1µF, **3½p.** 0·15µF, **4½p.** 0·22µF, **5p.** 0·33µF, **6p.** 0·47µF, **7½p.** 0·68µF, **11p.** 1·0µF, **13p.**

### MULLARD POLYESTER CAPACITORS C280 SERIES

250V P.C. mounting: 0·01µF, 0·015µF, 0·022µF, 3p. 0·033µF, 0·047µF, 0·068µF, **3½p.** 0·1µF, **4p.** 0·15µF, 0·22µF, **5p.** 0·33µF, **6½p.** 0·47µF, **8½p.** 0·68µF, **11p.** 1·0µF, **13p.** 1·5µF, **20p.** 2·2µF, **24p.**

### MYLAR FILM CAPACITORS 100V

0·001µF, 0·002µF, 0·005µF, 0·01µF, 0·02µF, 3p. 0·04µF, 0·05µF, 0·068µF, 0·1µF, 4p.

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|---|---|---|
| 2½ × 3¾ | 26p | 22p |
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| 3¾ × 3¾ | 28p | 28p |
| 3¾ × 5 | 34p | 34p |
| 17 × 2½ | 95p | 77p |
| 17 × 3¾ | 130p | 108p |
| 17 × 3¾ (plain) | 36p | 72p |
| 17 × 2½ (plain) | — | 57p |
| 2½ × 5 (plain) | — | 18p |
| 2½ × 3¾ (plain) | — | 15p |
| Pin insertion tool | 62p | 62p |
| Spot face cutter | 52p | 52p |
| Pkt. 50 pins | 20p | 20p |

### JACK PLUGS AND SOCKETS

| | | | |
|---|---|---|---|
| Standard screened | 28p | 2·5mm insulated | 12p |
| Standard insulated | 18p | 3·5mm insulated | 12p |
| Stereo screened | 40p | 3·5mm screened | 18p |
| Standard socket | 20p | 2·5mm socket | 10p |
| Stereo socket | 30p | 3·5mm socket | 11p |

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

2 pin, 3 pin, 5 pin 180°, 5 pin 240°, 6 pin, 7 pin
**Plug 12p. Socket 8p.**
4 way screened cable, **25p**/metre.
6 way screened cable **30p**/metre.

### BATTERY ELIMINATOR £1·70

9V mains power supply. Same size as PP9 battery.

### PRINTED BOARD MARKER 97p

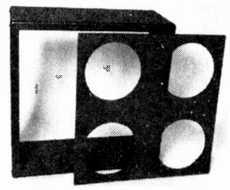
Draw the planned circuit onto a copper laminate board with the P.C. Pen, allow to dry, then immerse the board in the etchant. On removal the circuit remains in high relief.

# CUSTOM CABINETS

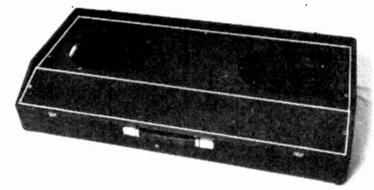
328/30 The Banks, Rochester, Kent. Tel: Medway (0634) 404199

## SPEAKER CABINETS IN KIT FORM REPRESENT HUGE SAVINGS

2′ x 12″ Cabinet



4′ x 12″ Cabinet



Disco Console (includes lid not shown)
Takes two slaves

For a long time now a large number of customers have asked us to produce cabinets in kit form, and above we show examples of cabinet styles and these are now available either fully built or in kit form ready for you to produce a professional finish in a very short time!

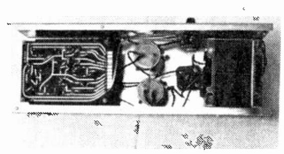
Kits are available in all specifications and all the kits contain everything you need as follows:-

1) 4 sides with handle cutouts, front edges rounded, 1 back with jack socket hole, and1 baffleboard with speaker cutout
2) P.V.C. cut to size for frame and back, plus false front and back timbers, white front piping and speaker cloth
3) Recessed handles with fixing screws, jack socket, all fixing screws, corner plates, glue, and full instructions!

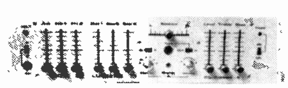
**PRICE & TYPE LIST**

| *Type* | *Size* | *Price manufactured* | *Kit price* |
|---|---|---|---|
| 2 x 12″ (illustrated above) | 36″ x 18″ x 13″ x $\frac{3}{4}$ | £19.50 | £12.50 |
| 4 x 12″ (illustrated above) | 31″ x 31″ x 13″ x $\frac{3}{4}$ | £24.50 | £17.50 |
| 4 x 12″ P.A. Column | 48″ x 27″ x 13″ x $\frac{3}{4}$ | £30.00 | £21.50 |
| 1 x 18″ | 31″ x 31″ x 13″ x $\frac{3}{4}$ | £24.50 | £17.50 |
| 1 x 15″ with two top horn cutouts | 36″ x 20″ x 13″ x $\frac{3}{4}$ | £21.00 | £13.50 |
| Mini Disco (state deck cutout BSR, GARRARD etc.) | 33″ x 20″ x 8″ x $\frac{1}{2}$ | £20.00 | £13.00 |
| Maxi Disco (illustrated) (state deck cutout BSR, GARRARD etc.) | 42″ x 20″ x 10″ x $\frac{1}{2}$ | £25.00 | £18.50 |

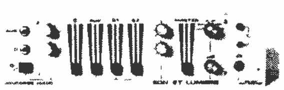
**Please ask for quotation on any other type or size of cabinet you may require.**



* 100 w RMS slave amp for Disco
* 100 w RMS continuous sine wave output
* Short and open circuit protection
* Built to highest industrial spec.
* Price £37.00 complete



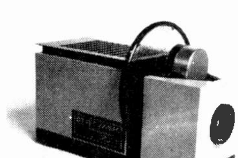
* Stereo studio disco mixer
* Full PFL and Monitor facilities
* As used by John Peel, Mark Wesley, Paul Burnett, DLT, Dave Christian, Tony Prince
* Price £120.00



* Concorde mono M400 mixer
* Full PFL and Monitor facilities
* Mike overide
* Magnetic inputs
* Broadcasting quality £85.00

## ALL OUR PRICES INCLUDE VAT AND UK DELIVERY

ERC 100 watt power amplifier
* Electrolytic capacitors and second generation ICs
* Fully protected against short or open circuit
* Less than 0.1% distortion at all powers
* Rise time 4muS-stability – Unconditional Price £66.50



Disco imp projector 150 watt tungsten
*unbeatable price £19.75*
Includes liquid wheel and postage
Normally £24–£27.50

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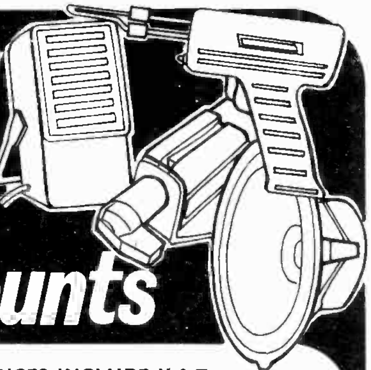
# 'BIG' Discounts



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Plain 2·05
With Co-Axial Tweeter 2·20
Twin Tweeter 3·70
Type 350, 8 ohm, 20W 7·50
6½in, 8 ohm, 10W 2·40
8in, 8 ohm, 10W 3·75
12in, 8 ohm, 20W 5·70
8in × 5in, C/Mag. 5W 1·25
8in × 5in, Dual cone 8 ohm, 10W 2·45
ELAC 8in 8 ohm Dual cone 2·25
ELAC 10in 8 ohm Dual cone 3·50
GOODMANS 6½in 8 ohm Dual cone 2·15
FANE, 7in × 4in, 3 or 8 ohm 1·00
CELESTION 8in, 15 ohm 1·55
ADASTRA 10in, 8 or 15 ohm, 10W 3·45
BAKER GROUP 25 12in, 8 or 15 ohm, 25W 7·50
P. & P. 0·30
5in, 8 ohm, C/Mag. 0·85
2½in, 8 ohm or 64 ohm 0·50
P. & P. 0·15

**TWEETER AND CROSSOVER**
EMI 3½in, 3 or 8 ohm C/Mag. 1·00
Cone Tweeter 8 or 15 ohm, 10W 2·40
Cone Tweeter 8 ohm, 3W 1·45
Horn Tweeter 8 ohm, 20W 6·40
Dome Tweeter 8 ohm, 30W 5·40
Crossovers CN23 (3 ohm), CN28 (8 ohm), CN216 (16 ohm) 1·10
P. & P. 0·15

**KIT FORM CABINETS, TEAK VENEER.** 12in × 12in × 6in with 8in, 8in × 5in or 6½in and 3½in cutout 2·45
17in × 10in × 9in with 8in or 13in × 8in cutout 3·50
18in × 11in × 9in with 13in × 8in cutout for EMI 350 4·25
P. & P. each 0·45

**MICROPHONES**
CM70 Planet stick metal, switch crystal 1·55
DM160 Dynamic omni-dir, ball metal 3·85
UD130 50K/600 ohm, uni-dir, ball metal 5·75
TW209 5·75
CONDENSER MIKE 600 ohm, uni-dir 9·35
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**SOLDERING IRONS**
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SKI Kit (15 watt iron, 2 spare Bib, etc.) 3·30
X25 25W (low leakage) 1·90
P. & P. 0·10

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GP93/1 Stereo crystal 1·25
GP94/1 Stereo crystal 1·65
GP95/1 1·35
GP96/1 1·65
GP101 0·80
GP104 1·65
SONOTONE 9THAC Stereo ceramic, diam. 1·70
19-TI Stereo crystal 0·80
BSR SC5M Stereo ceramic 2·70
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G850 2·95
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P. & P. 0·15

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|---|---|---|---|
| 5in | 50p | 65p | 85p |
| 5¾in | 65p | 80p | 1·15p |
| 7in | 85p | 1·15 | 1·55 |

P. & P. 1–3 each 0·09
4 or more lot 0·30

| **LOW NOISE CASSETTES** | 1–5 | 6–10 | 11–20 |
|---|---|---|---|
| C60 | 35p | 33p | 30p |
| C90 | 45p | 48p | 40p |
| C120 | 55p | 52p | 50p |

Cassette Head Cleaner 0·35
P. & P. 1–5 each 0·03
6–10 lot 0·15
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5¾in Reels 0·22
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Recording Tape Splicer, Ref. 20 1·15
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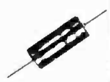
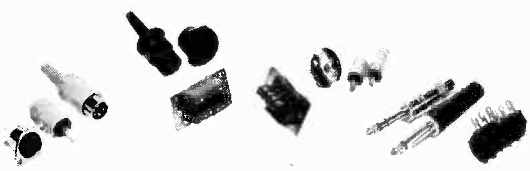
# CAPACITORS

Sub-miniature
Axial lead electrolytic



| Mfd | V | Price | 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 | 4 | 6p | | | |
| 4·7 | 63 | 6p | 100 | 10 | 6p | 470 | 6·3 | 6p |
| 6·8 | 40 | 6p | 100 | 25 | 6p | 470 | 10 | 10p |
| 6·8 | 63 | 6p | 100 | 40 | 6p | 470 | 25 | 12p |
| 10 | 25 | 6p | 100 | 63 | 12p | 470 | 40 | 18p |
| 10 | 63 | 6p | 150 | 6·3 | 6p | 680 | 6·3 | 10p |
| 15 | 16 | 6p | 150 | 16 | 6p | 680 | 16 | 12p |
| 15 | 40 | 6p | 150 | 25 | 6p | 680 | 25 | 18p |
| 15 | 63 | 6p | 150 | 40 | 10p | 680 | 40 | 22p |
| 22 | 10 | 6p | 150 | 63 | 12p | 1000 | 4 | 10p |
| 22 | 25 | 6p | 220 | 4 | 6p | 1000 | 10 | 12p |
| 22 | 63 | 6p | 220 | 10 | 6p | 1000 | 16 | 18p |
| 33 | 6·3 | 6p | 220 | 16 | 6p | 1000 | 25 | 22p |
| 33 | 16 | 6p | 220 | 25 | 10p | 1500 | 6·3 | 12p |
| 33 | 40 | 6p | 220 | 40 | 12p | 1500 | 10 | 18p |
| 47 | 4 | 6p | 220 | 63 | 18p | 1500 | 16 | 22p |
| 47 | 10 | 6p | 330 | 4 | 6p | 2200 | 6·3 | 18p |
| 47 | 25 | 6p | 330 | 10 | 6p | 2200 | 10 | 22p |
| 47 | 40 | 6p | 330 | 16 | 10p | 3300 | 6·3 | 22p |
| 47 | 63 | 6p | 330 | 63 | 22p | 4700 | 4 | 22p |

# PLUGS AND SOCKETS



**DIN PLUGS**
2 pin (1 flat) 8p
3 pin 9p
4 pin. 5 pin A (180°). 5 pin B (240°). 6 pin 10p

**DIN Sockets**
2 pin 6p
3 pin. 4 pin. 5 pin A (180°). 5 pin B (240°). 7p. 6 pin 9p

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P360 3 pin 1·5A chassis plug with line socket. Per pair 28p
SA 2190 3 pin 5A chassis plug 20p
SA 1862 Line socket for above 23p

**McMURDO**
RP8 8 way chassis plug 52p

RS8 way chassis socket 68p

**PHONO**
Plug plastic 5p
Plug screened 12p
Chassis socket 4p

**JACK**
Std. ¼" mono plug
Plastic 13p
Screened 21p

Std. ¼" stereo plug
Plastic 18p
Screened 30p
Open mono socket ¼" 10p; Moulded mono socket ¼" with 2 break contacts 14p; Moulded stereo socket ¼" with 3 break contacts 18p; 3·5mm. plug plastic 9p; screened 15p; open socket 8p.

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| NE561B. 16-pin DIL. Phase Locked Loop | £4·48 |
| SG1495D. 14-pin DIL. Four Quadrant Analogue Multiplier | £2·70 |
| SG3402N Amplifier/Multiplier | £1·69 |
| µA723C. TO99 (TO5). 2 to 37V Voltage Regulator | 75p |
| µA723C. 14-pin DIL. 2 to 37V Voltage Regulator | 75p |
| µA741C. 8-pin DIL. Op Amp | 36p |
| µA741C. 14-pin DIL. Op Amp | 45p |
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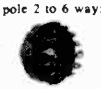
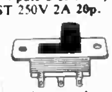
Mains rotary DPST 250V 2A 20p.



Slide Sub-miniature DPDT 9p



Push to make non-locking 12p

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DPDT 3A 240V a.c. 77p
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PP3, 6, etc., battery clip dual min. 9p.
PP1, 9, etc., battery clip separate per pair 6p.
Pair crocodile clips, 1 red, 1 black insulated sleeve 10p.
Solder Multicore 22 s.w.g. 10 metres 25p.
Silicone grease in special dispenser 20ml 54p.
Terminal Block 12-way 5A 14p.
Probe clips spring loaded per pair 30p.
Panel fuse holders 20mm 20p; 1¼in 35p.

**Transformers**
LT700 min. output transformer Pri. 1·2kΩ Sec 5Ω 200mW 50p.

**Sub-main. Mains Transformer**
6-0-6V 100mA 95p, 12-0-12V 50mA 95p.
Size: Both approx. 30 × 27 × 25mm.

**Min. Mains Transformer**
Size: 46 × 31 × 38mm.
0-12V 250mA 0-12V 250mA £1·36.

**Mains Transformer MT3AT**
Pri. 200-220-240V. Sec. 12-15-20-24-30V 1A £3·31.

**Mains Transformer MT206AT**
Pri. 200-220-240V Sec. 0-15-20V 1A 0-15-20V 1A £3·98.

**Hook-up wire**, 7 strand 0·2mm. PVC covered tinned copper wire for light general connexions up to 1·4A. 11 colours: black, blue, brown, green, grey, orange, pink, red, violet, white, yellow. 10 metres of any one colour 20p. Pack of 11 (1 of each colour) 10m. coils £2·05.

Single core screened 8p per metre.
**Twin** individually screened 10½p per metre.
**High quality** single screened 50Ω 100pF per metre, ideal for high grade audio connexions 15½p per metre.

**Mains** 3-core sub-miniature 1A black PVC covered 19 strand 0·1mm per conductor. 7½p per metre.

## POTENTIOMETERS

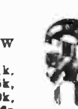
Rotary miniature carbon track ¼" spindle

Single gang Lin or Log
5k, 10k, 25k, 50k, 100k, 250k, 500k, 1M, 2M (and 1k Lin) 14p

Dual gang (Stereo) without switch Log or Lin 5k to 2M as above 44p

Single gang with DP switch 250V 2A Log or Lin 5k to 2M as above 29p

**PRESETS**
Sub-miniature 0·1W
Vert or Horiz
100, 250, 500, 1k, 2·5k, 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1M 6p



# RESISTORS

| | | | | |
|---|---|---|---|---|
| Carbon Film ½W 5% | 1Ω to 1M; 10% 1·2M to 10M | E12 | | 1p |
| Carbon Film ⅓W 5% | 1Ω to 10Ω; 10% 1·2M to 10M | E12 | | 1p |
| Carbon Film ⅛W 5% | 11Ω to 910k | E12 & E24 | | 1p |
| Carbon Film 1W 5% | 10Ω to 10M | E12 | | 3½p |
| Metal Oxide ½W 2% | 10Ω to 1M | E12 & E24 | | 4p |
| Wirewound 2½W 10% | 0·22ohms to 0·47ohms | E12 | | 12p |
| Wirewound 2½W 5% | 1ohm to 270ohms | E12 | | 12p |

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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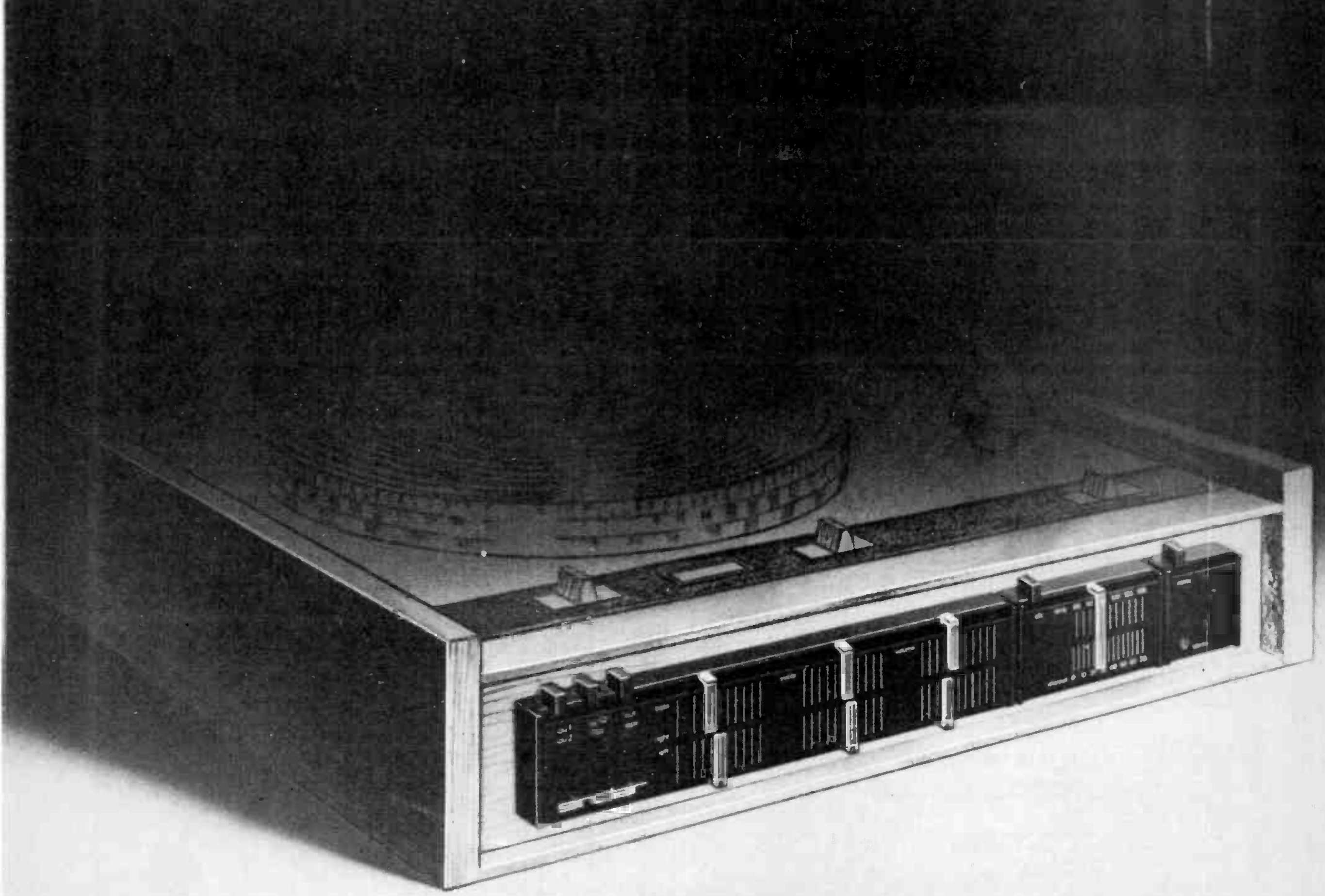
# Project 80

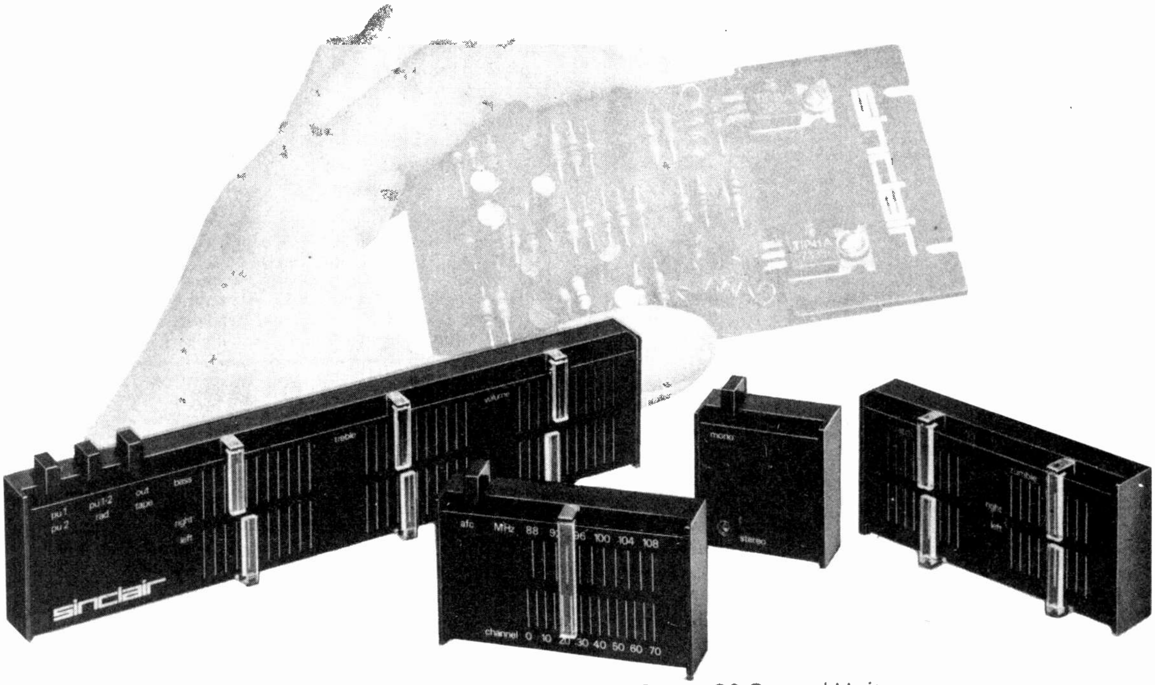
## a brilliant new concept in modular hi-fi



Project 80 is going to be the ultimate in modular hi-fi construction for a very long time to come. It combines the qualities most demanded of any modern domestic system – good circuitry, reliability and fine performance – with other features to be found nowhere else in the world. For example, *compactness* – Project 80 control units are $\frac{3}{4}$" deep × 2" high, and each one is completely self-contained. *Elegance* – all of Sinclair's design leadership has been concentrated on producing designs of outstanding functional elegance unsurpassed for styling and simplicity. *Flexibility* – the size and styling of Project 80 modules makes them the most versatile units ever. Combine them how you will, where you will, the Project 80 System of your choice gives you the best.

sinclair

# Sinclair Project 80



## technically the world's most advanced

Project 80 gives you choice from a range of 9 different modules for combining in a variety of ways to suit your requirements. The Stereo 80 is a versatile pre-amp control unit designed to meet all domestic hi-fi requirements including tape monitoring, high sensitivity magnetic cartridge input, and of course, individual slide controls on each channel for precise output matching. By separating the F.M. tuner and stereo decoder, useful economies can be effected where stereo radio reception is not needed. Two power amplifiers – Z.40 (18 watts RMS continuous into 4 ohms using 35V) and Z.60 (25 watts RMS continuous into 8 ohms using 50V) are available with choice of 3 different power supply units. The PZ.8 with its virtually indestructible circuitry is particularly recommended. For the final word in system building, the Active Filter Unit puts the finishing touch of quality to what are easily the world's most technically advanced hi-fi modules. Any further units likely to be added to Project 80 range will be compatible with those already available.

**Stereo 80 Control Unit** Size – 260 · 50 · 20mm (10¼ · 2 × ¾ins) Finish – Black with white indicators and transparent sliders **Inputs** – Magnetic pick up 3mV RIAA corrected. Ceramic pick-up 350mV Radio 100mV. Tape 30mV **Signal/noise ratio** – 60db **Frequency range** – 20Hz to 15KHz · 1dB. 10Hz to 25KHz + 3dB **Power requirements** – 20 to 35 volts **Outputs** – 100mV · AB monitoring for tape **Controls** – Press button tape radio and P U Sliders on each channel for volume bass treble RRP (add £1 19 VAT) **£11.95**

**Project 80 FM Tuner** Size – 85 × 50 × 20mm (3½ · 2 · ¾ins) **Tuning range** Dual varicap – 87 5 to 108MHz **Detector** – I C balanced coincidence One I.C equal to 26 transistors **Distortion** – 0 2% at 1KHz for 30% modulation 4 pole ceramic filter in I.F. section **Aerial impedance** – 75 Ω or 240 300 Ω **Sensitivity** – 5 microvolts for 30dB S/N ratio **Output** – 300mV for 30% modulation **Power requirements** – 25 to 35 volts (RRP add £1 19 VAT) **£11.95**

**Project 80 Stereo Decoder** Size – 47 · 50 · 20mm (1⅞ × 2 · ¾ins) One 19 transistor I.C. **Channel separation** greater than 30dB **Power requirements** – 25V **Output** 150mV per channel RRP (add 74p VAT) **£7.45**

**Active Filter Unit** Separate controls on each channel **Size** – 108 · 50 · 20mm (4¼ · 2 · ¾ins) **Voltage gain** – minus 0 2dB **Frequency response** – 40Hz to 22KHz controls minimum **Distortion** – at 1KHz – 0 03% using 30V supply **H.F. cut off (scratch)** – 22 KHz to 5 5KHz 12dB/oct slope **L F cut off (rumble)** – 28dB at 20Hz, 9dB/oct slope RRP (add 69p VAT) **£6.95**

**Z.40 Power Amplifier** Size – 55 · 80 · 20mm (2⅛ · 3⅛ · ¾ins) 9 transistors **Input sensitivity** – 100mV **Output** 18 watts RMS continuous into 4 Ω (35V) **Frequency response** 30Hz 100KHz · 3dB **S/N ratio** – 64dB **Distortion** – at 10 watts into 8 Ω less than 0 1% **Power requirements** – 12 to 35 volts, built in protection against overload RRP (add 54p VAT) **£5.40**

**Z.60 Power Amplifier** Size – 55 98 · 15mm (2⅛ · 3¾ · ¾ins) 12 transistors **Input sensitivity** – 100 250mV **Output** – 25 watts RMS continuous into 8 Ω (50V) **Distortion** ± typically 0 03% **Frequency response** – 15Hz to more than 200KHz ± 3dB **S/N ratio** – better than 70dB Built in protection against transient overload and short circuiting **Load impedance** – 4 Ω min safe on open circuit RRP (add 69p VAT) **£6.95**

**Power Supply Units** PZ 8 Stabilised Re entrant current limiting makes damage from overload or even direct shorting impossible Normal working voltage (adjustable) 50V RRP £7 98 · 79p VAT Without mains transformer **PZ 6** 35V stabilised RRP £7·98 · 79p VAT **PZ.5** 30V un stabilised RRP £4·98 49p VAT

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| Ref. No. | VA (Watts) | Weight lb | oz | Size cm. | P & P £ | p |
|---|---|---|---|---|---|---|
| 07 | 20 | 1 | 8 | 7·0 × 6·0 × 6·0 | 2·55 | 30 |
| 149 | 60 | 3 | 12 | 9·9 × 7·7 × 8·6 | 3·79 | 36 |
| 150 | 100 | 5 | 8 | 9·9 × 8·9 × 8·6 | 4·17 | 52 |
| 151 | 200 | 8 | 0 | 12·1 × 9·3 × 10·2 | 7·39 | 52 |
| 152 | 250 | 13 | 12 | 12·1 × 11·8 × 10·2 | 9·25 | 67 |
| 153 | 350 | 15 | 0 | 14·0 × 10·8 × 11·8 | 11·35 | 82 |
| 154 | 500 | 19 | 8 | 14·0 × 13·4 × 11·8 | 13·20 | * |
| 155 | 750 | 29 | 0 | 17·2 × 14·0 × 14·0 | 21·20 | * |
| 156 | 1000 | 38 | 0 | 17·2 × 16·6 × 14·0 | 27·40 | * |
| 158 | 2000 | 60 | 0 | 21·6 × 15·3 × 18·1 | 49·25 | * |

**AUTO TRANSFORMERS**

| Ref. No. | VA (Watts) | Weight lb | oz | Size cm. | Auto Taps | P & P £ | p |
|---|---|---|---|---|---|---|---|
| 113 | 20 | 1 | 0 | 5·8 × 5·1 × 4·5 | 0-115-210-240 | 1·34 | 22 |
| 64 | 75 | 2 | 4 | 7·0 × 6·7 × 6·1 | 0-115-210-240 | 2·64 | 30 |
| 4 | 150 | 3 | 4 | 8·9 × 7·7 × 7·7 | 0-115-200-220-240 | 3·18 | 36 |
| 66 | 300 | 6 | 4 | 9·9 × 9·6 × 8·6 | ,, ,, | 6·19 | 52 |
| 67 | 500 | 12 | 8 | 12·1 × 11·2 × 10·2 | ,, ,, | 8·33 | 67 |
| 84 | 1000 | 19 | 8 | 14·0 × 13·4 × 14·3 | ,, ,, | 13·50 | 82 |
| 93 | 1500 | 30 | 4 | 14·0 × 15·9 × 14·3 | ,, ,, | 17·50 | * |
| 95 | 2000 | 32 | 0 | 17·2 × 16·6 × 14·0 | ,, ,, | 25·35 | * |
| 73 | 3000 | 40 | 0 | 21·6 × 13·4 × 18·1 | ,, ,, | 32·80 | * |

**CASED AUTO TRANSFORMERS**

115 500W enclosed transformer, with mains lead and two 115V outlet sockets, £9·49, P & P 67p. 20W version, £2·02, P & P 22p.

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| Ref. No. | Amps. 12V | 24V | Weight lb | oz | Size cm. | Secondary Windings | P & P £ | p |
|---|---|---|---|---|---|---|---|---|
| 111 | 0·5 | 0·25 | | 8 | 4·8 × 2·9 × 3·5 | 0-12V at 0·25A × 2 | 1·34 | 22 |
| 213 | 1·0 | 0·5 | 1 | 4 | 6·1 × 5·8 × 4·8 | 0-12V at 0·5A × 2 | 1·58 | 22 |
| 71 | 2 | 1 | 1 | 12 | 7·0 × 6·4 × 6·1 | 0-12V at 1A × 2 | 2·09 | 22 |
| 18 | 4 | 2 | 2 | 12 | 8·3 × 7·7 × 7·0 | 0-12V at 2A × 2 | 2·95 | 36 |
| 70 | 6 | 3 | 3 | 8 | 8·9 × 8·0 × 7·7 | 0-12V at 3A × 2 | 3·52 | 42 |
| 108 | 8 | 4 | 5 | 8 | 9·9 × 8·9 × 8·6 | 0-12V at 4A × 2 | 3·96 | 52 |
| 72 | 10 | 5 | 6 | 4 | 9·9 × 9·6 × 8·6 | 0-12V at 5A × 2 | 4·67 | 52 |
| 116 | 12 | 6 | 6 | 12 | 9·9 × 10·2 × 8·6 | 0-12V at 5A × 2 | 5·61 | 52 |
| 17 | 16 | 8 | 8 | 12 | 12·1 × 9·9 × 10·2 | 0-12V at 8A × 2 | 7·22 | 52 |
| 115 | 20 | 10 | 11 | 8 | 14·0 × 9·6 × 11·8 | 0-12V at 10A × 2 | 9·20 | 67 |
| 187 | 30 | 15 | 15 | 8 | 14·0 × 12·1 × 11·8 | 0-12V at 15A × 2 | 16·94 | 82 |
| 226 | 60 | 30 | 32 | 0 | 17·2 × 15·3 × 14·0 | 0-12V at 30A × 2 | 22·50 | * |

**30 VOLT RANGE**

| Ref. No. | Amps | Weight lb | oz | Size cm. | Secondary Taps | P & P £ | p |
|---|---|---|---|---|---|---|---|
| 112 | 0·5 | 1 | 4 | 6·1 × 5·8 × 4·8 | 0-12-15-20-24-30V | 1·56 | 22 |
| 79 | 1·0 | 2 | 4 | 7·0 × 6·7 × 6·1 | ,, ,, | 2·11 | 36 |
| 3 | 2·0 | 3 | 4 | 8·9 × 7·7 × 7·7 | ,, ,, | 3·18 | 36 |
| 20 | 3·0 | 4 | 8 | 9·9 × 8·3 × 8·6 | ,, ,, | 3·96 | 42 |
| 21 | 4·0 | 6 | 4 | 9·9 × 9·6 × 8·6 | ,, ,, | 4·67 | 52 |
| 51 | 5·0 | 6 | 12 | 12·1 × 8·6 × 10·2 | ,, ,, | 5·83 | 52 |
| 117 | 6·0 | 8 | 0 | 12·1 × 9·3 × 10·2 | ,, ,, | 6·94 | 52 |
| 88 | 8·0 | 12 | 0 | 12·1 × 11·8 × 10·2 | ,, ,, | 9·00 | 67 |
| 89 | 10·0 | 13 | 12 | 14·0 × 10·2 × 11·8 | ,, ,, | 11·36 | 67 |

**50 VOLT RANGE**

| Ref. No. | Amps. | Weight lb | oz | Size cm. | Secondary Taps | P & P £ | p |
|---|---|---|---|---|---|---|---|
| 102 | 0·5 | 1 | 12 | 7·0 × 6·4 × 6·1 | 0-19-25-33-40-50V | 2·09 | 30 |
| 103 | 1·0 | 2 | 12 | 8·3 × 7·4 × 7·0 | ,, ,, | 3·08 | 36 |
| 104 | 2·0 | 5 | 8 | 7·9 × 8·9 × 8·6 | ,, ,, | 4·26 | 42 |
| 105 | 3·0 | 6 | 12 | 9·9 × 10·2 × 8·6 | ,, ,, | 5·79 | 52 |
| 106 | 4·0 | 10 | 0 | 12·1 × 10·5 × 10·2 | ,, ,, | 7·69 | 52 |
| 107 | 6·0 | 12 | 0 | 14·0 × 10·2 × 11·8 | ,, ,, | 11·38 | 67 |
| 118 | 8·0 | 18 | 0 | 14·0 × 12·7 × 11·8 | ,, ,, | 12·40 | 97 |
| 119 | 10·0 | 25 | 0 | 17·2 × 12·7 × 14·0 | ,, ,, | 18·62 | * |

**60 VOLT RANGE**

| Ref. No. | Amps. | Weight lb | oz | Size cm. | Secondary Taps | P & P £ | p |
|---|---|---|---|---|---|---|---|
| 124 | 0·5 | 2 | 4 | 7·0 × 6·7 × 6·1 | 0-24-30-40-48-60V | 2·12 | 36 |
| 126 | 1·0 | 3 | 4 | 8·9 × 7·7 × 7·7 | ,, ,, | 2·97 | 36 |
| 127 | 2·0 | 6 | 4 | 9·9 × 9·6 × 8·6 | ,, ,, | 4·67 | 42 |
| 125 | 3·0 | 8 | 12 | 12·1 × 9·9 × 10·2 | ,, ,, | 7·11 | 52 |
| 123 | 4·0 | 13 | 12 | 12·1 × 11·8 × 10·2 | ,, ,, | 9·20 | 67 |
| 40 | 5·0 | 12 | 00 | 14·0 × 10·2 × 11·8 | ,, ,, | 10·83 | 67 |
| 120 | 6·0 | 15 | 8 | 14·0 × 12·1 × 11·8 | ,, ,, | 13·35 | 82 |
| 121 | 8·0 | 25 | 00 | 14·0 × 14·7 × 11·8 | ,, ,, | 15·01 | * |
| 122 | 10·0 | 25 | 0 | 17·2 × 12·7 × 14·0 | ,, ,, | 19·60 | * |
| 189 | 12·0 | 29 | 00 | 17·2 × 14·0 × 14·0 | ,, ,, | 21·60 | |

**MINIATURE TRANSFORMERS WITH SCREENS**

| Ref. No. | mA | Weight lb | oz | Size cm. | Volts | P & P £ | p |
|---|---|---|---|---|---|---|---|
| 238 | 200 | | 2 | 2·8 × 2·6 × 2·0 | 3-0-3 | 1·44 | 10 |
| 212 | 1A, 1A | 1 | 4 | 6·1 × 5·8 × 4·8 | 0-6, 0-6 | 1·67 | 22 |
| 13 | 100 | | 4 | 3·9 × 2·6 × 2·9 | 9-0-9 | 1·23 | 10 |
| 235 | 330, 330 | | 4 | 4·8 × 2·9 × 3·5 | 0-9, 0-9 | 1·67 | 10 |
| 207 | 500, 500 | 1 | 00 | 6·1 × 5·4 × 4·8 | 0-8-9, 0-8-9 | 2·23 | 22 |
| 208 | 1A, 1A | 1 | 12 | 7·0 × 6·4 × 6·1 | 0-8-9, 0-8-9 | 3·00 | 30 |
| 236 | 200,200 | | 4 | 4·8 × 2·9 × 3·5 | 0-15, 0-15 | 1·67 | 10 |
| 214 | 300, 300 | 1 | 4 | 6·1 × 5·8 × 4·8 | 0-20, 0-20 | 1·76 | 22 |
| 221 | 700 (d.c.) | 1 | 8 | 7·0 × 6·1 × 6·1 | 20-12-0-12-20 | 1·55 | 30 |
| 206 | 1A, 1A | 2 | 12 | 8·3 × 7·7 × 7·0 | 0-15-20, 0-15-20 | 4·05 | 38 |
| 203 | 500,500 | 2 | 4 | 8·3 × 7·0 × 7·0 | 0-15-27, 0-15-27 | 3·10 | 38 |
| 204 | 1A, 1A | 3 | 4 | 8·9 × 7·7 × 7·7 | 0-15-27, 0-15-27 | 3·15 | 38 |

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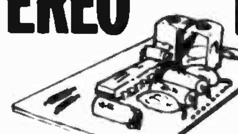

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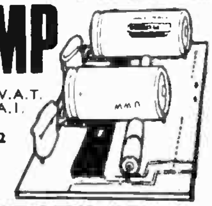

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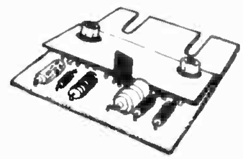

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| AD161 | 40p |
| AD162 | 40p |
| AF114 | 25p |
| AF115 | 25p |
| AF116 | 25p |
| AF117 | 25p |
| AF118 | 60p |
| AF172 | 30p |
| ASY28 | 30p |
| ASZ21 | 60p |
| BA102 | 33p |
| BA112 | 50p |
| BA114 | 18p |
| BA156 | 15p |
| BC107 | 12p |
| BC108 | 12p |
| BC109 | 12p |
| BC147 | 12p |
| BC148 | 12p |
| BC149 | 12p |
| BC153 | 15p |
| BC157 | 14p |
| BC158 | 15p |
| BC159 | 15p |
| BC169C | 14p |
| BC182 | 14p |
| BC183 | 14p |
| BC184 | 14p |
| BC212 | 14p |
| BC213 | 14p |
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| BC238 | 12p |
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| BD131 | 75p |
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| BFX84 | 30p |
| BFX85 | 30p |
| BFX86 | 30p |
| BFX88 | 30p |
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| BFY44 | 50p |
| BFY50 | 25p |
| BFY51 | 25p |
| BFY52 | 25p |
| BFY53 | 25p |
| BFY90 | 68p |
| BSW63 | 65p |
| BSW68 | 80p |
| BSY95A | 12p |
| C111 | 50p |
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| MJ340 | 55p |
| MJ481 | 95p |
| MJ2801 | £1·25 |
| MJ2901 | £2·20 |
| MJE340 | 50p |
| MJE370 | 75p |
| MJE371 | 90p |
| MJE520 | 65p |
| MJE2955 | £1·95 |
| MJE3055 | 85p |
| MM1613 | 43p |
| MM1712 | 80p |
| MPF102 | 45p |
| MPF103 | |
| (2N5457) | 35p |
| MPF104 | |
| (2N5458) | 35p |
| MPF105 | |
| (2N5459) | 40p |
| MPSA06 | 35p |
| MPSA16 | 30p |
| MPSA56 | 35p |
| MPSU06 | 75p |
| MPSU56 | 70p |
| NKT135 | 35p |
| NKT222 | 25p |
| NKT401 | 85p |
| NKT404 | 80p |
| NKT773 | 30p |
| NKT774 | 25p |
| OA5 | 20p |
| OA10 | 20p |
| OA47 | 10p |
| OA70 | 12p |
| OA79 | 12p |
| OA81 | 10p |
| OA90 | 10p |
| OA91 | 10p |
| OA200 | 10p |
| OA202 | 10p |
| OA210 | 35p |
| OA211 | 38p |
| OC16 | 90p |
| OC19 | 65p |
| OC22 | 55p |
| OC26 | 85p |
| OC28 | 65p |
| OC30 | 80p |

| | |
|---|---|
| OC36 | 85p |
| OC42 | 40p |
| OC44 | 20p |
| OC45 | 20p |
| OC70 | 15p |
| OC71 | 17p |
| OC72 | 20p |
| OC75 | 25p |
| OC76 | 25p |
| OC77 | 40p |
| OC81 | 25p |
| OC83 | 25p |
| OC84 | 25p |
| OC139 | 30p |
| OC140 | 30p |
| OC170 | 25p |
| OC171 | 30p |
| OC200 | 50p |
| OC201 | 80p |
| OC202 | 75p |
| TIP29A | 49p |
| TIP30A | 58p |
| TIP31A | 62p |
| TIP32A | 74p |
| TIP33A | £1·05 |
| TIP34A | £1·55 |
| TIP35A | £3·35 |
| TIP36A | £2·65 |
| TIP41A | 75p |
| TIP42A | 90p |
| TIP29B | 58p |
| TIP30B | 66p |
| TIP31B | 70p |
| TIP32B | 82p |
| TIP33B | £1·12 |
| TIP34B | £1·88 |
| TIP35B | £2·81 |
| TIP36B | £3·64 |
| TIP41B | 83p |
| TIP42B | 98p |
| TIP29C | 71p |
| TIP30C | 78p |
| TIP31C | 85p |
| TIP32C | £1·05 |
| TIP33C | £1·30 |
| TIP34C | £1·90 |
| TIP35C | £3·20 |
| TIP36C | £4·10 |

| | |
|---|---|
| TIP41C | 95p |
| TIP42C | £1·10 |
| TIS50 | 40p |
| ZTX107 | 15p |
| ZTX300 | 15p |
| ZTX500 | 18p |
| ZTX501 | 20p |
| ZTX504 | 50p |
| ZTX531 | 30p |
| ZTX550 | 25p |
| IN659 | 8p |
| IN914 | 8p |
| IN916 | 8p |
| IN4001 | 8p |
| IN4002 | 9p |
| IN4003 | 9p |
| IN4004 | 10p |
| IN4005 | 12p |
| IN4006 | 15p |
| IN4007 | 18p |
| IN4148 | 7p |
| 2N696 | 25p |
| 2N697 | 20p |
| 2N698 | 25p |
| 2N706 | 12p |
| 2N706A | 15p |
| 2N708 | 15p |
| 2N930 | 20p |
| 2N1132 | 25p |
| 2N1302 | 18p |
| 2N1303 | 18p |
| 2N1304 | 25p |
| 2N1305 | 25p |
| 2N1306 | 25p |
| 2N1307 | 25p |
| 2N1308 | 25p |
| 2N1309 | 25p |
| 2N1613 | 25p |
| 2N1711 | 25p |
| 2N2147 | 70p |
| 2N2160 | 65p |
| 2N2217 | 25p |
| 2N2218 | 25p |
| 2N2219 | 25p |
| 2N2222 | 20p |
| 2N2222A | 25p |
| 2N2398 | 70p |
| 2N2646 | 50p |

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|---|---|
| 2N2846 | £1·50 |
| 2N2904 | 25p |
| 2N2905 | 25p |
| 2N2096 | 25p |
| 2N2907 | 25p |
| 2N2926 | 12p |
| 2N3053 | 25p |
| 2N3054 | 65p |
| 2N3055 | 50p |
| 2N3232 | 78p |
| 2N3525 | 95p |
| 2N3702 | 14p |
| 2N3703 | 12p |
| 2N3704 | 12p |
| 2N3705 | 12p |
| 2N3706 | 12p |
| 2N3707 | 12p |
| 2N3708 | 12p |
| 2N3709 | 12p |
| 2N3771 | £2·70 |
| 2N3772 | £2·75 |
| 2N3773 | £2·85 |
| 2N3819 | 35p |
| 2N3820 | 55p |
| 2N3866 | 85p |
| 2N3904 | 22p |
| 2N3905 | 25p |
| 2N4058 | 12p |
| 2N4059 | 12p |
| 2N4060 | 12p |
| 2N4061 | 12p |
| 2N4126 | 17p |
| 2N4286 | 15p |
| 2N4287 | 15p |
| 2N4288 | 15p |
| 2N4289 | 15p |
| 2N4290 | 15p |
| 2N4444 | £1·80 |
| 2N4871 | 35p |
| 2N4920 | 60p |
| 2N5191 | 98p |
| 2N5194 | £1·10 |
| 40360 | 50p |
| 40361 | 50p |
| 40362 | 55p |

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|---|---|
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| SN7401 | 20p |
| SN7402 | 20p |
| SN7403 | 20p |
| SN7404 | 20p |
| SN7405 | 20p |
| SN7406 | 30p |
| SN7407 | 30p |
| SN7408 | 20p |
| SN7409 | 45p |
| SN7410 | 20p |
| SN7411 | 23p |
| SN7412 | 42p |
| SN7413 | 30p |
| SN7416 | 30p |
| SN7417 | 30p |
| SN7420 | 20p |
| SN7422 | 48p |
| SN7423 | 48p |
| SN7425 | 48p |
| SN7427 | 42p |

| | |
|---|---|
| SN7428 | 50p |
| SN7430 | 20p |
| SN7432 | 42p |
| SN7433 | 70p |
| SN7437 | 65p |
| SN7438 | 65p |
| SN7440 | 20p |
| SN7441AN | 75p |
| SN7442 | 75p |
| SN7443 | £1·00 |
| SN7445 | £2·00 |
| SN7446 | £2·00 |
| SN7447 | £1·75 |
| SN7448 | £1·75 |
| SN7450 | 20p |
| SN7451 | 20p |
| SN7453 | 20p |
| SN7454 | 20p |
| SN7460 | 20p |
| SN7470 | 30p |
| SN7472 | 30p |

| | |
|---|---|
| SN7473 | 40p |
| SN7474 | 40p |
| SN7475 | 55p |
| SN7476 | 45p |
| SN7480 | 80p |
| SN7481 | £1·25 |
| SN7482 | 87p |
| SN7483 | £1·00 |
| SN7484 | 90p |
| SN7486 | 45p |
| SN7490 | 75p |
| SN7491AN | £1·00 |
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| SN7493 | 75p |
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| SN7495 | 80p |
| SN7496 | £1·00 |
| SN7497 | £6·25 |
| SN74100 | £2·50 |
| SN74104 | £1·45 |
| SN74105 | £1·45 |

| | |
|---|---|
| SN74107 | 50p |
| SN74110 | 60p |
| SN74118 | £1·00 |
| SN74119 | £1·90 |
| SN74121 | 65p |
| SN74122 | £1·35 |
| SN74123 | £2·70 |
| SN74141 | £1·00 |
| SN74145 | £1·50 |
| SN74150 | £3·35 |
| SN74151 | £1·10 |
| SN74153 | £1·35 |
| SN74154 | £2·00 |
| SN74155 | £1·55 |
| SN74156 | £1·55 |
| SN74157 | £1·80 |
| SN74160 | £2·60 |
| SN74161 | £2·60 |
| SN74162 | £3·40 |
| SN74163 | £3·40 |
| SN74164 | £2·75 |
| SN74165 | £4·00 |

| | |
|---|---|
| SN74166 | £4·00 |
| SN74167 | £5·25 |
| SN74170 | £4·10 |
| SN74174 | £2·00 |
| SN74175 | £1·35 |
| SN74176 | £1·60 |
| SN74177 | £1·60 |
| SN74180 | £1·55 |
| SN74181 | £7·00 |
| SN74182 | £2·00 |
| SN74184 | £2·45 |
| SN74185A | £2·40 |
| SN74190 | £1·95 |
| SN74191 | £1·95 |
| SN74192 | £2·00 |
| SN74193 | £2·00 |
| SN74194 | £2·50 |
| SN74195 | £1·85 |
| SN74196 | £1·50 |
| SN74197 | £1·50 |
| SN74198 | £4·60 |
| SN74190 | £4·80 |

QUANTITY DISCOUNTS—12 + 10%, 25 + 15%, 100 + 20%.

### S.C.R.s

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|---|---|
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| CRS1/10 | 56p |
| CRS1/20 | 60p |
| CRS1/40 | 65p |
| CRS1/60 | 90p |
| CRS3/10 | 62p |
| CRS3/20 | 62p |
| CRS3/40 | 90p |
| CRS7/400 | £1·00 |
| CRS16/100 | 85p |
| CRS16/200 | 90p |
| CRS16/600 | £1·60 |
| C106B | 45p |
| C106D | 70p |
| 40669 | 90p |
| TIC44 | 35p |
| 2N4444 | £1·90 |
| BT10/5004 | 90p |

**BRIDGE RECTIFIERS**

| | |
|---|---|
| WO2 1A 200V | 38p |
| BY164 1 4A 200V | 57p |
| MDA952/2 6A 100V | 80p |

**ZENER DIODES**

| | |
|---|---|
| BZY88 Series 400mW 3 3V–33V, 5% | 11p |
| 1 5W range | 25p |
| 10W range | 45p |

**L.E.D.**

| | |
|---|---|
| TIL209 | 28p |
| HP5082 | 28p |
| MA2082R | 25p |

**L.D.R.**

| | |
|---|---|
| ORP12 | 60p |
| NE555 Timer | 90p |

### TRIACS

| | |
|---|---|
| TXL228B 8A 400V | 95p |
| SC40D | £1·40 |
| SC40E | £1·65 |
| SC45D | £1·70 |
| SC45E | £2·10 |
| SC50D | £2·42 |
| SC50E | £2·70 |
| DIAC | 25p |

### LINEAR I.C.s

| | |
|---|---|
| LM309K 5V, 1A, Voltage Reg. | £2·10 |
| LM723C 2-37V, 150mA Voltage Reg. | £1·05 |
| MFC4000 250mW Audio | 60p |
| TBA800 5Watt Audio | £1·50 |
| 709C Op Amp D I L / TO99 | 45p |
| 741C Op Amp 8/14 D.I L./TO99 | 55p |
| 748C Op Amp D I L | 75p |
| 747C Dual Op Amp | £1·20 |
| ZN414 Radio I C | £1·25 |
| TAD100 Radio I C inc Filter | £1·90 |
| CA3014 | £1·55 |
| CA3018 | £1·00 |
| CA3028 | £1·20 |
| CA3036 | £1·00 |
| CA3046 | 95p |
| CA3048 | £2·35 |
| CA3075 | £1·80 |
| CA3090Q | £4·85 |
| MC1303L | £2·20 |
| SN76023 6W Audio I C with circuit | £1·75 |

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| AB13 | 6 | 4 | 2 | 70p |
| AB14 | 7 | 5 | 2½ | 84p |
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| AB16 | 10 | 7 | 3 | £1·22 |
| AB17 | 10 | 4½ | 3 | £1·00 |
| AB18 | 12 | 5 | 3 | £1·20 |
| AB19 | 12 | 8 | 3 | £1·60 |

**ALUMINIUM BOXES WITH SLOPING TOP PANEL—IDEAL FOR PRE-AMPS, ETC., USING SLIDER CONTROLS**

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AB22 As above but 12" long £2·40

**V41 VU METER** £2·50
The V41 is calibrated −20 to +3 and 0-100% making it suitable for use as a recording level meter or as a power output indicator
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**Dimensions:** 40 × 40 × 29mm

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| | Size | |
|---|---|---|
| For 8 × 5in Speaker | 7½ × 11½ × 5½ | £3·50 |
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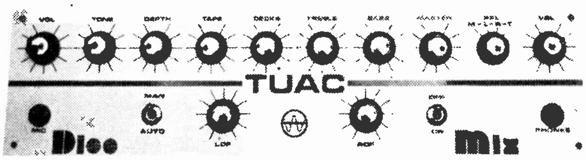


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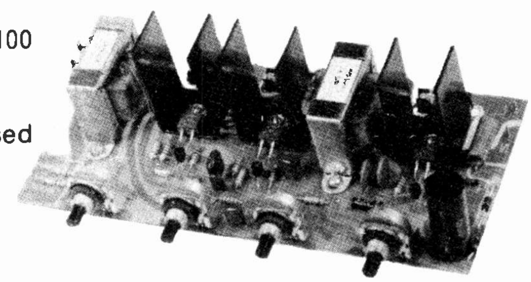

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**SILICON P.N.P.**

| Type | Voltage | Frequency | Price |
|---|---|---|---|
| BCY 71 | 45 | 200 MHz | 12p |
| BFS 92 | 100 | 70 MHz | 20p |
| BFS 95 | 40 | 70 MHz | 17p |
| BFX 12 | 25 | 210 MHz | 10p |
| 2N 2906 | 60 | 200 MHz | 15p |
| 2N 3702 | 40 | 100 MHz | 11p |
| 2N 3703 | 50 | 100 MHz | 12p |

**SILICON N.P.N.**

| Type | Voltage | Frequency | Price |
|---|---|---|---|
| BC 108 | 30 | 150 MHz | 15p |
| BC 109 | 30 | 150 MHz | 15p |
| BF 179 | 225 | 125 MHz | 40p |
| BF 180 | 30 | 625 MHz | 25p |
| BFW 58 | 80 | 80 MHz | 15p |
| BFX 43 | 30 | 500 MHz | 20p |
| BFX 86 | 40 | 50 MHz | 17p |
| BFY 53 | 30 | 50 MHz | 10p |
| 2N 697 | 60 | 40 MHz | 12p |
| 2N 709 | 15 | 900 MHz | 30p |
| 2N 718 | 60 | 60 MHz | 12p |
| 2N 753 | 25 | 250 MHz | 12p |
| 2N 744 | 20 | 300 MHz | 12p |
| 2N 1613 | 75 | 60 MHz | 17p |
| 2N 2220 | 60 | 250 MHz | 15p |

**SILICON N.P.N.**

| Type | Voltage | Frequency | Price |
|---|---|---|---|
| 2N 3053 | 60 | 100 MHz | 17p |
| 2N 3707 | 30 | | 12p |
| 2N 5179 | 20 | 900 MHz | 40p |

**GERMANIUM P.N.P.**

| Type | Voltage | Frequency | Price |
|---|---|---|---|
| ACY 44 | 50 | 1 MHz | 10p |
| ADY 26 | 80 | 75 watts | £1 |
| AF 124 | 20 | 75 MHz | 20p |
| AFY 19 | 32 | 350 MHz | 20p |
| ASY 32 | 25 | 5 MHz | 10p |
| ASZ 21 | 15 | 450 MHz | 20p |
| GET 113 | 32 | | 10p |
| GET 120 | 32 | 2 watts | 10p |
| OC 123 | 50 | 1 MHz | 10p |
| OCP 70 | Light-sensitive | | 20p |
| 2N 1307 | 30 | 10 MHz | 15p |
| 2N 1309 | 30 | 15 MHz | 15p |
| 2N 443 | 60 | 150 watts | £1 |

**HIGH FREQUENCY POWER**

| Type | Voltage | Frequency | Price |
|---|---|---|---|
| BFR 64 | 40 | 1,200 MHz | £1 |
| BLY 89A | 35 | 650 MHz | £5 |
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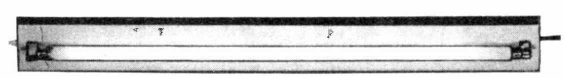

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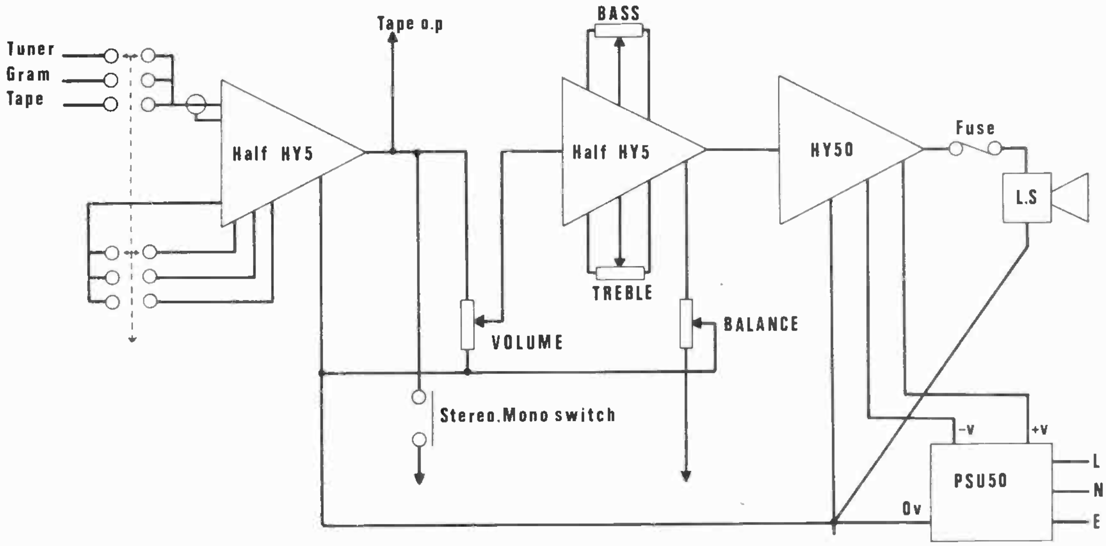
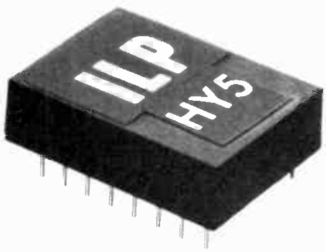
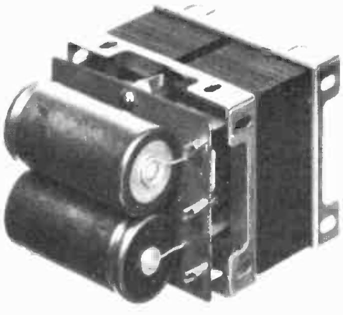



MONO ELECTRICAL CIRCUIT DIAGRAM WITH INTERCONNECTIONS FOR STEREO SHOWN







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The PSU50 can be used for either mono or stereo systems.

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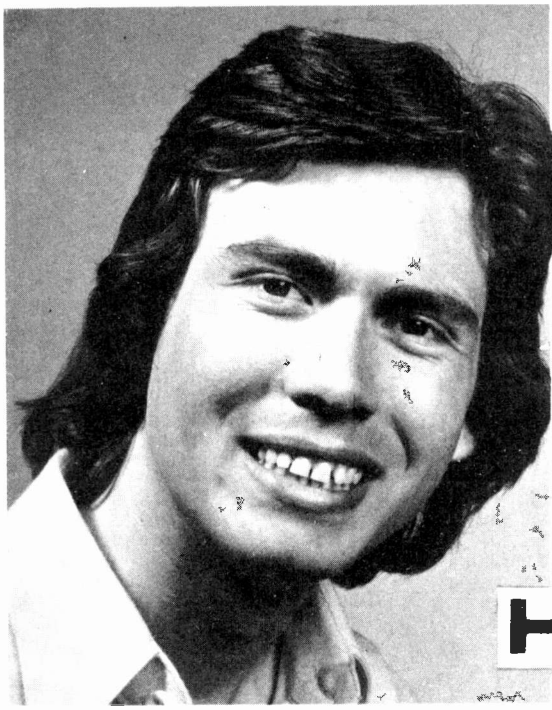

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# PE

## SORRY FOR THE DELAY

FIRST a word or two of explanation and apology. Like our weather this summer, the economic and industrial climate has been unsettled and changeable over the whole country. And the Publishers of this magazine have had their share of problems, as many readers will have guessed. We can only apologise to all our readers and advertisers who regularly support us for any disappointment, perplexity and inconvenience they may have experienced by the delayed appearance of some recent issues of PRACTICAL ELECTRONICS.

Because of continuing production problems erratic publication dates must be expected for the next few issues, also. But we hope soon everything will be restored to normal. In the meantime, while writing, we have to admit not knowing just when this particular issue will appear on the bookstalls. It may be during the second half of August, but more probably during the first half of September (yes, we did try ESP, but alas to no avail).

## A NEW SEASON—AND A NEW VIEW

In any event, September is a significant turning point in the year so far as hobbies are concerned. It is a month when those typically summer activities start to fade and become overshadowed by the different prospects that lie just ahead for the autumn and winter—the period when indoor activities really come into their own. Now the electronics constructor faces his most productive period of the year and starts to think again of projects long intended, but not so far realised. A foraging amongst back numbers of periodicals probably brings to light some design ear-marked long ago for the earliest possible attention. And there is the constant flow of new ideas that come from sources such as this magazine regularly each month (normal conditions prevailing).

Some constructors like a reasonably large and involved project to get their teeth into, and something which will keep them usefully occupied over several months. This kind of need will be satisfied in many instances by the P.E. Closed Circuit Television Camera. Although CCTV systems are common enough in commercial and industrial fields, this particular type of instrument has not yet come into general use. Since most homes possess the necessary monitor in the form of the normal TV set, it is a pity that a private, personal CCTV facility is not more readily available. With our specially commissioned design for a camera, this does now become a reasonable and economic proposition for the average constructor, and permits him to extend his technical knowledge and experience by acquiring new skills in video work which can be applied to instruct or entertain his own family or circle of friends, in a multitude of ways.

Of course, some constructors prefer smaller and less complicated designs. We don't neglect or ignore them. There is always a wide choice of subjects in P.E. each month.

Whatever the individual choice may be, of this there is no doubt: by becoming immersed in his hobby the electronics constructor can forget for a while some of the more gloomy news which seems to provide a constant background to present day affairs.

F.E.B.

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# PE CCTV MONOCHROME CAMERA

BY A.V. FLATMAN * B.Sc.

## Ideally suited for:

- HOME ENTERTAINMENT
- LECTURING
- REMOTE MONITORING
- SURVEILLANCE

MOST commercially available closed circuit television equipment is of semi or fully professional quality and is therefore financially prohibitive to a large group of potential users. This project describes an economical and relatively simple, black and white, amateur grade CCTV Camera.

The constructor should, without the use of specialised test equipment, be able to build this interesting and extremely useful item for less than £60—the cost being controlled to a large extent by the lens used with the camera.

### GENERAL DESCRIPTION

The greatest economy is made by basing the design of the camera unit on an amateur grade one inch diameter Vidicon (namely the EMI 9677). This device may be obtained, together with its scan coil assembly and pin connector, from EMI Electron Tube Division, 243 Blyth Road, Hayes, Middlesex UB3 1HJ.

7400 family logic is utilised to generate the complex synchronisation signals required within the camera system. This feature renders the widely used, discrete component equivalent obsolete and enables a cheaper, more compact and less power consuming replacement. The hybrid nature of the circuitry, due to the combination of digital integrated circuits and transistors, will, it is hoped, give the constructor some interesting examples of how these contrasting components may live together in harmony.

The camera, whose circuitry is mounted on two printed circuit boards and is compatible to either 625 or 405 line TV standards (by a simple adjustment), may be coupled to a remote TV monitor via a single coaxial link. Alternatively, the unit may be used in conjunction with a standard domestic 625 line TV receiver with the aid of a u.h.f. modulator. This will enable the video information from the camera to be injected into the receiver aerial socket.

A strong aluminium case houses the mains-powered camera in a compact yet accessible manner and caters for the attachment of a standard photographic tripod.

### BRITISH TV STANDARDS

A television picture is made up of a series of merging horizontal lines. One complete picture or frame is scanned out every 1/25 second, and is "enhanced" by the tube phosphor for a very short time—thus enabling following frames to be scanned-out to give a flicker free and lifelike appearance to the moving picture.

If one visualises a picture being sliced into thin horizontal strips, which are linked end-to-end to form a long chain, then it is not a difficult conception to understand how the information is conveyed from a TV camera to its monitor. Reconstruction of the "mutilated" picture in the above example requires knowledge of the exact location of each strip, and introduces the need for two groups of

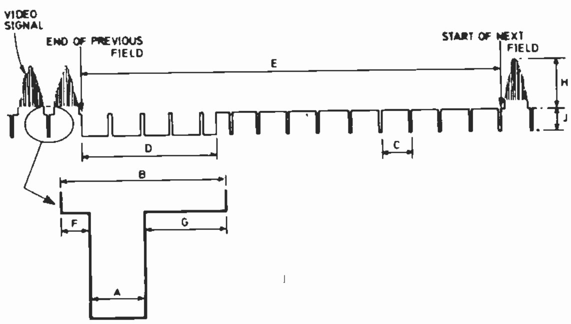



Fig. 1.1. CCIR 625/405 line TV Standards

Table 1·1

| | | 625-Line | 405-Line |
|---|---|---|---|
| A | Line sync pulse | 4$\mu$s | 8$\mu$s |
| B | Line blanking period | 12$\mu$s | 18$\mu$s |
| C | Line period | 64$\mu$s | 98$\mu$s |
| D | Field sync pulse | 250$\mu$s | 350$\mu$s |
| E | Field blanking period | 1·28ms | 1·4ms |
| F | Front porch | 2$\mu$s | 2$\mu$s |
| G | Back porch | 6$\mu$s | 8$\mu$s |
| H:J | Video: Sync ratio | 7:3 | 7:3 |
| H + J | Composite video level | IV pk/pk | IV pk/pk |

*North Staffordshire Polytechnic

information—video and synchronisation. For convenience, both groups of information are then compressed into a composite signal to enable single channel conveyance.

Approximate CCIR 405/625 line TV standards are shown in Fig. 1.1. Video and sync information are easily distinguished by their respective positive and negative-going directions. Most aspects of the composite video waveform shown may be summarised as follows.

**Line Sync Pulse** The leading edge of the line sync pulse marks the end of a line scan and initiates a beam flyback in the scanning process. Inaccuracy in the generation of these sync pulses will give rise to line slip or the breaking up of the monitored picture—they must therefore be inserted precisely in time with fast vertical edges.

**Line Blanking Period** The electron beam in any TV system requires a finite time to traverse the face of the tube. To allow for this flyback time, and to prevent the action of beam flyback from interfering with the intended scanning process (by retracing itself), a line blanking period is employed. This period blanks-off the video signal and starts slightly before the line sync pulse, ending some microseconds after its completion and accounts for up to 15 per cent of the total available line time.

**Front Porch** This period allows time for the video signal voltage to fall to the blanking level before the action of the line sync pulse.

**Back Porch** Composite video signals are often processed by amplifiers having no d.c. coupling facilities. This unfortunately allows the video levels to drift and give a mean voltage level coincident with zero volts d.c. D.c. restoration is simply achieved in the TV monitor/receiver by clamping the reference level to the back porch for the duration of the following line. All picture half tones are thus faithfully reproduced.

**Field Sync Pulse** The leading edge of the field sync pulse marks the end of a complete field and initiates a beam flyback. As field deflection coils are generally more inductive than line deflection coils, the time taken for a flyback operation is understandably longer (as $t = L/R$ seconds). The energy in the field sync pulse must then be correspondingly larger than that in the line sync pulse. Pulse energy is calculated as the product of its height (volts) and its width (seconds) and is, in this case, more conveniently controlled by its width. A field sync pulse of 160μs–300μs width performs the required task admirably, at the same time making it easily differentiated from the line sync pulse.

A frame sync pulse of at least 150μs duration would obliterate several line sync pulses and momentarily inhibit the operation of the line generator in the monitor/receiver. It is preferable to maintain the free-running of the line generator due to its difficult fast-starting properties. For this reason, the long field sync pulse is broken up into a series of broad pulses, enabling the delivery of a pulse whenever the line generator expects one.

In more sophisticated TV systems, the field sync pulse is the most complex signal of them all. This is to cater for the fully synchronised interlacing; whereby in 625 line standards, for example, field 1 would commence scanning at the top left hand corner and comprise 312·5 lines, whilst field 2 would start scanning the inter-leaved remainder of the 625 lines halfway along the top line. Interlaced scanning is accurately achieved in this way but is unfortunately costly in circuitry. The alternative to fully synchronised scanning will be explained shortly.

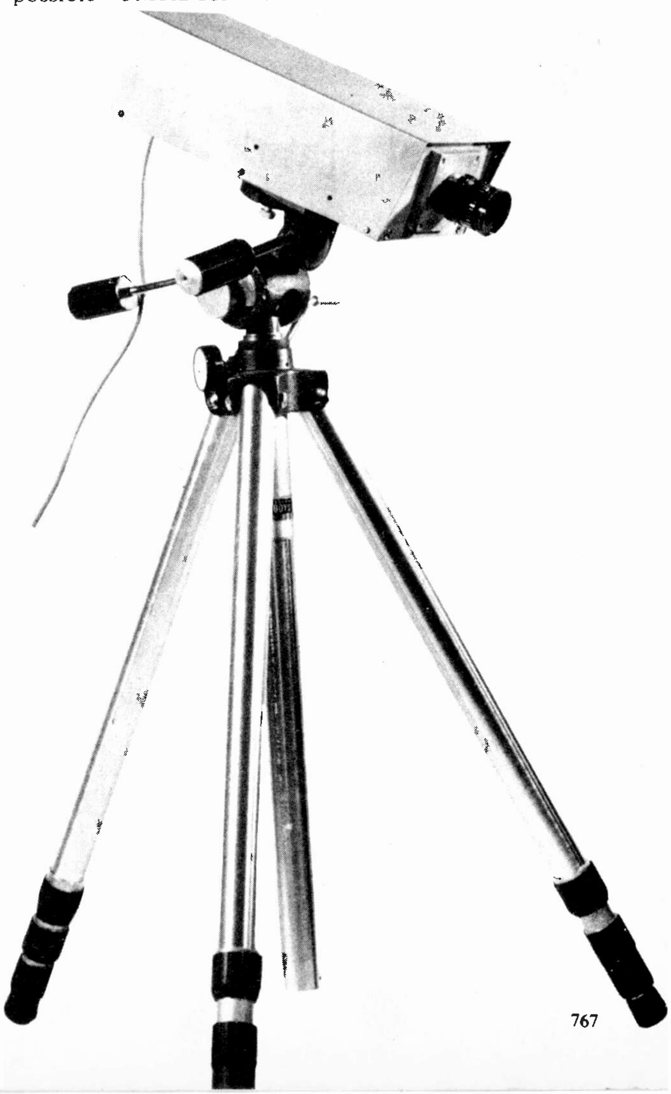
**Field Blanking Period** Blanks the video signal whilst field flyback is performed, taking about 20 line periods.

**Composite Video Bandwidth** The theoretical maximum frequency of the signal from a TV Camera is given by:

$f_{max} = \frac{a N^2 P}{2}$ where N is the number of lines in a picture frame, P is the number of frames/second and $a = \frac{4}{3}$ the picture aspect ratio.

For 625 lines $f_{max}$ =6·5MHz; for 405 lines $f_{max}$ = 2·74MHz.

The theoretical maximum bandwidth assumes equal horizontal and vertical resolution. In practice this is not so and lower working bandwidths are possible—5MHz for 625 line standards.

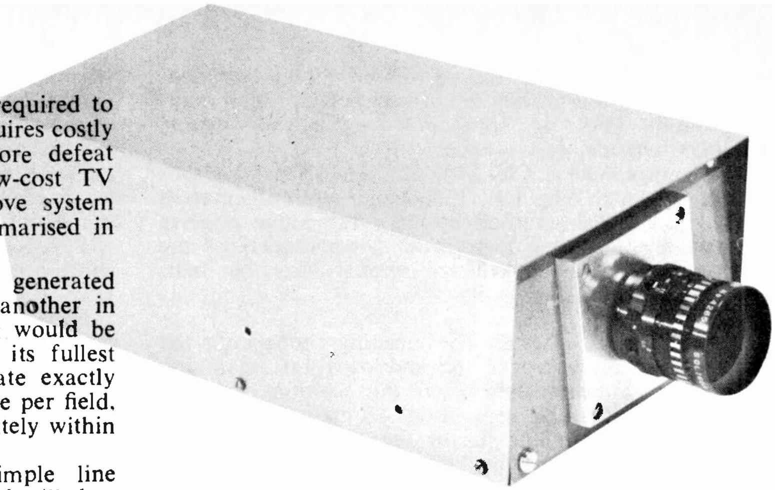


## RANDOM INTERLACING

The CCIR system of field sync pulses required to generate fully synchronised interlacing requires costly additional circuitry, which would therefore defeat the object of producing a compact, low-cost TV camera. For this reason alone, the above system is not incorporated and will not be summarised in this preamble.

If the field and line sync pulses were generated separately and not synchronised to one another in any way, a system of random interlacing would be obtained. To use random interlacing to its fullest potential, the line generator must generate exactly half the number of lines in a picture frame per field, thus positioning the interlaced field accurately within the first field.

In practice, the frequency of a simple line generator will have a limited stability—and will thus impair the accurate positioning of interlaced fields. Alternate fields will randomly vary in position to give a maximum possible resolution of 625 lines/frame—and a mean resolution of slightly less than 625 lines/frame.



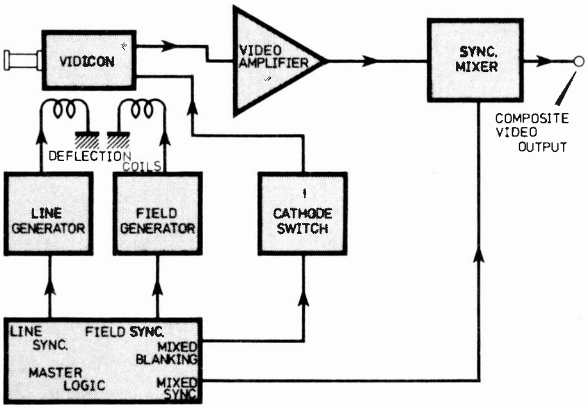



**Fig. 1.2. CCTV camera system block diagram**

## TV CAMERA SYSTEM

The schematic diagram of the TV Camera is shown in Fig. 1.2. All the sync signal timing and generation is performed by the Master Logic, which may be thought of as the system heart. Each of the control pulses is then directed to its appropriate location.

Scanning within the Vidicon camera tube is made possible by driving the deflection coils with current waveforms, which are synchronised to the line and field sync pulses and generated by the Line and Field Generators. Actual width and height of the scanned area are set within the Line and Field Generator circuitry.

The scanning beam of the Vidicon is switched off by the Cathode Switch to inhibit the video signal during blanking periods. The video signal is amplified up to the required level and mixed with the line and field sync pulses—driving composite video into a 75 ohm load.

## MASTER LOGIC

Examination of the Table 1.1 of the CCIR TV standards shows that the shortest period involved is 2μs (625 line front porch). A convenient and accurate technique of obtaining a great proportion of the pulses required within the Master Logic would be to generate a 2μs pulse chain from a 250kHz clock and successively divide it down in time using a binary counter. A 4-stage binary counter, using SN7473's, would count to 16 negative going pulse edges before repeating itself, giving a repeat time of $16 \times 4 = 64$μs, or the line time of a 625 line picture. Within this 64μs repeat time, logic gates could easily construct pulses of various durations from any combination of the available 2μs "time slots".

Fig. 1.3 shows the Master Logic circuit diagram and Fig. 1.4 its relevant waveforms.

A 4-stage divider, comprising BS1, 2, 3 and 4, is driven from a variable frequency clock to give pulse chains A, B, C, D and E, and their inverted complements. The clock is basically two cross-coupled NAND gates, G3 and G4, which means that either output A or $\bar{A}$ is high (+ 5V) at any one time. If A is high, then D2 becomes reverse biased and C2 is allowed to charge via the input resistance of G2. The output of G2 will subsequently become low (0V) and $\bar{A}$ high, causing D2 to conduct and rapidly discharge C2. The repeat of this procedure will occur now in the other half of the clock (concerning G1, D1 and C1), thus completing the loop and maintaining repetitive generation of 2μs pulses. R1 and VR1 control the capacitor charge rate (clock frequency), and G5 is simply a self starting gate, ensuring the output of G2 to be low immediately after switch-on.

Remembering that all inputs of a NAND gate must be high for its output to be low, the selection of line sync and blanking pulses may now be understood. The first six 2μs time slots are selected by G6 and G7 to represent a line blanking period of 12μs. The first 2μs time slot represents the front porch, whilst the second and third are selected by G8, G9, G10 and G11 to represent a line sync period of 4μs. This latter pulse is inverted by G12 to give it the correct positive going direction.

## FIELD CONTROL SIGNALS

Concentrating now on the field control signal generation, we move to the waveform shaper. When the high gain stage comprising TR1, R2 and R3 amplifies the Vidicon heater voltage, which is already 6·3V a.c. or 18V pk/pk, the resultant will be the square shaped waveform with 20ms cycle time, as shown by H. D3 simply protects TR1 against the high reverse $V_{be}$. C3 and R4 will further act to differentiate this square-shaped signal to present negative edges to Monostable 1 input every 20ms. Monostable 1 will then generate the field blanking pulse of 1·2ms and Monostable 2 the field sync pulse of 250μs—both Monostables being effectively triggered by the negative-going edges J.

The operation of both monostables is understood from the description of the clock, which is basically two monostables itself. Again, the values of C4 and C6 determine the widths of the generated pulses, which are available together with their complements at the outputs of the monostable.

Line and field blanking pulses, F (12μs) and K respectively, are mixed in G16 and inverted by G17 to give the correct negative going direction.

The mixing of line and field sync pulses is not so straightforward. In the absence of a field sync pulse, line sync pulses are routed through G13 and G15 to be outputted as positive going signals. However, in the presence of a field sync pulse, the mixed sync output is made high, whilst line sync pulses are routed through G14 and G15 to be effectively inverted at the output. In this way, the long field

## MASTER LOGIC CIRCUIT

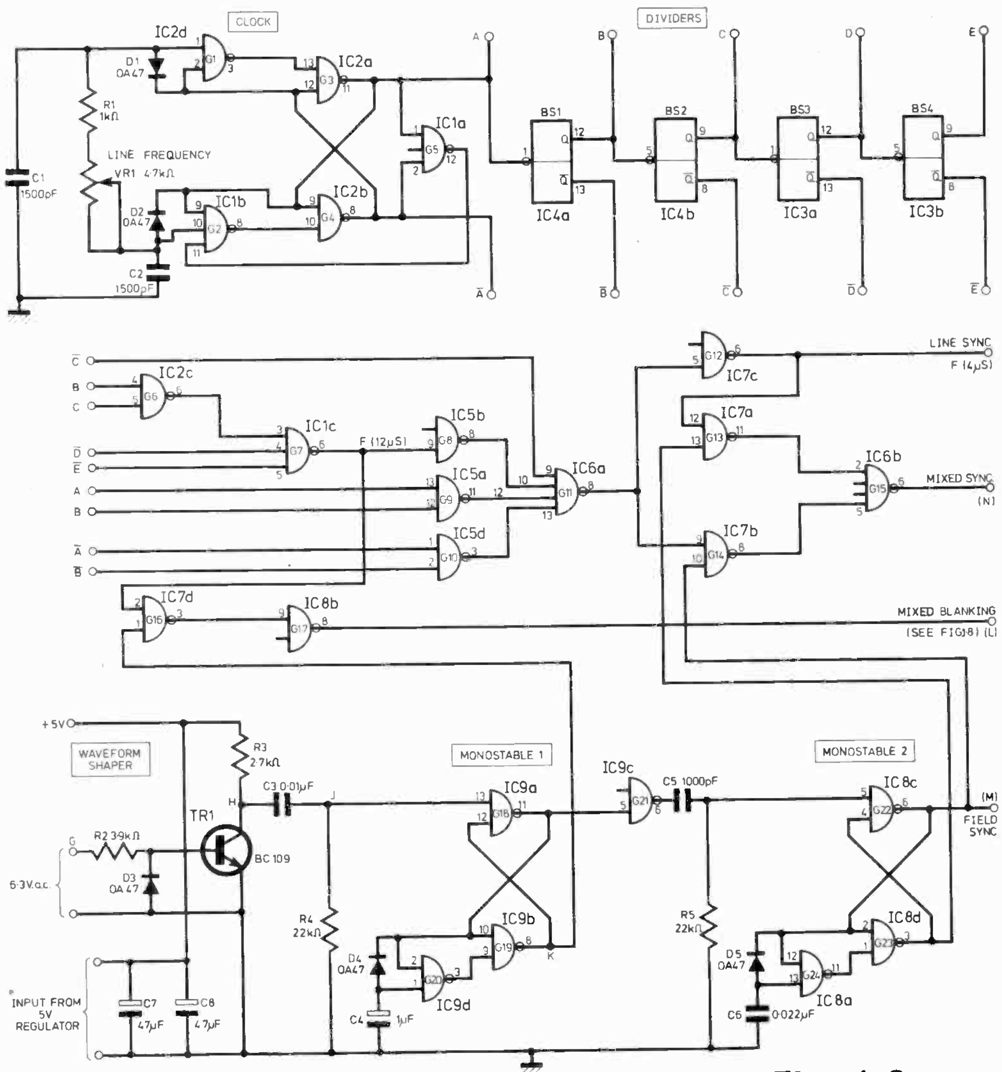



Fig. 1.3

sync pulses are divided into a series of broad pulses and line sync pulses are still conveyed.

VR1 is adjusted for 625-line operation by setting the clock frequency to 250kHz (2μs time slots), or for 405-line operation by setting the clock frequency to 162kHz (3·1μs time slots).

As previously stated, the master logic is the heart of the TV camera system and controls the timing of all control signals. Tremendous flexibility is obtained by the use of a master clock, which, by the adjustment of a single control, enables the alteration of all the required control signals to suit almost any TV standards.

## THE VIDICON

A cross sectional view of the Vidicon, given in Fig. 1.5, shows how a scene is imaged onto the photoconductive target by an optical lens. The focused image, which the human eye knows to be a complex light pattern, is then converted into an electrical charge pattern by the photoconductive target.

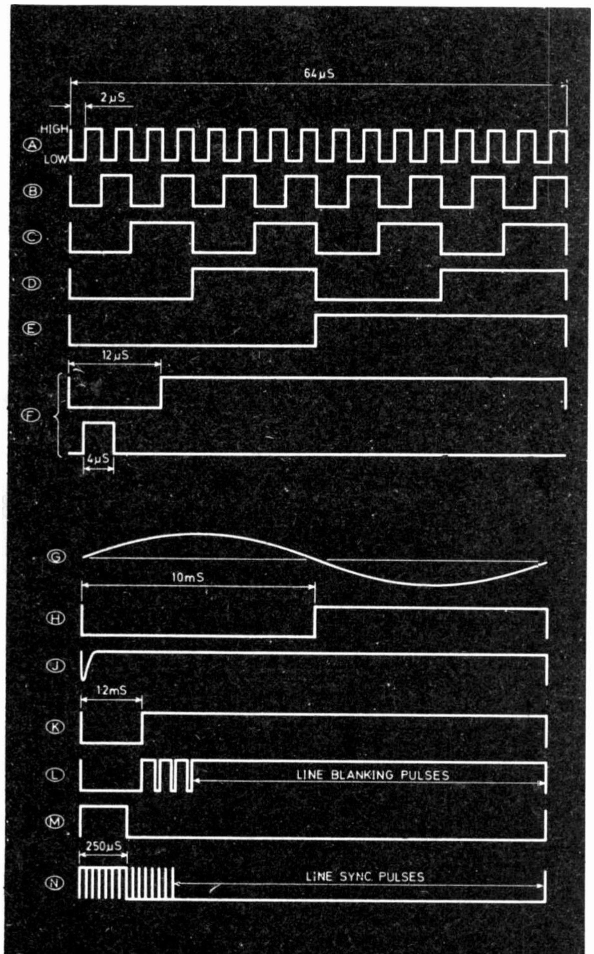



Fig. 1.4. Master Logic waveforms; (a) clock; (b)–(e) outputs from four stage divider; (f) line blanking pulse and 4μs sync pulse; (g) 6·3V, 50Hz signal; (h) output from Waveform Shaper; (j) Monostable 1 trigger pulse; (k) field blanking pulse; (l) mixed blanking pulses; (m) field sync pulses; (n) mixed sync pulses

An electron beam is generated by the Vidicon electron gun (comprising cathode, control grid Gi and limiter anode G2) and focused into a fine spot on the rear surface of the target. Suitable beam deflection, made possible by the scan coils, will then scan the beam in a raster fashion to cover the required area of the focused image. The beam current is adjusted to neutralise the electrical charge pattern during the scanning process and enables yet another conversion; this being the conversion of electrical charge into current. We now have a complex current pattern which resembles the initial light pattern of the focused image, and, although the

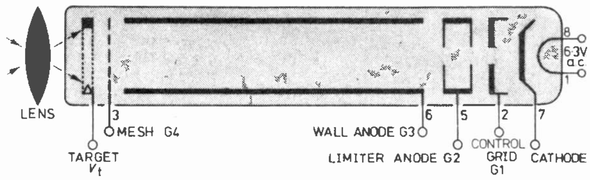



**Fig. 1.5. The EMI 9677 1in Vidicon**

range of target current is small, it is now in a form found most convenient for electronic processing (i.e. amplification).

A potential $V_t$ is applied to the target in order to enable the electron beam to reach its rear surface (just as in valve theory we have to apply positive anode potentials to enable current flow from the cathode). This potential roughly determines the operational sensitivity, higher values of $V_t$ giving a more efficient conversion (more target current per level of light intensity). Typical values of $V_t$ are + 50V for low-light conditions, and + 20V for bright-light conditions. One point to remember is that operation at high values of $V_t$ gives correspondingly higher "black" currents (target current representing black or unlight areas of the image), resulting in a "grey" reproduction of the shade black.

Sensitivity may also be controlled to some extent by the electron beam current. Beam current is simply controlled by the control grid potential $V_{G1}$, higher currents being obtained from less-negative value of $V_{G1}$. The beam current is adjusted to neutralise or discharge the electrical charge pattern established on the target; a typical value of $V_{G1}$ being + 20V with respect to the cathode. It must be appreciated that operation at high beam currents will correspond to a larger focused spot—and a lower picture resolution.

## VIDEO SIGNAL CURRENT

Assuming the Vidicon camera tube to be suitably adjusted (i.e. correct electrode potentials are applied) for the capture of a well illuminated scene, the video signal current from the target will range from approximately 10nA, representing the black level, and 300nA, representing the full white level. This range of currents must be suitably amplified to give a working level of 700mV pk/pk.

The most convenient way of amplifying this signal would be to convert it to a voltage signal prior to amplification. To do this, various points must be

# COMPONENTS . . .

### Resistors

| | |
|---|---|
| R1 | 1kΩ |
| R2 | 3·9kΩ |
| R3 | 2·7kΩ |
| R4 | 22kΩ |
| R5 | 22kΩ |
| R6 | 220kΩ |
| R7 | 6·8kΩ |
| R8 | 47kΩ |
| R9 | 1kΩ |
| R10 | 470Ω |
| R11 | 470Ω |
| R12 | 2·7kΩ |
| R13 | 470Ω |
| R14 | 3·9kΩ |
| R15 | 6·8kΩ |
| R16 | 1kΩ |
| R17 | 180kΩ |
| R18 | 18Ω |
| R19 | 2·2kΩ |
| R20 | 470Ω |
| R21 | 2·2kΩ |
| R22 | 10kΩ |
| R23 | 82Ω |
| R24 | 82Ω |
| R25 | 470Ω |
| R26 | 1kΩ |
| R27 | 1kΩ |
| R28 | 1·5kΩ |
| R29 | 1kΩ |
| R30 | 470Ω |
| R31 | 220Ω |
| R32 | 1kΩ |
| R33 | 5·6kΩ |
| R34 | 1·2kΩ |
| R35 | 10kΩ |
| R36 | 100Ω |
| R37 | 150kΩ |
| R38 | 100kΩ |
| R39 | 2·8kΩ |
| R40 | 100kΩ |
| R41 | 15Ω |
| R42 | 390kΩ |
| R43 | 1kΩ |
| R44 | 680Ω |
| R45 | 470Ω |
| R46 | 100Ω 5% 2 watt |
| R47 | 2·7kΩ |
| R48 | 270Ω |
| R49 | 390Ω |
| R50 | 100Ω 5% 1 watt |

All 5% $\frac{1}{2}$ watt carbon except where otherwise stated

### Capacitors

| | |
|---|---|
| C1 | 1,500pf Ceramic |
| C2 | 1,500pf Ceramic |
| C3 | 0·01μF Polyester (Mullard C280) |
| C4 | 1μF Elect. 10V |
| C5 | 1,000pF Ceramic |
| C6 | 0·022μF Polyester (Mullard C280) |
| C7 | 47μF Elect. 10V |
| C8 | 4·7 μF Elect. 10V |
| C9 | 1 μF Elect. 63V |
| C10 | 1μF Elect. 63V |
| C11 | 47μF Elect. 25V |
| C12 | 10μF Elect. 25V |
| C13 | 10μF Elect. 25V |
| C14 | 4·7μF Elect. 25V |
| C15 | 4·7μF Elect. 25V |
| C16 | 10μF Elect. 25V |
| C17 | 4·7μF Elect. 25V |
| C18 | 47μF Elect. 25V |
| C19 | 100μF Elect. 25V |
| C20 | 470pF Ceramic |
| C21 | 4·7μF Elect. 25V |
| C22 | 470μF Elect. 10V |
| C23 | 1,000μF Elect. 25V |
| C24 | 16μF Elect. 350V |
| C25 | 16μF Elect. 200V |
| C26 | 32μF Elect. 200V |
| C27 | 0·22μF Polyester (Mullard C280) |
| C28 | 1,000μF Elect. 25V |
| C29 | 470μF Elect. 10V |
| C30 | 470μF Elect. 10V |
| C31 | 220μF Elect. 10V |

### Transistors

| | |
|---|---|
| TR1–TR10 | BC109 (10 off) |
| TR11 | BF178 |
| TR12 | BC109 |
| TR13 | 2N4060 |
| TR14 | 2N5245 |
| TR15–TR16* | BFY51 (2 off) |
| TR17 | BC109 |
| TR18* | BFY51 |
| TR19 | BC109 |

* transistors must include clip-on heatsinks

### Integrated Circuits

| | |
|---|---|
| IC1 | SN7410 |
| IC2 | SN7400 |
| IC3–IC4 | SN7473 (2 off) |
| IC5 | SN7400 |
| IC6 | SN7420 |
| IC7–IC9 | SN7400 (3 off) |

### Diodes

| | |
|---|---|
| D1–D5 | OA47 (5 off) |
| D6 | OA202 |
| D7 | BZY88 400mW 5·6V Zener |
| D8–D11 | IN4001 (4 off) |
| D12 | IN4007 |
| D13 | IN4005 |
| D14 | BZY88 400mW 5·6V Zener |
| D15 | BZY88 400mW 3·9V Zener |

### Potentiometers

| | |
|---|---|
| VR1 | 4·7kΩ miniature skeleton |
| VR2 | 100Ω miniature skeleton |
| VR3 | 470Ω miniature skeleton |
| VR4 | 1kΩ miniature skeleton |
| VR5 | 4·7kΩ miniature skeleton |
| VR6–VR7 | 50kΩ linear (2 off) |
| VR8 | 470Ω miniature skeleton |
| VR9 | 100Ω miniature skeleton |
| VR10 | 100Ω 1W wire wound |

All skeleton pots are horizontal mounting type

### Transformers

T1 Type 634 Pri–250V, Sec. 17·5V @ 1·6A (R.S. Components)

T2 Midget mains Pri–245V, Sec. 125–0–125V @ 50mA; 6·3V @ 1·2A (R.S. Components)

### Inductors

L1, L2 150 and 85 turns respectively of 36 s.w.g. enamelled copper wire on Mullard FX2239 ferrite cores

| | | |
|---|---|---|
| L3 | Focus coil | EMI, |
| L4–L5 | Line scan coils | 243, Blyth Road, |
| L6–L7 | Field scan coils | Hayes, Middlesex |

### Vidicon Tube

V1 9677 Vidicon (EMI) (see text)

### Camera Lens

Soligor television lens, f1·9, 25mm focal length (Dixons Photographic)

### Miscellaneous

Flush-mounting Coax Socket
D.p.s.t. Mains toggle
3 knobs
Assorted 6BA, 4BA and 2BA nuts and bolts
$\frac{1}{4}$in × $\frac{1}{4}$in steel rod
Eight 2BA chrome-head screws
Length of 3-core Mains lead
Sheet 18 s.w.g. aluminium 18in × 6$\frac{1}{4}$in
Sheet 20 s.w.g. aluminium 11$\frac{3}{4}$in × 12$\frac{5}{8}$in
1in × $\frac{1}{4}$in aluminium 3$\frac{1}{2}$in long
2$\frac{3}{4}$in × 2$\frac{3}{4}$in × $\frac{1}{2}$in aluminium block
Rubber grommet $\frac{1}{4}$in × $\frac{1}{2}$in
6·3V Pilot lamp (panel mounting)

considered. Let us firstly examine the equivalent input network required to convert the video current to a voltage signal, which will subsequently be presented to the Video Amplifier input. Such a network is shown in Fig 1.6.

The output of the Vidicon may be considered as being a current source (i.e. having infinite shunt resistance). Conversion of signal current to voltage is then simply achieved by passing $I_t$ through $R_{in}$, the input resistance of the Video Amplifier. Now, by Ohm's law, $V = I_t \times R_{in}$, and the magnitude of the voltage available at the Video Amplifier input will be proportional to the value of $R_{in}$. Unfortunately, however, there exists an equivalent shunt capacitance, $C_{in}$, which is made up from the output capacitance of the Vidicon and the input capacitance, of the Video Amplifier. $C_{in}$ will, in conjunction with $R_{in}$, determine the frequency response of the input network by:

$$f_{max} = \frac{1}{2\pi\ C_{in}\ R_{in}}\ \text{Hz}$$

Therefore, as $C_{in}$ is essentially fixed, $R_{in}$ must be limited to a value giving the 5MHz maximum working frequency required for 625-line operation.

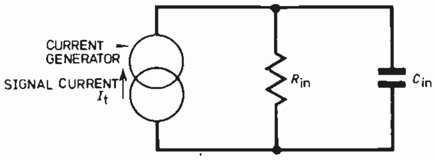



**Fig. 1.6. Equivalent input network of the Video Amplifier**

## VIDEO AMPLIFIER

The Video Amplifier circuit diagram is shown in Fig. 1.7. Due to the application target, the first stage potential, $V_t$, to the Vidicon target, the first stage of the Video Amplifier is a.c. coupled via C10. $V_t$ is then simply conveyed to its destination by R6 after being decoupled by C9 to prevent any unwanted signals breaking through to the extremely sensitive amplifier input.

As a common emitter stage presents a relatively low impedance at its input, we are presented with two alternatives in design. Either overall negative feedback is applied to the amplifier to increase its input impedance, or an emitter follower front end is used. Overall negative feedback tends to create instability in wideband amplifiers, whilst an emitter follower stage inherently presents a relatively high input impedance. The first stage is therefore chosen to be an emitter follower or impedance converter of unity voltage gain.

The equivalent shunt input capacitance, $C_{in}$ is 6pF. Now, for 5MHz bandwidth, commanded by 625 line TV standards, the total shunt input resistance, $R_{in}$, may be calculated as:

$$R_{in} = \frac{1}{2\pi\ C_{in}\ f_{max}} = 5{\cdot}3\text{k}\Omega$$

In practice, $R_{in}$ is made up from resistors R6, R7 and R8, which are designed to give an equivalent shunt resistance of 5·3kΩ. The input resistance of TR2 is very high and may be neglected in the above calculation.

From knowledge of the maximum signal current, $I_{t(max)}$, the input voltage developed across $R_{in}$ may be found as:

$$V_{in(max)} = I_{t(max)} \times R_{in} = 300\text{nA} \times 5{\cdot}3\text{k}\Omega$$
$$= 1{,}590\mu\text{V pk/pk}$$

A Video Amplifier gain of 440 is therefore required to produce the required 700mV of video signal at the output. Additional gain will also be made available for increased sensitivity if required.

Most of the signal gain is achieved by the second stage, which is a cascode amplifier, comprising TR3, TR4 and associated components.

Low-noise BC109's are used in this novel mode to enable high gain, wideband amplification. Stage 2 is directly coupled from stage 1 and achieves a voltage gain of 70.

The output signal from the cascode stage is taken to the next voltage gain stage via an emitter follower. This emitter follower, TR5 and R16, is directly coupled to the cascode stage and establishes a low

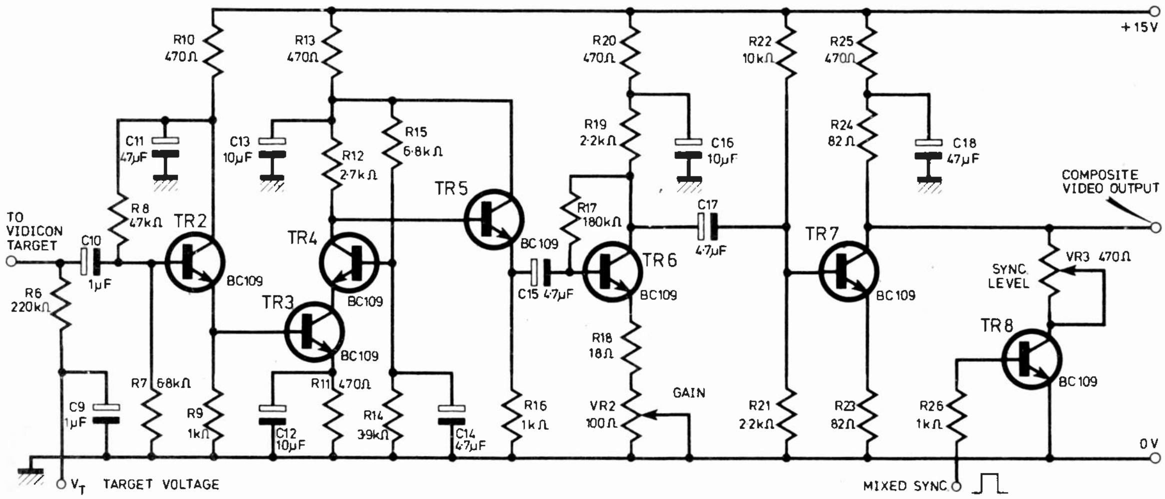



**Fig. 1.7. Video Amplifier and Sync Mixer**

impedance drive into the capacitive input of the common emitter stage built around TR6. Wideband amplification is ensured by the use of this accepted technique.

Local negative feedback is applied to TR6 to control its stage gain, VR2 giving the required range of amplification of between 6 and 40. Sufficient gain has now been contributed to the Video Amplifier to give 700mV of video signal.

Two further functions are to be facilitated in the video amplification—180 degree phase shift to give a positive going video waveform, and impedance conversion to give 75 ohm output impedance. The final stage of TR7 and associated components is a common emitter amplifier with approximately 75 ohms load in both collector and emitter circuits and therefore performs the impedance conversion and acts as a unity-gain signal inverter.

A.C. coupling has been utilised in the Video Amplifier via C10, C15 and C17. Each value of capacitance is designed to pass the lowest frequency component of the video signal—that being the field repetition frequency of 50Hz.

The supply to each stage is individually decoupled to prevent unwanted breakthrough (feedback) of the various signals within the TV Camera system.

## SYNC MIXER

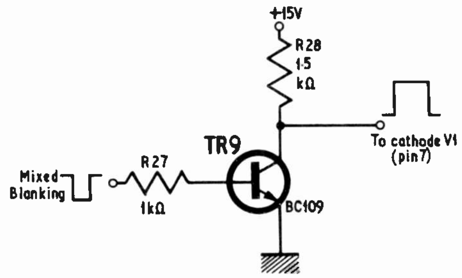
Mixed sync pulses are used to switch TR8, which in turn will switch the d.c. level of the collector of TR7 negatively by a controlled amount. VR3 is adjusted to enable 0·3V negative sync pulses to be superimposed on the video signal.

## CATHODE SWITCH

Blanking is facilitated by the Cathode Switch, whose circuit diagram is shown in Fig. 1.8.

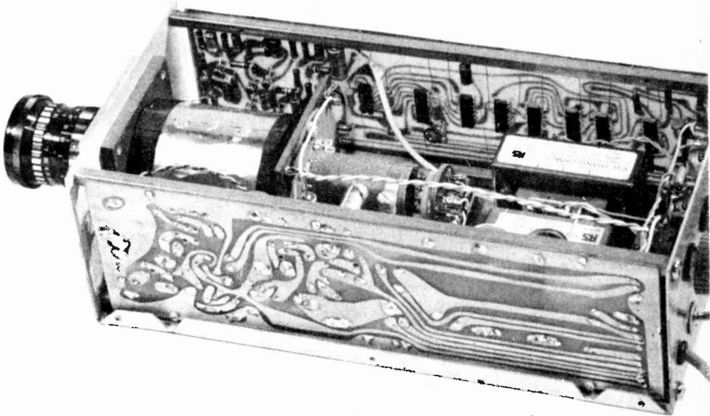
The Vidicon electron beam current may be cut off by either applying a large negative potential to the control grid G1, or conversely, a large positive potential to the cathode. Arguing for and against these two methods, beam cut off control via the cathode seems to be most convenient.

As all Vidicon electrode potentials are measured with respect to the cathode, alteration of the cathode potential therefore controls several mechanisms within the tube. The beam current is reduced and a limited number of electrons reach a less positively biased target with the application of +15V to the cathode.

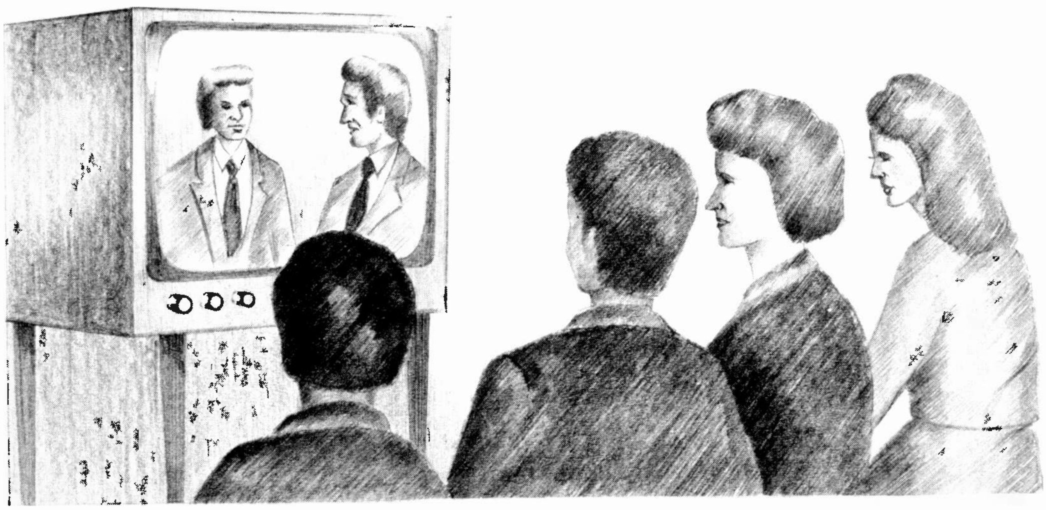



Mixed blanking pulses are used to switch TR9 and apply the Vidicon cathode with one of two potentials —0V to make the required beam current available for scanning, and +15V to blank or switch off the beam during flyback periods.

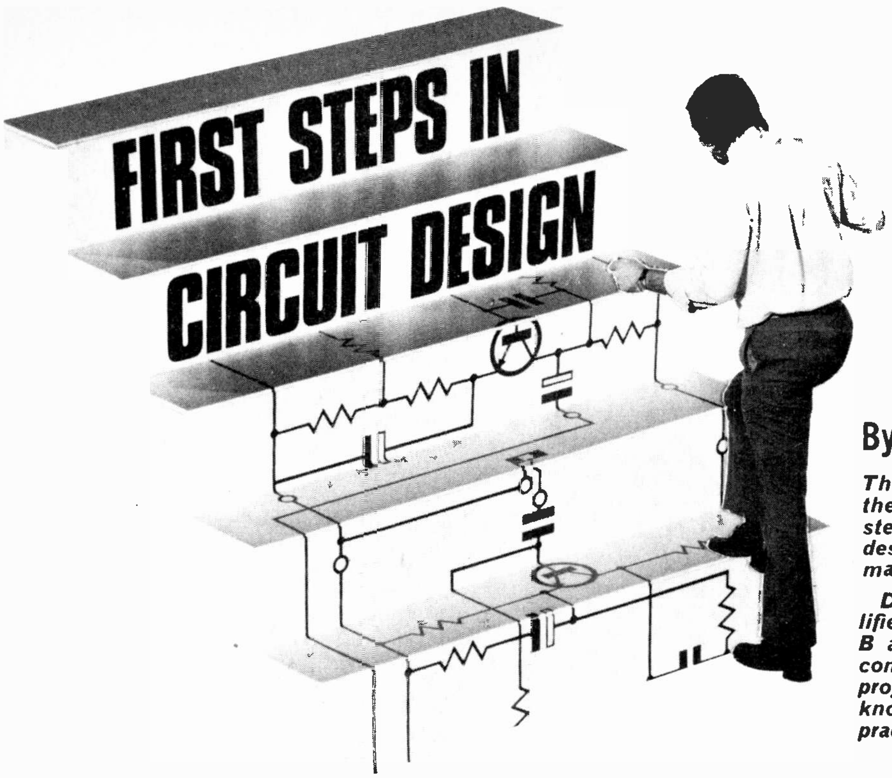
The video signal is now blanked and sync pulses added accordingly to produce the composite video waveform.



**Next month: P.C.B. construction and more camera electronics**



# FIRST STEPS IN CIRCUIT DESIGN



## 6

By A. P. Stephenson

***This series, specially written for the beginner, takes you step-by-step through transistor circuit design in a simple, non-mathematical way.***

***Design of a small signal amplifier will be followed by a Class B amplifier and the series will conclude with a constructional project so that your theoretical knowledge can be put into practice.***

STABLE and predictable power amplifiers are not easy to design and it is only fair to warn would-be designers of the danger of increasing the bank overdraft!

A miscalculation in a resistor value, a too hasty twiddle of a preset, or a loose nut on a heatsink, can often be enough to trigger off an avalanche of disaster.

A typical sequence of events would commence with a slight rise in the temperature in the output transistors; this increases the drive current which in turn increases the temperature and so on. Eventually (usually after a few milliseconds) bang go the outputs, the drivers and, if you are particularly unlucky, the loudspeaker cones.

In fact the writer's experience suggests that the fuse is the hardiest component in the chain.

Strictly speaking, the power amplifier should be left in the hands of the professional.

## 6.1. POWER AND VOLTAGE AMPLIFIERS COMPARED

If one's aims are moderate, in the sense of only a few hundred milliwatts rather than tens of watts, there is no reason for not trying one or two circuits if only to get the feel of the beasts. The best way to start is to list the problems of power amplifiers in comparison with voltage amplifiers.

Voltage amplifiers normally operate with relatively small signal swings well within the available limits of ground and supply rail.

Thus distortion due to non-linearity is not too serious because the small part of the transistor characteristic used is almost a straight line.

Power amplifiers, in order to operate efficiently, must use all the available voltage swing, giving rise to distortion levels which would be unacceptable without circuit sophistication.

The power output transistors require large currents, sometimes many amps. This means considerable heat production which tends to be cumulative because

(a) Leakage current is no longer negligible.
(b) Base to emitter voltage ($V_{BE}$) can no longer be taken as 0·6V because of the relation to temperature ($V_{BE}$ falls by 2mV for every degree C rise).
(c) $h_{FE}$ is dependent on temperature, rising as temperature increases. Thus the drive increases with temperature.

High power transistors have a much lower $h_{FE}$ —20 or 30 instead of 200 or 300.

## 6.2. BASIC CIRCUIT OUTLINES

Class B push-pull is used almost exclusively for power output stages but, unlike the old valve circuits, modern circuits dispense with transformers.

There are many possible permutations as will be seen in the following selection. No intricate details will be shown, merely the outlines.

### PURE COMPLEMENTARY PUSH-PULL

Figs. 6.1 and 6.2 show two complementary push-pull circuits which have the merit of neatness, balance, low impedance output, and high, equal drive impedances.

There is one practical disadvantage—it is difficult to match high power *pnp* and *npn* transistors. So-called "matched pairs" are available on the market but are quite expensive if close matching is required.

### QUASI-COMPLEMENTARY PUSH-PULL

Because it is easier to match transistors of the same type, particularly *npn* pairs, the arrangements shown in Figs. 6.3 and 6.4 are very popular.

There are two snags however: one transistor is an emitter follower and the other is grounded emitter. The other snag is the input phasing which means that a pair of anti-phase signals are necessary.

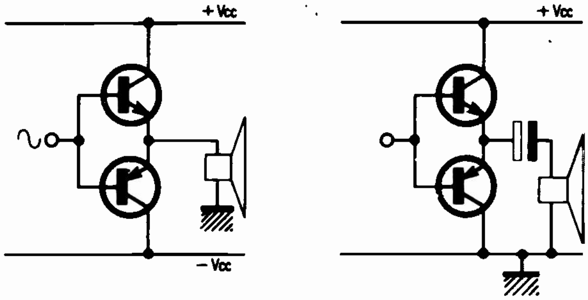



**Fig. 6.1. Complementary push-pull circuit using a centre-tapped supply rail and Fig. 6.2. using a single supply rail**

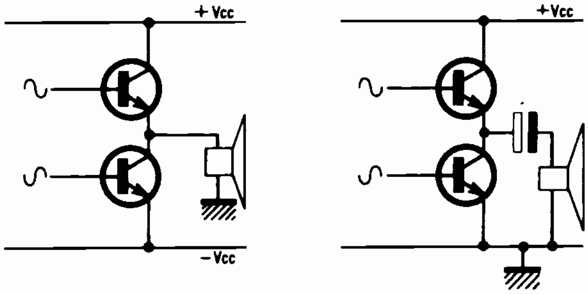



**Fig. 6.3. Quasi-complementary push-pull circuit with a centre-tapped supply and Fig. 6.4. using a single supply rail**

## 6.3. QUIESCENT CURRENT IN CLASS B

The virtue of pure Class B can be stated in one word—efficiency.

With the volume control turned down (i.e. no drive signal) the power-hungry output stages are also off and draw no current. Thus the power consumed by the output stages is proportional to the input signal.

In Class A the output stages are permanently consuming power without an input signal.

### CROSSOVER DISTORTION

Unfortunately we are unable to use pure Class B with transistor pairs because of the rather disagreeable "crossover distortion".

Consider what happens if we apply a signal to a pair of complementary outputs whose bases are tied together (see Fig. 6.5).

The top waveform is the input signal voltage which drives TR1 to conduction on the positive input cycles and TR2 on the negative. Thus the load receives its current only from one transistor at a time, because the other is cut off.

The bottom waveform shows the current through the respective transistors and the distortion due to "crossover".

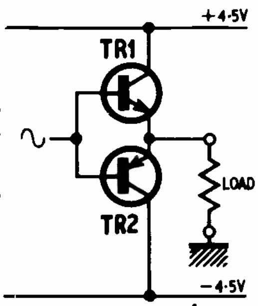
From zero volts to +0·6V there is no current in TR1 and from zero volts to −0·6V there is no current in TR2. Thus we have discontinuities in the current waveform in the vicinity of the crossover point at zero volts.

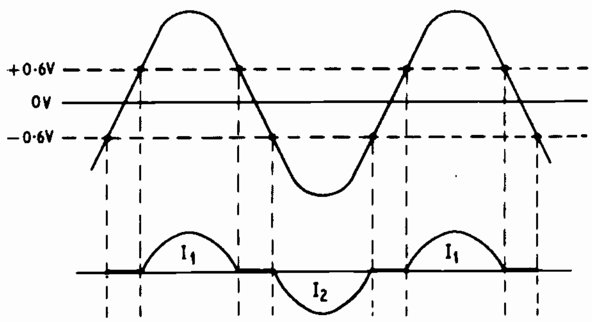
To overcome this, the transistors are usually operated with a small forward bias so that, in the absence of an input signal, they are both slightly conducting.

The value of this current is called the "quiescent current" and is, in practice, a rather trial and error affair being a compromise between acceptable crossover distortion and acceptable quiescent dissipation.

**Fig. 6.5. Circuit showing how crossover distortion arises. The circuit (left) shows a complementary output pair with bases driven from the same signal.**

**The transistors do not conduct until the base/emitter voltage reaches 0·6V thus causing the distortion as shown right**



## 6.4. THE DRIVER STAGE

A simple driver stage can be used to serve two purposes: to provide some voltage gain; and to develop the 1·2 volts needed to ensure that both bases are slightly forward biased at zero signal.

Fig. 6.6 shows a simple but quite workable little circuit which is worth studying.

Note carefully the following points:

(a) The d.c. voltage drops are the quiescent values (zero signal).

(b) To avoid a centre tapped supply, the loudspeaker is connected via a d.c. blocking electrolytic capacitor to ground—a well-established practice although alternatively it could be returned to the positive rail, with the capacitor polarity reversed.

(c) The diode is not absolutely necessary, but does help to compensate for $V_{BE}$ changes in the output transistors.

In theory, we could have two diodes and scrap VR1 altogether, because the two together would give us the 1·2V needed to turn on the bases of TR1 and TR2. However, this assumes that the temperature coefficients of both diodes and transistors are identical.

By using one diode and a "twiddler" we can make a fine adjustment in quiescent current.

(d) The bias current for TR3 is bled from the output line via R2 which introduces heavy d.c. negative feedback and keeps the output locked at midpoint (4·5V).

There is no signal negative feedback so the gain is not affected.

(e) The "voltage gain" of the circuit is a figure whose calculation can easily be tackled from the wrong lines.

Superficially we may be tricked into thinking that TR3 is an ordinary voltage amplifier stage with a gain equal to $R_C/r_e$ where $R_C$ is R1.

There is nothing wrong with the equation but it is erroneous to think that R1 in the diagram is the collector resistor since it is swamped by the $R_{IN}$ of the output transistors.

The effective signal load of TR3 is the input resistance of an emitter follower stage which is

$$R_{IN} = h_{FE}\ R_L$$

where $R_L$ is the loudspeaker impedance.

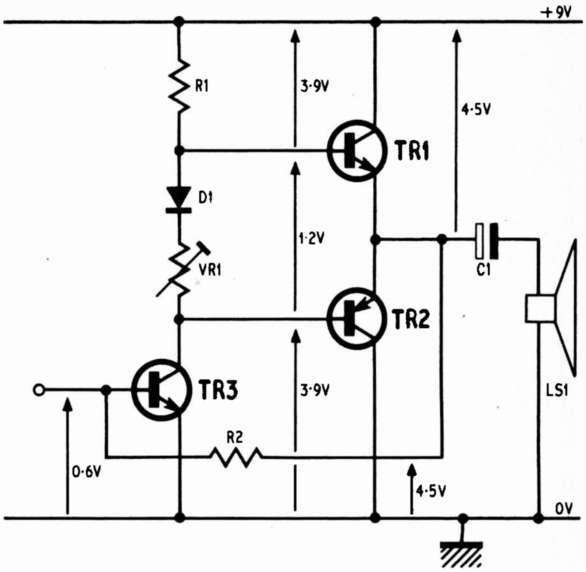



**Fig. 6.6. Complementary output stage with a simple driver circuit using single diode for base/emitter voltage stabilisation**

### EXAMPLE

Assume the $h_{FE}$ of the output transistors is 50, the collector current of TR3 1mA, and the speaker impedance 8 ohms.

The voltage gain from the base of TR3 to speaker is

$A = R_C/r_e$ where $r_e = 25/I_C$ (mA) $= 25$ ohms
and $R_C = h_{FE}.R_L = 50 \times 8 = 400$
Hence gain $= 400/25 = 16$.

(f) The input resistance ($R_{IN}$) of TR3 is

$h_{fe} \times r_e$ in parallel with $R2/A$

If this seems strange, remember that the method of obtaining the bias is fundamentally "collector-to-base feedback" which was discussed in section 4.1.

The gain of the emitter followers being unity means that, although R2 is taken from the output stages, it is effectively taken from the collector of TR3.

## 6.5. LIMITATIONS OF THE SIMPLE CIRCUIT

The high frequency response of the circuit described is poor mainly due to the capacity of the collector-base diode of TR1. When TR1 is off the capacity is across R1.

To reduce this effect we can bootstrap R1 by splitting it in two and connecting the output to the junction via a large blocking capacitor.

This has the effect of making R1 higher by a factor equal to the reciprocal of one minus the voltage gain of the output transistor ($\alpha$).

$$R1' = \frac{R1}{1-\alpha}$$

This does however introduce some positive feedback.

Another advantage of this bootstrapping technique is that the current through TR3 is virtually constant since the voltage across R1 is kept constant.

Thus the drive to the output transistors is via a constant current source which decreases the non-linearity of the $V_{BE}$ characteristic of the output stages.

**Next month: Concluding article and special constructional project linked to this series**

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## CLOCK CHIPS

| | | Price | Pin Count |
|---|---|---|---|
| MM5311 | Basic clock chip, BCD outputs | £9·00 | 28 |
| MM5314 | As MM5311, no BCD outputs | £7·20 | 24 |
| MM5309 | As MM5311 plus reset to zero | TBA | 28 |
| MM5316 | 4 digit alarm chip, Liq. Crys. drive | £15·00 | 40 |
| MM5375 | 6 digit alarm, Sperry drive | TBA | 24 |
| MK5017 | 6 digit alarm, sleep and snooze | £14·00 | 24 |
| MK50250 | 6 digit alarm | £7·60 | 28 |
| CT7001 | Alarm/date/sleep/snooze/etc. | £16·50 | 28 |
| CT7002 | As CT7001 but BCD outputs | £16·50 | 28 |
| TMS3952 | Alarm/stopwatch | £20·00 | 28 |
| CT6002 | CMOS, Liq. Crys. drive, for battery clock | £22·65 | 40 |

## DIGITRONIC II

BYWOOD are pleased to announce our first *complete* kit for a digital clock. The chip used is commercially still on the secret list, but it has been proved to be a success in many applications both in the UK and in the USA. Its functions are a basic six digit clock with 12/24 hour display options (it will switch from 12–24 and back at any time). The timing frequency used is the mains 50Hz but it is hoped to make a quartz crystal unit available soon. The digits are Sperry types, four are 0·55in and two are 0·33in high. Many other features are available including a reset to zero facility so the clock can be used for elapsed time counting. The kit contains everything except a mains plug at only £29·65 or it is available ready built for only £33·65!

This is a really beautifully finished unit—send S.A.E. for details.

## DISPLAY READOUTS

| | | Price |
|---|---|---|
| DL707 | Common Anode 0·3in LED | £1·70 |
| DL704 | Common Cathode DL707 | £1·70 |
| DL747 | Common Anode 0·6in LED | £2·45 |
| DG10A | Phosphor-diode 8·5mm | £1·10 |
| DG12H | Phosphor-diode 12·5mm (0·5in) | £1·20 |
| LC823440 | Field effect Liq. Crys., four digits | £16·00 |
| 3015F | Minitron filament, 9mm digit | £1·25 |
| 3016F | Minitron type filament, 12mm digit | £1·25 |
| 3017F | Minitron type filament, 16mm digit | £2·00 |
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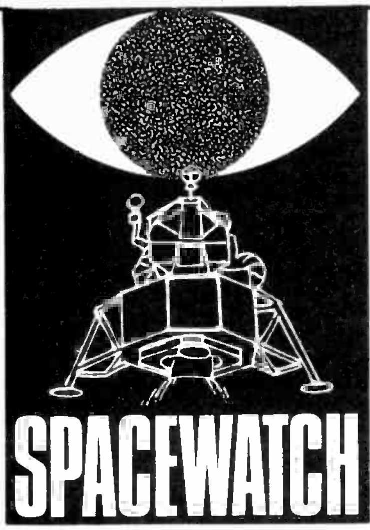



BY FRANK W. HYDE

## RESULTS FROM JUPITER

The data returned from *Pioneer 10* about Jupiter will take a great deal of time to analyse and correlate. However, there is now emerging some early interpretation of the data.

When the study of the radio radiations began, with the discovery in 1955 of the intense outbursts of energy from the planet, it was clear that for this effect to occur it required an intense magnetic field to be present. This is because high electron energy, more than 3MeV, is needed to produce synchroton radiation.

The Earth-based results had indicated that the magnetic field was more intense than that of the Earth, as high as 8/10 gauss, and it was suggested that the magnetic field was in fact 11° off centre and at a meridian of about 220°. These theories were based on the radio rotation period of Jupiter.

It was also suggested that because the pole of the magnetic field was so far inclined from the rotation axis, it produced a variability which gave rise to the radiation.

## ANALYSIS RESULTS

An analysis of the whole matter by using both the geographical axis and the magnetic axis gave results which indicated that Jupiter's satellite Io had a profound effect on the times of the radio radiations. In tests carried out by the writer and others as part of a NASA project under the leadership of C. H. Barrow this effect was found to be correct for about 60 per cent of the events. The events not lining up with this can now be explained as a result of the *Pioneer* findings.

The in situ measurements that were made by the spacecraft have shown that there are two areas of magnetic effect. One is the field of 4 gauss, which extends to a distance of 20 Jupiter radii, and the other a non dipole field which extends to 108 Jupiter radii. In the latter field the lines seem to be centred near the equator. This displaced relative to the magnetic equator is about 0·1 Jupiter radius north. The longitudinal position is about 174°.

At the central region of the magnetic field the magnetosphere seems to behave in the same way as that of the Earth. In the region beyond this protons and electrons are concentrated near to the equator. This seems to be emphasised on the dawn side.

It is clear that the satellites Amlthea, Io, Europa and Ganymede are "absorbers" of electrons. Thus, there is an explanation for the variations in the Jupiter radiations.

It also raises the question of Saturn which though of a similar composition chemically and physically shows no observable magnetic field. It could be that the presence of the rings of the planet inhibit the formation of a magnetic field. This should be cleared up by *Pioneer 11* which is to pass inside the rings.

Meanwhile *Pioneer 10* is leaving the Solar system at the rate of 280 million miles a year. At present it continues to send back data of its environment.

## SATELLITES ON CALL

The call for satellite assistance is now beginning to be a part of the peaceful economic use of space technology.

The Australian Government sought the assistance of NASA to photograph Lake Eyre during the recent serious flooding. The photographs are required in order to see what were the reasons for the immense amount of water flowing in formally dry watercourses in Australia's most arid regions. Lake Eyre is at the present time covering an area of 300 square miles and the satellite pictures will enable a plan to be formulated in case of future floodings.

Water is pouring in from as far away as Western Queensland and it is thought that if the level of the lake can be kept high, then the rainfall can be increased in areas as far apart as South Australia, New South Wales and Western Australia.

It is also being suggested that pumping sea water into the area could have a profound effect on the environment. It is a new economical possibility that Australia must consider.

## SUNSPOTS AND THUNDERSTORMS

It has long been a joke that almost anything can be predicted by sunspot cycles, from birth incidence to car sales. However, some of the correlations are now receiving special attention and one of these is the event of the thunderstorm.

Using the 11 years sunspot cycle there does appear to be a positive link between the sunspots and thunderstorms. Data produced by M. F. Stringfellow working at the Electricity Council's research centre, who examined records from 1930 to 1973, based on the number of faults induced in overhead lines, taken together with the number of thunderstorm days has revealed a formula.

It is claimed that the events are related in that the number of lightning flashes is proportional to the square of the mean number of events. This can be applied in a predictive form to provide warning in advance. It is certain this cyclic variation is consistent and had an amplitude of ± 30 per cent of the mean.

The next solar maximum is predicted to have a two-fold increase on 1973.

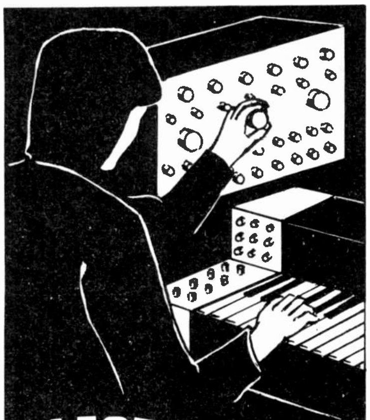
## BEADS FROM THE MOON

The minute and almost spherical glass beads, returned from *Apollo 12*, found in the Lunar regolith to the extent of 1 per cent have been studied by B. Scarlett and R. E. Buxton of Loughborough University of Technology. Results have shown that they are the product of the break up of liquid jets of rock. These delicate jets are produced when a meteorite impacts the Lunar surface.

The beads vary in size and composition from 0·1 micrometres to 1·0mm. They are coloured red, yellow, silver, grey or just opaque. It is this variance which suggest meteoritic bombardment as the source rather than the well mixed volcanic mixture. The sizes indicate that the temperature formation is not less than 1,450°K and probably in excess of 2,000°K.

The two researchers offer certain conclusions about the beads and "balloons". One of these larger spheres was some 260 micrometres in diameter with a wall thickness of 5 micrometres. These are probably blown up because of the volatilisation of some of the lighter constituents like sodium and magnesium.

Calculations show that if these particles are formed as Scarlett and Buxton suggest, the maximum size cannot exceed 1mm. Surface tension would fix a lower limit of size at about $10^{-2}$ micrometre.



# ELECTROMUSE

By Malcolm Pointon

WE are going through a patch at the moment not too dissimilar to that experienced by the early classical composers in Mannheim during the eighteenth century. These men discovered the expressive power of the orchestra and spent their time composing symphony after symphony which used dramatic contrast between wind and string timbres, carefully controlled gradations of dynamics, incredible (for the time) finesse in melodic phrasing and demanded an extremely professional approach to ensemble playing. Previous ages had not regarded shades of attack, decay, dynamics or phrasing as necessary to the overall musical effect, so it was quite natural that these new experiences were shunned by some and extolled by others.

About a hundred and fifty years later the orchestra, much augmented, had reached the peak of its achievement in symphonic works like Mahler's Ninth Symphony, Strauss' "Also sprach Zarathustra" (from which BBC TV took its theme music for the Apollo space shots), Stravinsky's "Rite of Spring" and Debussy's "La Mer".

Here, in 1974, we are at the beginning of a new phase, but it is so new that we cannot see where it is all leading. We have at our disposal electronic equipment whose potential is beyond imagination, acoustic instruments which are widening their scope, and yet we are still grovelling in the primeval mud waiting for the particles to settle.

The Mannheim composers churned out symphony after symphony, yet out of this vast acreage of manuscript paper and man-hours there is little of musical value left. Until Mozart and Haydn arrived and saw a way through there was little in the way of substance but a heck of a lot of mannerisms and repetitive sound effects. What they did not appreciate was that sound effects do not necessarily constitute a satisfactory piece of music.

We are in that same position. The Synthesiser can produce an incredible range of effects, but let us never forget that effects, noises, sounds—call them what you will—are meaningless abstractions in themselves; until they are laid before our ears with some kind of structure—albeit apparently random—they might as well not exist at all.

## Pitch systems

Until comparatively recently art-music (as opposed to popular or folk music) was indulged in only by those who had some standing in society or who were educated sufficiently to be able to read and write. In early Christian Europe the priests acquired literacy in order to propagate the faith and their written music set the trend for future generations. In order to remember melodies set to specific liturgical texts a new script had to be devised, and it is from this early notation that we know what sort of pitch system they employed. All the chants were based on a series of scales (of Greek origin) containing seven notes to the octave.

These 'modes' took as their key-note (i.e. the note which was a point of focus or of rest) the first pitch in the ascending scale. If one plays the white notes on a modern keyboard starting from D and ending on the D an octave above the Dorian mode will be heard, D being its key-note. It so happens that seven modes were employed, equivalent to playing an ascending sequence of seven notes from any of the seven white notes of a keyboard.

By the sixteenth century some of these modes had proved more popular than others and certain coincidental chords had gained wide acceptance. A hundred or so years later the number of modes had dropped to two and become the major and minor scales, with certain chords from within them predominating. From this point on the whole focus of music has been on the two modes; any elaboration, including excursions into so-called 'chromatic' notes (i.e. discrete pitches not contained in the modes themselves), was largely decorative.

## Rhythm changes

Rhythm has undergone similar changes. In the Middle Ages polyrhythm was not unknown; there are numerous examples of pieces in three melodic lines performed simultaneously which differ from each other in rhythmic phrasing, metre and accentuation as well as language! But the introduction of the bar-line killed that. Originally brought in to aid the performer's eye across the page by grouping rhythmic pitches together, the bar-line became a rigid constraint; underlying pulses were largely grouped into continuous repetitions of 2, 3, 4 or 6 beats at a time with strong accentuation at the beginning of each bar.

In the less clearly-defined area of timbre ideas have changed too. In most early music vocal or instrumental timbre was unimportant. Even as late as the Baroque period (roughly 1650 to 1750) the choice of musical instruments for a given piece was fairly arbitrary, given that the violin family held sway anyway, and instrumental effect, beyond a few acceptable techniques, was negligible. The nineteenth century saw the growth of the orchestra into a mammoth acoustic synthesiser, yet, because of the rhythmic and tonal restrictions imposed on the notes themselves, orchestration tended to represent the icing on the cake.

Schoenberg reached breaking point with the old hierarchical structure of pitch relationships around 1910 when he realised that decorative chromaticism was clogging up the works; he eventually structured chromaticism. Stravinsky and Bartok rebelled against the rigidity of the bar-line at about the same time. In the 1920s Varèse upset the whole works by putting pitch, timbre, rhythm and structure on an equal and totally new footing.

## Towards emancipation

And now, in the (emancipated?) second half of the twentieth century, electronic technology, though not geared specifically to music, has allowed us to widen our horizons beyond the 'natural'. The aural universe is now apparently boundless and open to everyone, and with the lead given us by Schoenberg and others our ears should be cleansed and our endeavours positively bursting with euphoric enthusiasm. We can now accept or reject the old order of pitch relationships, even 'play between the cracks' of the twelve-note keyboard; we can move into rhythmic patterns unperformable by a human being (though conceived by one); we can choose our dynamics from the inaudible to the painful; we can order timbre to taste; we can utilise the space around the listener; we can be as strict or as free as our imagination permits; the rules are the ones we make ourselves.

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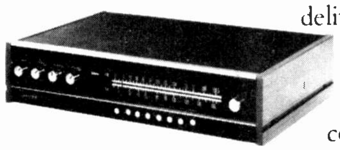

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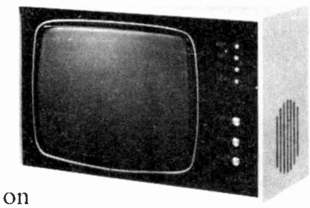

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| 33μF | 40V | 6½p | 1000μF | 16V | 20p |
| 32μF | 63V | 6½p | 1000μF | 25V | 25p |
| 47μF | 10V | 6½p | 1500μF | 6·4 | 15p |
| 47μF | 25V | 6½p | 1500μF | 16V | 25p |
| 47μF | 63V | 6½p | 2200μF | 10V | 25p |
| | | | 3300μF | 6·4 | 26p |

| VEROBOARD | 0·1 | 0·15 |
|---|---|---|
| 2½ × 5" | 36p | 36p |
| 2½ × 3¾" | 33p | 25p |
| 3¾ × 5" | 42p | 46p |
| 3¾ × 3¾" | 36p | 36p |
| 2½ × 1" | 9p | 9p |
| 2½ × 5" (Plain) | — | 19p |
| 2½ × 3¾" (Plain) | — | 16p |
| 5 × 3¾" (Plain) | — | 29p |
| Insertion tool | 73p | 73p |
| Track Cutter | 56p | 56p |
| Pins, Pkt. 50 | 22p | 22p |

**TRANSISTORS**

| | | | |
|---|---|---|---|
| AC126 | 16½p | BC212L | 12p |
| AC128 | 22p | BC213L | 12p |
| BC107 | 11p | BC214L | 17p |
| BC108 | 12p | OC44 | 18p |
| BC109 | 13p | OC71 | 13p |
| BC148 | 12p | OC81 | 16p |
| BC149 | 12p | OC170 | 23p |
| BC182L | 12p | TI543 | 33p |
| BC183L | 12p | 2N2926 | 11p |
| BC184L | 13p | 2N3702 | 11p |

**POTENTIOMETERS**
Carbon Track 5KΩ to 2MΩ, 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 |
| OA5 | 42p |
| OA47 | 9p |
| OA81 | 11p |
| OA200 | 8p |

| PLUGS | |
|---|---|
| DIN 2 Pin | 12p |
| 3 Pin | 13p |
| 5 Pin 180° | 16p |
| Std. Jack | 20p |
| 2·5mm Jack | 13p |
| Phono | 6p |

| SOCKETS | |
|---|---|
| DIN 2 Pin | 10p |
| 3 Pin | 10p |
| 5 Pin 180° | 12p |
| Std. Jack | 15p |
| 2·5mm Jack | 13p |
| Phono | 6p |

**ELECTROLYTIC CAPACITORS.** Tubular & Large Cans (μF/V): 1/25, 2/25, 4/25, 4·7/10, 5/25, 8/25, 10/10, 10/50, 16/25, 22/63, 25/25, 25/50, 32/25, 50/25, 100/10, 100/25, **6½p**. 50/50, **8p**. 100/50, 200/25, **11p**. 250/50, **18p**. 500/10, **11p**. 500/25, **15p**. 500/50, **18p**. 1000/10, **15p**. 1000/25, **22p**. 1000/50, **40p**. 2000/10, **20p**. 1000/100, **90p**. 2000/25, **30p**. 2000/100, **95p**. 2500/25, **38p**. 2500/50, **62p**. 3000/50, **80p**. 5000/25, **66p**. 5000/50, **£1·10**.
**HI-VOLT**: 8/350, **19p**. 16/350, **22p**. 32/350, **33p**. 50/250, **20p**. 100/100, **20p**. 100/250, **30p**.

**METALLISED PAPER CAPACITORS**
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500V: 0·025, 0·05, **6p**. 0·1, **6p**. 0·25, **7½p**. 0·5, **9p**.
1000V: 0·01, **11p**. 0·022, **13p**. 0·047, 0·1, **15p**. 0·22, **23p**. 0·47 **28p**.

| Integrated Circuits | |
|---|---|
| μA709C | 50p |
| μA741C | 55p |
| μA723C | £1 |
| ZN414 | £1·32 |

| | |
|---|---|
| Screened Wire, Metre | 6½p |
| Twin Screened Wire, Metre | 12p |
| Stereo Screened Wire, Metre | 12p |
| Connecting Wire, All colours, Metre | 2½p |
| Neon Bulb, 90V Wire Ended | 5 for 24p |
| Panel Neon, 240V, Red, Amber, Clear | 16½p |

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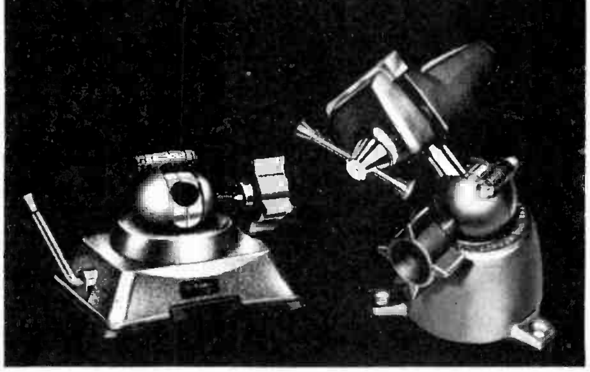

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### *Learning by Experience*

By now many readers are probably thinking that my presentation of the subject shows rather much bias, considering that I have said more than once that I am not easily convinced. If this is so, I can only repeat that I constantly seek proof that a phenomenon is not explainable by *normal* means, but here it must be clearly understood what we mean by normal.

My own belief is that ESP covers a number of presently little-known phenomena, as well as completely unknown ones. But let me give a simple example. Most of us can drive a car or motor-cycle, or at least a bike. Whatever you can drive or ride, cast your mind back to the early day of mastering your vehicle. Remember how you used to panic and force the gear into reverse at about 30 m.p.h., or steer the handlebars to the left when you were falling to the right.

But whatever the mistake, you knew better at the time, but your conscious mind was panicked into doing either the wrong thing, or the right thing too late. But how many times do you find yourself doing silly things like that now? Not very often, if at all. This is mainly because you have conditioned yourself to take the proper course *automatically*. But how?

Well, we cannot be certain exactly, but we do know that practice makes perfect, and that we do not have to think out reasons for doing some things once experience has taught us they are the right things to do at particular times.

The examples above are concerned with facts that conscious learning has precipitated into our sub-conscious mind, and are treated as facts which are known to be true, so our conscious mind can conveniently forget about the experience that taught them to us.

### *Subconscious Learning*

But it is not only conscious learning that can take place. Experiments using lower forms of animal life, where conscious thinking is absent or near-absent, show that experience is learned at a different level, but certainly learning takes place. When assessing results of experiments concerning ESP we must always look for this kind of learning. Not that it will preclude the existence of ESP altogether but simply that it enables us to categorise what is responsible. At present, I would consider the subconscious learning process as a legitimate ESP phenomenon, because it cannot be placed in the group of experiences using the five senses.

Subconscious learning is a very useful asset, and it is a good idea to try to cultivate it. I first discovered it after trying to find out what it was that certain successful people had in common. To me it appeared that people I knew who seemed to "get on" did so without flustering and without going about everything deliberately. They seemed to have a curious quality of being able to stay in top gear in everything and very rarely had to change down. Was it, I wondered, that their success made them carefree, or could it be that they owed their success to the state of mind of keeping their cool?

## ESP etc
**By Brian Baily...**

Many years taught me a lot about this. I tried to take things more lightly whenever I could, and if I met obstacles which seemed unsurmountable, I just passed them over and left them for another time, rather like you are told to do in an examination when you don't understand a question. Come back to it later. By this means, you would expect to get along all right on all the easy stuff, but later on you would expect to be faced with a mountain of insoluble problems.

### *Limitations of Logic*

Logically, this would be true. But statistically, the experience is quite different. In the intervening time, each problem seems to have turned itself around, to show a quite different side, which then looks so simple that you wonder why you did not turn it round in the first place. But you couldn't, because your conscious mind is logical, and logic is certainly not the solution to all problems.

Of course, the problem itself had not altered, but ever since the time that you looked at it initially your subconscious has been working, unbeknown to your conscious mind, on the problem, and has presented the facts, probably quite randomly, and arranged them in a way that logic would not have led you to on its own. Hence, you suddenly see a chink of light and this could be the very thing which leads to the solution you require.

I must stress that some of the above is based on suppositions, as I doubt if any true analysis has been carried out (or even could be) on the actual workings involved.

If you are doubtful about the validity of what I have written, why not try out a few exercises for yourself. Select a few jobs which are not vitally important for starters, of course, or even invent an experiment or two. For instance, try your friends at judging quantities of small identical items, such as beads, beans or dried peas. You will be amazed how accurate some become at selecting say, 30, 50 or 100. Now, if in your first attempts someone arrives at EXACTLY the right number, then you may (or may not) have reason to question whether another form of ESP has crept in, as experience, conscious or subconscious, cannot be seen to be involved.

### *Decision Makers*

You may well wonder why I have dwelled upon the subject this month, in the form I have chosen. But I assure you, it is very relevant to what I wish to present now and later. Firstly, it has now been established that many people in top managerial positions make decisions which they cannot at the time justify by any particular logical or statistical data. Naturally, it is hard to get an admission out of such people, as admissions to this sort of thing would appear most unscientific. But such decisions later prove to be right, against all evidence of facts available at the time.

A detailed analysis was made of results of some special experiments and is covered in detail in Vol. 1 No. 7 of the *Journal of Paraphysics*, in an article by Prof. John Mihalosky, Newark College of Engineering.

This article is of great interest, and I am going to quote here a few extracts from its text. A number of top decision-makers were asked how they came up with the particular decisions they had to make, many upon which millions of pounds profit or loss might hinge, and the answers were: "I don't think businessmen know how they make decisions. I know I don't" and "You don't know how you do it; you just do it" and "There are no rules"; and "It is like asking a baseball player to define the swing that has always come natural to him" or, as one put it, "Whenever I think, I make a mistake". One even said, "I have found that some of the most horrible mistakes we have made came after I ignored my intuition under the pressure of what looked at the time like unshakeable evidence".

Well, what do *you* think?

# DEVICES ...APPLICATIONS

## PROTECTED POWER TRANSISTOR WITH A GAIN OF A MILLION

THE NEW LM395 series of devices available from National Semiconductor look like a normal TO3 power transistor, but are actually integrated circuits which behave like fast *npn* power transistors with a current gain of the order of a million. They contain some fifty internal components, including 21 transistors.

The protective circuits incorporated in these devices are one of their most important features. If the temperature of the chip exceeds 165°C, the power output stage is shut down. This enables a much smaller heatsink to be used with safety than would otherwise be possible. In addition, a current limiting circuit prevents damage to the device by excessive current.

Any number of the devices can be connected in parallel to increase the current capacity, since no device will pass more than the limiting value of the current.

### THE LM395

The LM395 is the most economical device in the series, the price being about four times that of the well-known 2N3055 power transistor. The LM195 and LM295 are similar to the LM395, but can operate over a wider temperature range and have the higher maximum operating voltage of 42V.

The LM395 may be destroyed if the maximum permissible voltage rating (36V) is exceeded, but it is almost impossible to destroy it in any other way.

Even if this device is destroyed by the application of an excessive voltage, it will become open circuited and will protect other devices in the circuit. (A normal power transistor becomes short circuited if an excessive voltage is applied to it.)

### CONNECTIONS

The connections to the LM395 series of devices are shown in Fig. 1. It should be noted that the case of the device is connected to the emitter electrode. It is expected that the same type of device will be available in the smaller TO5 package in due course.

The typical base current is quoted as 3μA. If a current appreciably greater than this is fed into the base, the collector voltage will fall to its saturation value of about 1·8V for collector currents of up to 1A.

It was found that the device conducted when the base was open circuited, but became non-conducting when the base was connected to the emitter.

The switching time is typically 500ns.

### TYPICAL APPLICATIONS

#### 1. Simple current limiter

The circuit of Fig. 2 forms a very simple current limiter. The internal circuit of the device limits the collector to emitter current to about 2A (minimum 1A at 15V). When no heatsink was used with an LM395 in this circuit with a 6V supply, the current fell to about 0·5A after a short time as the device became hot.

If the base connection is switched from the collector to the emitter of the device, the collector current will fall to the quiescent value of a few milliamps.

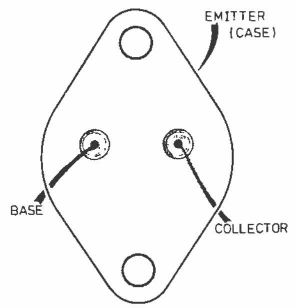



**Fig. 1. Connections of the LM395 series of devices (looking at underside)**

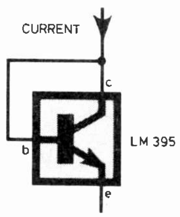



**Fig. 2. A simple current limiter circuit using the LM395**

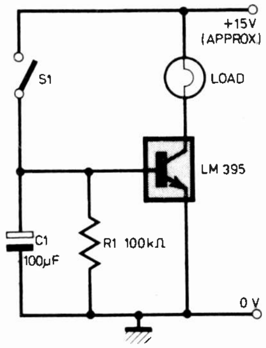



**Fig. 3. A simple time delay circuit**

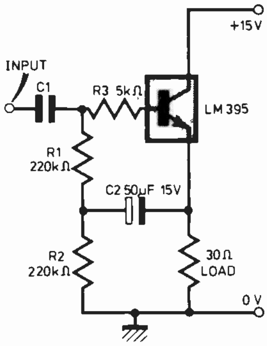



**Fig. 4. A very high impedance emitter follower circuit**

The base current which must be switched is very small and one could, for example, use the output from a TTL circuit to control a current of at least 1A in the emitter-collector circuit.

**2. Time Delay**

A very simple time delay circuit is shown in Fig. 3. When S1 is opened, C1 discharges through R1. The LM395 remains fully conducting until the voltage between the base and emitter falls below 1V. When the values of R1 and C1 shown are used, the current in the load begins to fall about ten seconds after S1 is opened.

The load shown in Fig. 3 is a lamp, but other types of load may be used. The maximum current is about 2A and this will not be exceeded even if the load is accidentally shorted.

**3. Emitter Follower**

An LM395 emitter follower circuit with a very high input impedance is shown in Fig. 4. The output voltage is fed back to the junction of R1 and R2 so that the voltage across R1 remains almost constant.

This feedback arrangement ensures that the input impedance is very high. The resistor R3 is required to prevent possible oscillation and should be used in all LM395 emitter follower circuits.

The circuit of Fig. 4 can be used to control a current of over 1A in the load using a control signal of high impedance.

**4. 1A Regulator**

The circuit of a voltage regulated supply which can deliver up to 1A is shown in Fig. 5. The output can be set anywhere in the range of 4·5V to 30V by adjusting VR1. The output current is automatically limited by the circuits inside the LM395.

The LM305 device is a voltage regulator which accepts an unregulated input at pins 2 and 3 and provides a regulated output from pin 8. The latter controls the LM395 which is connected as an emitter follower.

The voltage controlling signal is taken from the tapping on the load in the emitter circuit.

**5. Power pnp transistor**

If one requires a *pnp* circuit which is equivalent to the LM395, one may use the arrangement shown in Fig. 6. When a current is taken from the base lead through R1, the transistor TR1 conducts and supplies base current to the LM395.

This circuit has the same thermal overload protection and current protection as the LM395 itself. It may be used in the same way as an LM395 with all polarities reversed.

The LM395 can also be used in operational amplifier circuits which must provide a high output power, in high power oscillators at frequencies up to 1MHz, in switches with optical isolation, etc.

Further details on the LM395 series of devices are available from National Semiconductor, The Precinct, Broxbourne, Hertfordshire.

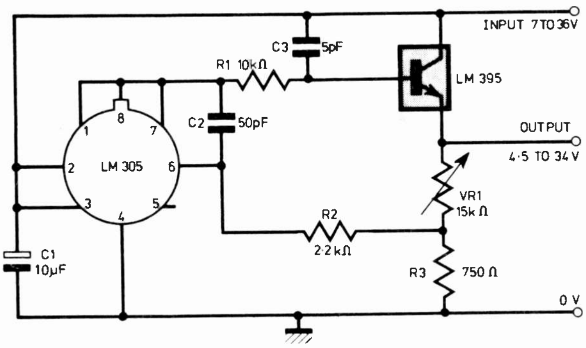



**Fig. 5. A one amp voltage regulator with current limiting**

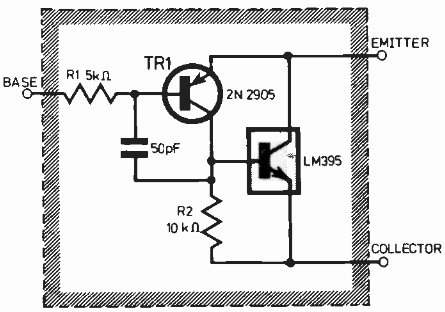
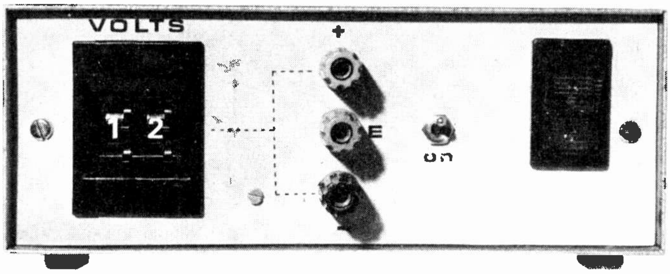



**Fig. 6. A *pnp* circuit for a power transistor with thermal overload and current limiting**




# BENCH POWER SUPPLY

## By D.W. LLOYD

This article describes a bench power supply using the minimum of components without sacrificing performance. Normally power units with similar specifications cost anything up to £30; this unit should cost much less than that.

One of the items that makes power supplies costly is the meter which so many people rely on for accuracy when setting up the output voltage. This device however is inaccurate or, to be more correct, will only typically be 2 per cent accurate or worse, which is the tolerance on most meters.

The power unit described here uses no meter and is as accurate as the tolerance on a chain of switched fixed resistors with which the voltage can still be read directly. As can be seen from the illustrations the output voltage is set up by the use of thumb wheel switches and on the particular unit shown the output voltage is in fact controllable from zero volts up to 19V in 1V steps.

### SPECIFICATION . . .

| | |
|---|---|
| **Supply** | 230V ± 20V, 50/60Hz |
| **Output Voltage** | Up to 0 to 19V in 1V steps or as required (see text) |
| **Output Current** | 250mA, 1A or 2A |
| **Output Regulation** | 0·08 per cent |
| **Line Regulation** | For 10 per cent line variation is 0·05 per cent |
| **Ripple** | 3mV |
| **Output Resistance** | 10mΩ |
| **Temperature Coeff.** | 0·02 per cent |

### BASIC CIRCUIT

The basic circuit is shown in Fig. 1 from which it can be seen that the mains supply transformer is provided with two secondary windings. One, identified A, is the power supply source proper, whilst the second is a low current winding which powers the regulator chip IC1. This floating mode of powering for the chip allows the sweep of voltage fed to the error amplifier in the regulator to be increased beyond the limits of the voltage of the main power supply.

In this way it is possible to control output voltage from 0 volts to full voltage from winding A.

In addition to allowing full sweep of the output voltage, the use of this floating independent supply for the chip also assists in regulation. Clearly the regulator supply will not vary in the same way that the main supply will as the load is varied.

The circuit is simple and effective in regulation and has the added advantage of being flexible on the current front. By selection of the series regulating transistor the unit can be preset to supply up to 250mA, 1A or 2A whilst using the same control board. The only other basic alteration to increase current output is of course the provision of a suitably rated transformer.

The voltage regulator used in the circuit is the 723, generally available from several manufacturers. This chip contains an accurate reference source, an error amplifier and a controlled output with current limit facilities.

Operation of the output is effected as a result of variations in the measured voltage, in this case the output of the main power supply, being fed to the error amplifier which then controls the output to maintain the main voltage at a constant level.

Current limit is achieved by placing a known low value resistor, in the present case R1, in the regulated supply line and making use of the voltage developed across it (which is proportional to current through it) to operate a limit on the current allowed through the main supply. Frequency compensation is provided on the chip through a feedback link to pin 13 via capacitor C4.

### OPERATION

The regulator supply, winding B, is rectified by bridge rectifier D2 and smoothed by C2 before passing to pins 7 and 12 of the i.c.

Similarly, the output of winding A is rectified by diode bridge D1, smoothed by capacitor C1 and then subjected to regulation as a result of the output current and voltage requirements. Control is effected mainly by the series transistor TR1 in the case of 250mA output or TR2/TR3 in the case of 1 or 2A outputs. Connections for the three forms of circuit are shown in Fig. 1.

Resistors R2 and R3 are used either in parallel or associated with TR2 and TR3 which are run in parallel. Thus they present a 1·1Ω series resistance.

The main sensing and control signal is obtained from the series chain R4, VR2 and R6, being tapped from this chain and fed via R5 to pin 4 of the regulator i.c. Resistor R4 determines the output voltage and can be made up in a number of ways.

In the prototype R4 is formed of a series of discrete resistors selected to give unit and decade switching of the output voltage from 0V to a maximum dependent on the output of winding A. In the prototype this is 19V. Selection of the resistors is by means of two thumbwheel switches S3 and S4 connected between points P3 and P4 of the circuit although of course rotary switches or, for that matter a 10-turn potentiometer, could be used if desired.

In order to allow the controlled voltage to be swung down to zero volts the non-inverting input of the error amplifier in the regulator chip is connected to the negative output rail whilst the inverting input is connected to the sensed voltage. In this way the negative supply to the i.c. from winding B is negative with respect to the negative of the main output by the same value as the reference voltage.

Any variations in the main output are fed back into the regulator and serve to control the output in the opposite sense, thus giving stabilisation. The chain including VR2, R6 and R4 serves to set the point about which stabilisation occurs.

Preset potentiometer VR2 serves to ensure that the current through the chain is 10mA, a value at which the values of the step resistors selected by S3 and S4 can thus become 1kΩ and 100Ω respectively for steps of 10V and 1V respectively. In this way the output voltage control is as accurate as the resistors selected so that 1 per cent resistors give a control function to 1 per cent and 0·1 per cent to the same 0·1 per cent level.

## EARTHING

It will be seen that neither side of the output is earthed to the chassis or to an output earth point. This allows the unit to be used in any configuration of other units; to supply, for example, the positive or the negative half of a double supply or perhaps even be used in series with another supply to uprate the output voltage.

An earth terminal connected to the unit case is mounted on the front panel and can be connected externally as required to either rail.

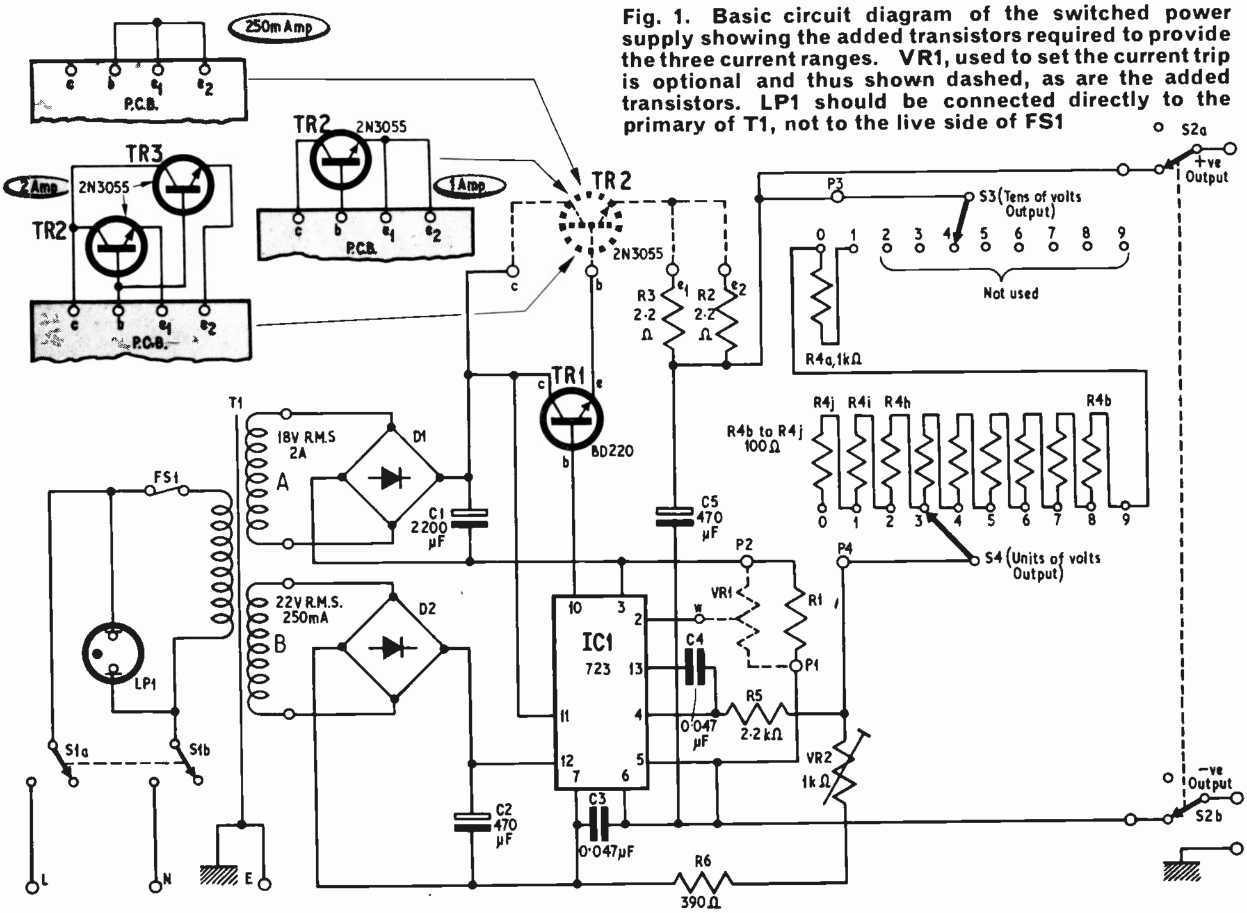


**Fig. 1. Basic circuit diagram of the switched power supply showing the added transistors required to provide the three current ranges. VR1, used to set the current trip is optional and thus shown dashed, as are the added transistors. LP1 should be connected directly to the primary of T1, not to the live side of FS1**

# Components . . .

**Resistors**
R1 1Ω 1W, wire-wound (n.i.) for 1A version
R2 2·2Ω 2W
R3 2·2Ω 2W
R4a 1kΩ or as required, see text; 1% or better
R4b to j 9 × 100Ω or as required, see text, 1% or better
R5 2·2kΩ 2%
R6 390Ω 2%

**Potentiometers**
VR1 100Ω pre-set
VR2 1kΩ pre-set

**Semiconductors**
D1 10DB1A bridge rect.
D2 10DB1A bridge rect.
TR1 BD220
TR2 2N3055
TR3 2N3055
IC1 723 d.i.l. stabiliser i.c.

**Capacitors**
C1 2,200μF, 25V
C2 470μF, 50V
C3 0·047μF
C4 0·047μF
C5 470μF, 25V

**Switches**
S1 D.P.D.T. mains switch
S2 D.P.D.T. miniature 2A d.c. toggle
S3 Digital Thumbwheel (Birch Stolec Ltd.)
S4 Digital Thumbwheel (Birch Stolec Ltd.)

**Transformer**
T1 240V, 50Hz I/P, 18V r.m.s. @ up to 2A and 22V at 250mA O/Ps. Type 1069, £3·85, Zeta Windings, 26 All Saints Rd., London, W.11; Toroidal form is Type T1182 from Siga Electronics Ltd., Sandy, Beds.

**Miscellaneous**
Case, terminals, p.c.b., 1A fuse (FS1) and holder

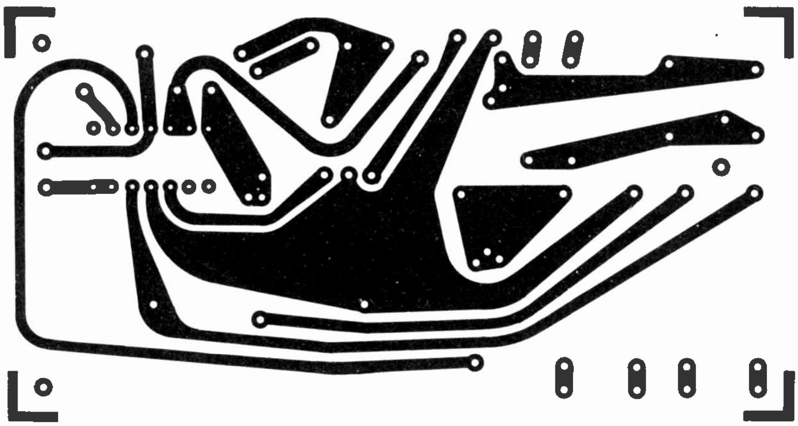


Fig. 2. Printed circuit master for the power supply

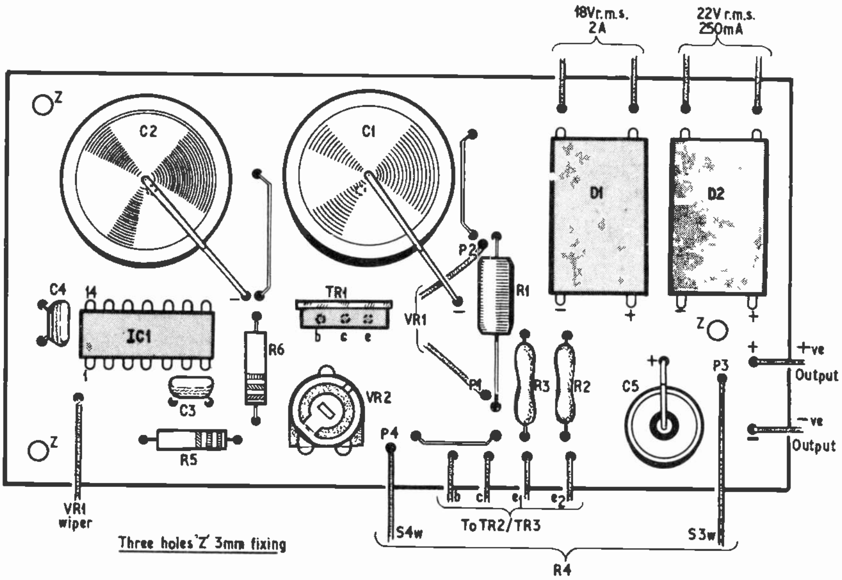



Fig. 3. Layout of components on the circuit board of Fig. 2 identifying the flying leads to other cicuit devices

## CONSTRUCTION

As can be seen from the illustrations, construction is simple and in fact is quite flexible since some of the options used in the prototype can be altered to suit individual requirements.

For example, whilst the printed circuit board and layout shown in Fig. 2 and Fig. 3 includes only the main components of the circuit, with the transformer and switched resistors mounted elsewhere, some constructors may wish to have a much larger board and mount all or most of the components thereon.

As has been noted, switch S3/S4 could be replaced by a rotary unit or even by a potentiometer if required or even by a fixed value resistor if only one output voltage is required. It should be remembered that any deviation from the electrical arrangement suggested might degrade the performance by introducing errors so alterations in this part of the circuit should be viewed with some care.

A single-throw mains switch with self-contained neon indicator was used in the prototype but of course any suitable arrangement can be used here as in the switching of the d.c. rail by switch S2. This latter is included in the circuit so as to avoid build-up and decay time problems which occur when switching the mains supply. The latter being switched ON most of the time and supply switching being effected in the d.c. rail.

There is no particular problem with the remainder of the assembly except perhaps with the power transistors used at TR2 and TR3 where these are needed. In the prototype the output was set to 1A so that only TR2 was required. The (or each) device is mounted on the back panel of the unit using the mica insulating washer supplied with the transistor so as to avoid shorting the transistor to earth.

## MAINS TRANSFORMER

A toroidal transformer was used in the prototype as one was to hand and in any case is smaller than its more normal counterpart, thus allowing a smaller case to be used. Using a toroidal transformer the radiated magnetic field is also smaller than with a conventional device, but either may be used if required.

The square holes in the front panel for the thumbwheel switches were cut by first drilling and then filing. If some other form of switching is used then obviously this step is avoided.

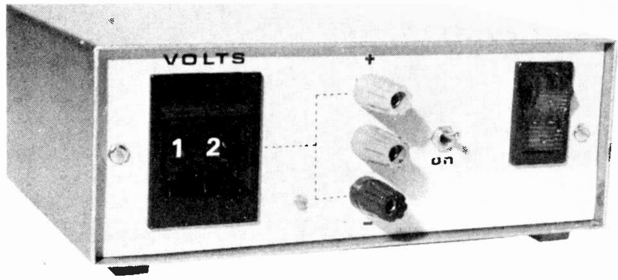
Finishing touches have been added using Letraset over the top of a coat of paint followed by fixing varnish to give a professional appearance.

## TESTING

After assembly the first thing to check is the isolation of the power transistor/s case/s. A simple resistance check here and at the mains input lines to ensure that nothing is shorted to chassis or elsewhere is always valuable at this stage.

Switching on the supply should now illuminate the mains neon indicator and of course produce voltages in the circuit. Check that the voltage across C1 is not less than 22V. That across C2 should be not less than 28V and not more than 40V.

The output level is set quite simply by placing a voltmeter across the output, setting the switches to give a 1V output and then adjusting VR2 until the output is indeed 1V.



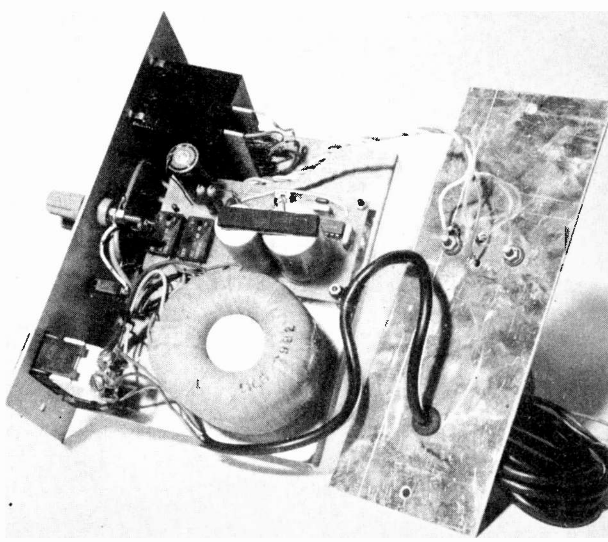

## CURRENT LIMITING

It is quite simple to set the current limit to the required value. Take the case of a 1A unit. Set the output switches to the 10V position and connect a 10Ω load so that a 1A current flows. Monitoring the output voltage, adjust an added current limiting potentiometer VR1 between points P1 and P2 (shown dotted in Fig. 1) till the output voltage just starts to fall. Turn the potentiometer back a little so that the supply is operating in the regulated portion of its curve and the output is now set to limit at just over 1A. The potentiometer may now be replaced by fixed resistors if required. If VR1 is not used at all and the load current determined by R1 alone then points W and P1 on the circuit should be shorted together.

A simple way of testing this is to leave the meter connected, remove the load and then to switch on with the meter switched to a range greater than 2A. In this case the meter forms its own load and the reading should be just over 1A.

A check of the voltage over the load(meter) will show that this has dropped to a very low level. This illustrates the way in which this design acts to protect load circuitry connected to the output when shorts exist in that load. ★

**Exploded view of the prototype power supply showing the use of a toroidal mains transformer, digital thumbwheel switches and the power transistor mounted on the rear panel**



# 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.

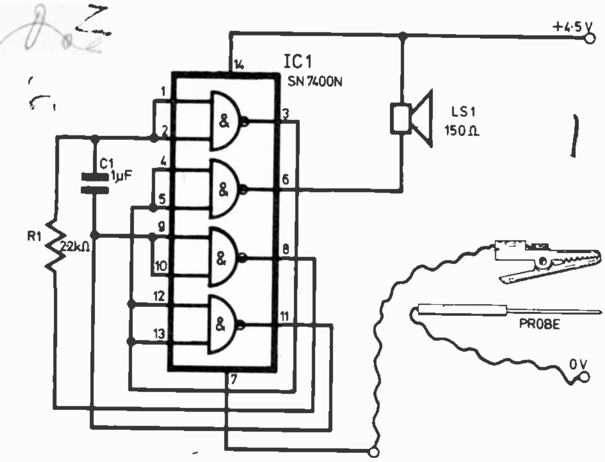



**Fig. 1. Integrated circuit continuity tester**

## A SIMPLE CONTINUITY TESTER

Fig. 1 shows three gates of the familiar 7400 connected via R1 and C1 to form a relaxation oscillator continuity tester. The output is fed through the remaining gate, which acts as a buffer amplifier, to LS1, a miniature earphone. With the values shown for R1, C1 and LS1 the frequency is about 800Hz. Virtually any earphone or loudspeaker can be used. If one of a lower resistance is chosen the signal may be unacceptably loud, but can be reduced to any level by inserting a suitable series resistor.

The test leads can be in either positive or negative supply. When they are joined the note will sound and the current flowing will be about 8mA. The oscillator will continue to sound until the battery has run down to three volts or less.

When the test leads are connected across a resistance a higher note is produced. The device is useful up to some 400 ohms or so and is just audible across 1 kilohm. The smallest resistor which can be distinguished from no resistance at all is about 4 ohms.

Diodes, if tested so that they are reverse biased, do not of course make the oscillator sound. If forward biased the note is about a third, musically speaking, higher than when the leads are shorted. The polarity of the test leads should therefore be marked. Capacitors of 40µF and up give a chirp as they charge.

R. Parfitt, Croydon.

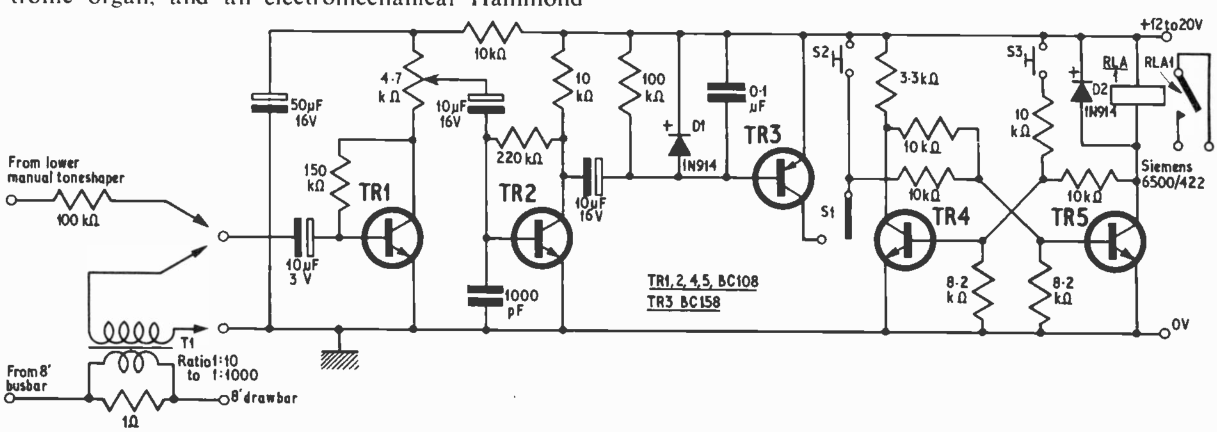
## TOUCH START OF AUTOMATIC RHYTHM DEVICE

Very few electronic organs manufactured before 1970 are equipped with facilities for remote control of an automatic rhythm device. This circuit is activated by an audio signal from the lower manual (or pedal), making it possible for the performer to play the prelude on the upper manual and the pedal, and when the first note is played on the lower manual, the rhythm accompaniment is started.

At the front end of the circuit two alternatives are shown; a high impedance input for connection to the lower manual toneshaper output of an electronic organ, and an electromechanical Hammond organ connection using a transformer and a series resistor.

The transformer could be any output transformer for use in portable radios with a ratio of 1 : 10 to 1 : 1,000. An incoming signal will be amplified through TR1 and TR2, and turn on TR3. If S1 is closed, a current will pass through to TR5, triggering the bistable, causing the relay to pull in. S2 and S3 are used for manual start and stop.

K. B. Sorensen,
Copenhagen,
Denmark.



## DISTANCE MEASURER FOR GOLFERS

This is a simple project for all those golfers who feel they have the need to measure the length of their drives.

The distance is measured by counting the number of revolutions of the wheel of the golf trolley. Having 12in diameter wheels, one revolution of the wheel of the trolley under load is very nearly one yard ($\pi$d).

A small magnet was fitted to the hub of a wheel and a dry reed switch fitted to the axle. Each revolution closes the contacts briefly, but not for long enough to operate the counter.

A simple monostable is included to extend the time of the pulse long enough to operate the awkward counter (see Fig. 1). The time interval is adjusted by changing the value of capacitor C1 but 6·8$\mu$F was found to be adequate.

The counter draws about 18mA at 36V, so a switching transistor is included. This can be any *npn* type capable of handling the current.

D. F. Woods,
London N11

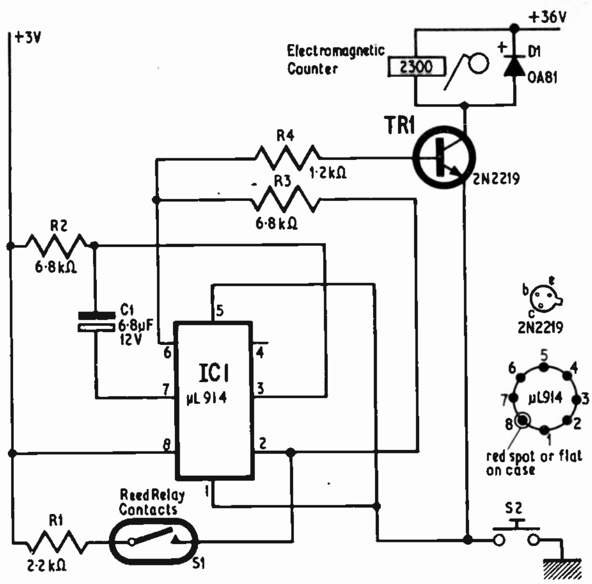



**Fig. 1. Circuit of the distance measurer for golfers**

## TOY TRAIN SPEED CONTROLLER

Like a few thousand other parents, I quickly learnt this Christmas that a train set has only one speed, this being set by the age of the battery.

Worse still, a well-used model eats batteries at the rate of one a day. Obviously something better was called for and the circuit of Fig. 1 was developed.

Components D1, D2 and C1 form a conventional supply. Positive going pulses are passed via D4 and D5 to the divider R1 and VR2 where they are tapped off. As soon as the pulses exceed 0·7V, TR1 is switched on. How early or late in the cycle TR1 is switched depends on the setting of VR2. D7 and D8 clip the driving pulses.

Transistor TR1 in its turn switches on the constant current generator R5, R6, D6, TR2, and TR3 which should turn very hard on. Thus at the rails we have constant amplitude, current limited pulses of variable width with a repetition frequency of 100Hz.

Diode D3 shields the circuit from the back e.m.f. of the motor. C2 is an r.f. suppressor.

The design is robust enough to work into an open or a short circuit. TR3 is mounted on a small heatsink.

Obviously train sets vary, but for a loaded train to be derailed while going flat out on a radius of 15in, an h.t. exceeding 20V is required across C1. At the other extreme a well oiled motor on a clean track can be made to creep around at one inch per second.

**One final word of caution:** if the circuit is to be used only by a child, please enclose it in a sealed metal container with a good earth connection.

J. Vella
Carlisle

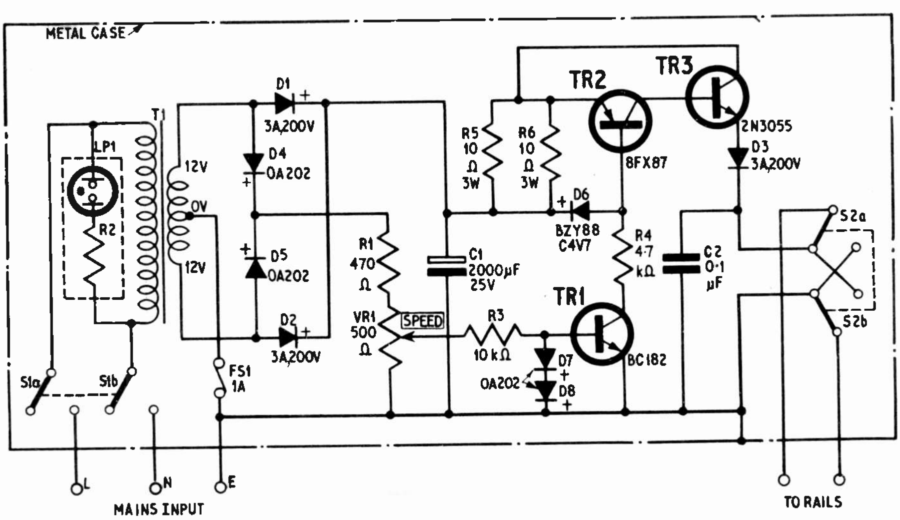
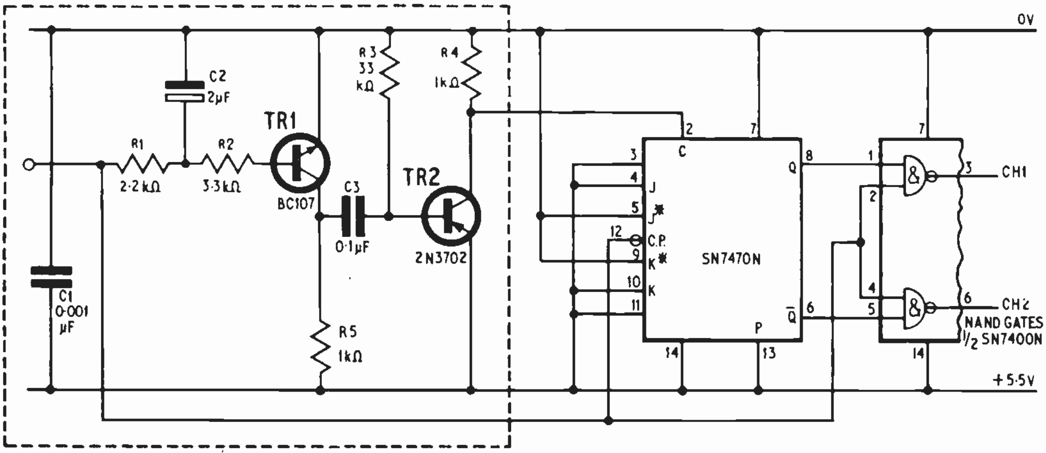



**Fig. 1. Circuit of the toy train speed controller**

# RADIO CONTROL DECODER




THE circuit of Fig. 1 shows a decoder capable of dealing with a two-channel system. It was developed as a result of work carried out with the Radio Control System described in P.E. in December 1971 and the following two issues.

The section of the circuit enclosed in a dashed line replaces the re-triggerable monostable and associated components of the earlier system and can be used in its place to supply the clear pulse to the shift register for more than two channels if required.

Positive pulses are fed from the receiver (if negative then they can be inverted by a spare gate). TR1 is held on by the input voltage whilst the pulses are being received and remains on for a short time after the second pulse.

When TR1 turns off a positive pulse through C3 turns TR2 off for a short time. It is normally held on by R3 connected to the 0V rail. This produces the required negative-going clear pulse.

The outputs from the edge-triggered flip-flop are fed to two gates along with the input signal and the separate outputs are obtained. The unused J and K inputs are connected to positive to give better noise immunity.

A. Sansome, Sutton Coldfield.

# BOOK REVIEWS

**EFFECTIVE TECHNICAL WRITING AND SPEAKING**
**By Barry T. Turner**
**Published by Business Books Ltd.**
**206 pages, 9½in × 6¼in. Price £4·75**

THE so-called "communications explosion" places greater and heavier responsibilities upon all communicators, whether they be scientists, engineers, technical writers in industry, or contributors to the technical press.

This book has been prepared to help those who may be called upon to present technical information through the medium of the printed or spoken word. The author is Professor of Industrial Management, University of Newcastle-upon-Tyne. The work is an excellent textbook covering the special requirements and practices involved in the many forms that communication can take.

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On the aural side, the preparation and delivery of talks and lectures, and the running of meetings receive detailed treatment.

As would be expected, this book is itself a good example of the doctrine it preaches; clear exposition of facts, good division and arrangement of contents, supported by many useful references for "Further Reading," and finally nicely rounded off with an extensive and valuable collection of appendices.

An indispensible companion for all who, whether in the course of duty or by choice, have at times to perform in the role of a communicator of technical information.

F.E.B.

**SEMICONDUCTOR DEVICES: Testing and Evaluation**
**By C. E. Jowett**
**Published by Business Books Ltd.**
**134 pages, 9½in × 6¼in. Price £5·00**

THIS is a specialist's book, and is probably unique. It deals with the subject of standard comprehensive testing of semiconductor devices within industry. Thus its appeal will be chiefly to those engaged professionally as designers or technicians and to college and university students. To such readers, this volume will no doubt constitute a definitive source of reference, and its recommendations and procedures are thus likely to become widely adopted.

The tests described are divided into four classes: environmental, mechanical, and electrical tests for transistors and diodes.

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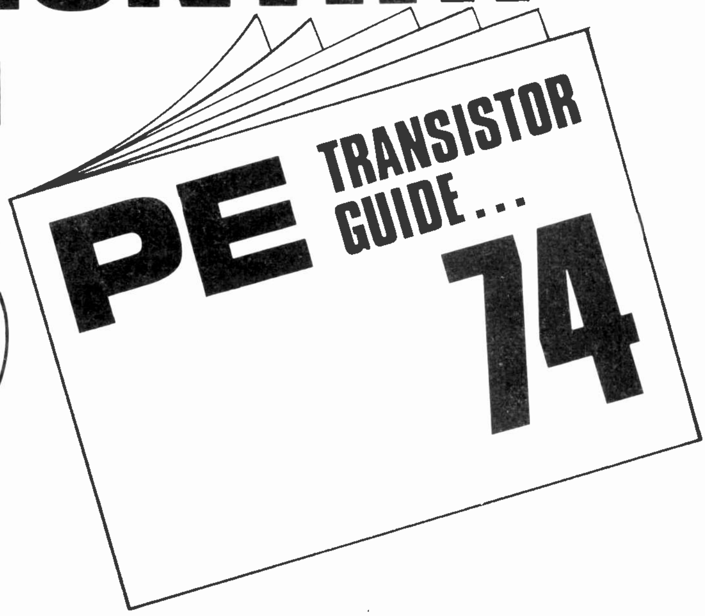


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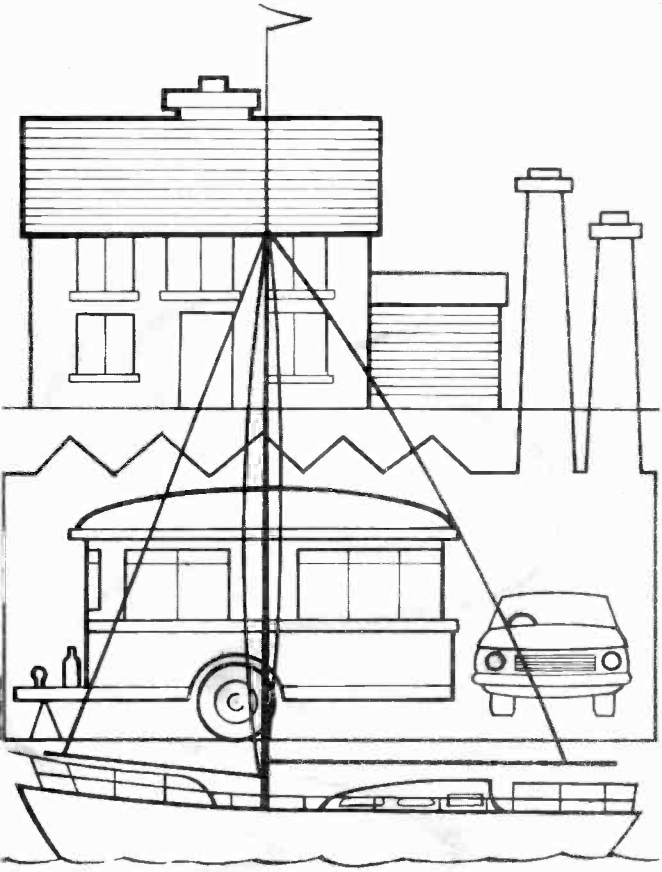
**Because of prevailing production problems, no firm publishing date can be announced for the October issue. Readers are advised to check regularly with their local supplier from mid-September onwards.**



# GAS DETECTORS

## . . . FOR HOME · FACTORY CARAVAN · BOAT

By J. C. PERRETT

*Several circuit variations using state-of-the-art catalytic gas/smoke detectors to indicate the presence of such dangerous materials as methane, propane or butane*

THE increasing use of portable gas stoves in caravans and boats each year brings its own crop of accidents, so that any instrument which might give adequate warning of a dangerous situation must be considered useful, particularly if it is easy to build and use.

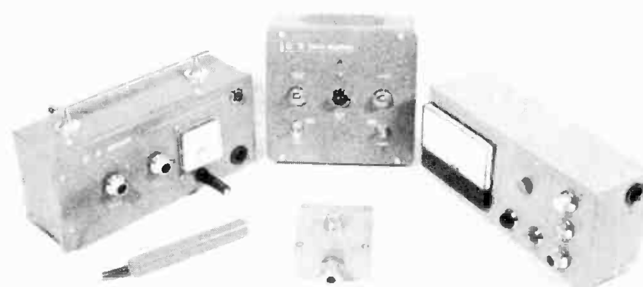
The various circuits described in this article meet this sort of demand, and may be used either as alarms or monitors for changing levels of gas or smoke in the home, boat, caravan and even industrial environment. A total of six circuits are shown. The first is a general test circuit which allows the user to ascertain the performance of the sensor used with any type of gas or smoke.

Other circuits include mains driven units which may trigger audible alarms or lamps, and a portable battery/mains unit which allows operation from dry batteries, suiting the circuit to leak detection of gas from pipes or tanks. The sensor is remote from the instrument.

The penultimate circuit discussed is that of a twin station unit designed specifically for use in boats from either 12 or 24V. A multi-station unit is discussed as an experimental project.

### THE SENSOR

The systems proposed use one or other of the Figaro Engineering sensors described in the July and September 1973 issues of Practical Electronics. When the sensor is exposed to fresh air it assumes a high resistance state but as it absorbs de-oxidising or combustible gases such as hydrogen, carbon monoxide, methane, propane, butane, alcohol, or the carbon dust contained in smoke, the resistance decreases.



The devices vary in characteristic. Type 308 sensor has a very long warm up time of between 5 and 10 minutes and is, therefore, better suited for use where only occasional turning off or on is required. However, the device is very sensitive to carbon monoxide and smoke.

Three other types of sensor are available and are suited for high voltage use up to 100V. These are the type 109 general purpose detector requiring a 1V heater and a 4kΩ load which takes 2 to 3 minutes to warm up and the 105 which has a warm up time of approximately 1½ minutes.

Finally, the type 102, suitable for carbon monoxide and smoke detection, has a 1V heater and requires 5 to 10 minutes warm up time.

The life of all devices is approximately two years with normal use.

## CIRCUITS

Fig. 1 shows a basic experimental circuit which will allow a reader to determine for himself the reactions of the transducer to various stimuli if VRL7 is plotted against concentration of the stimulus in air.

An alarm may constitute almost anything, though a 6V bell is used in the most simple prototype. Because the current for the bell (Fig. 2) is fed through a thyristor, the bell becomes polarity conscious. This unit may be simply built on a piece of tag strip and is useful for permanent site monitoring of environments where gas appliances are used.

The components to the left of the line Z-Z in Fig. 1 constitute a mains power supply and is repeated in some following circuits and denoted by the reference to Z-Z in those figures.

The circuit of Fig. 3, the first prototype, is also mains operated, but includes meter monitoring and a light which gives visual warning of a predetermined level of gas.

The alarm is driven by monitoring the voltage across transducer using the meter bridge circuit, D1 to 4. This voltage is also applied to the base of TR1. The 1kΩ VR2 is the alarm sensitivity control which attenuates the voltage available to drive the base

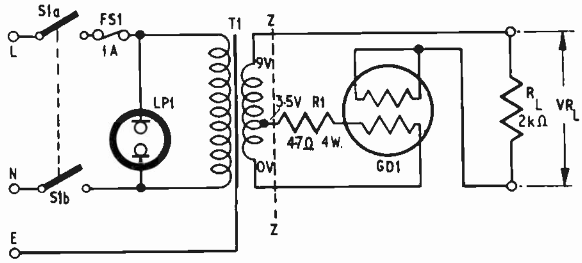
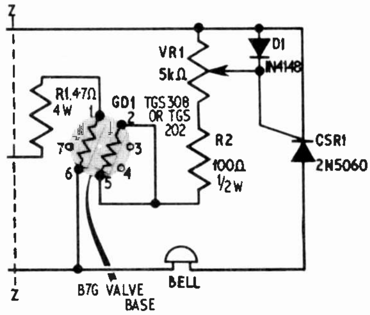


Fig. 1. Test circuit for examining the characteristics of the Figaro gas detectors

Fig. 2. A basic detector in its simplest form




# COMPONENTS . . .

**Resistors**
- R1 4·7Ω 4W
- R2 1·8kΩ ¼W
- R3 1·8kΩ ¼W
- R4 470Ω

**Potentiometers**
- VR1 5kΩ Lin.
- VR2 1kΩ Lin.

**Semiconductors**
- D1 to 4 OA91 (4)
- D5 1N4001
- TR1 BC107
- TR2 BFY50

**Miscellaneous**
- F2 2A fuse and holder
- GD1 TGS 308 or TGS 202 and B7G valve holder
- LP2 6V bulb and SL90 holder
- LP3 6V bulb and SL90 holder
- ME1 1mA moving coil meter
- Case AB17 aluminium box, 10 × 4·5 × 3in

## MAINS GAS/SMOKE DETECTOR

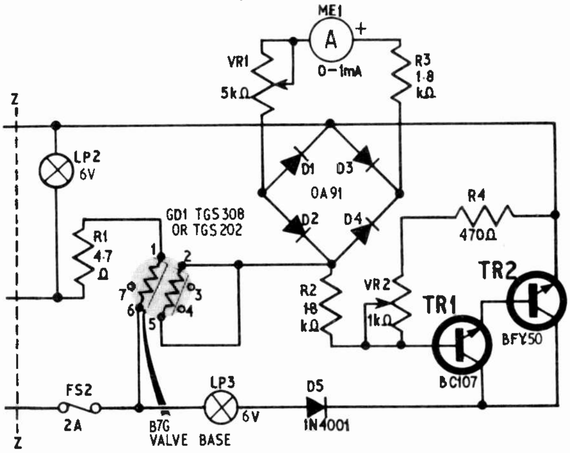
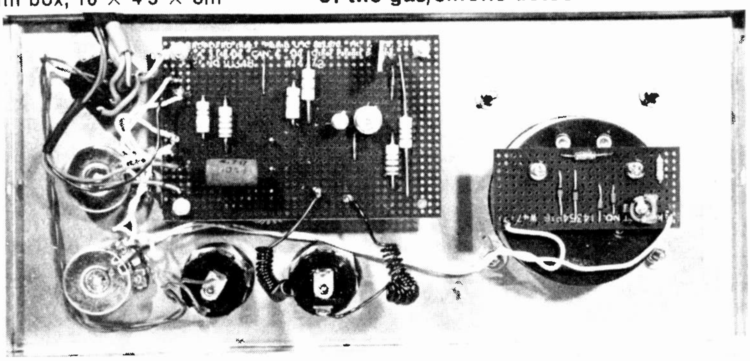


Fig. 3. The prototype mains operated version of the gas/smoke detector

**Rear view of the front panel of the mains unit showing location of the various components, Veroboard and meter. The detector socket is mounted in the panel behind the Veroboard**



of TR1. The inclusion of diode D5 prevents the base/collector junction of TR1 becoming forward biased during the time when the emitters of TR1 and TR2 become positive.

The detector itself may be neatly mounted using a B7G valve base, as shown in the illustrations; the heater becoming pins 1 and 6. The sensors may be fitted either way round, in pins 1, 6, 2, 5 of the valve base. Such a circuit is simple and may easily be assembled onto Veroboard.

It is possible for the detector to be used remote from the main circuit board by using a 3-core mains lead of at least 5A capacity. If a very long length of lead is used the resistance of the cable connected to pins 1 and 6 of the B7G base should be subtracted from the 4·7Ω ballast resistor R1 so that the heater voltage remains correct for the type of sensor fitted.

The circuit of Fig. 3 is one of the non-latching type and will automatically stop showing an alarm condition when the gas concentration falls below the level set by the alarm sensitivity control VR2.

## PORTABILITY

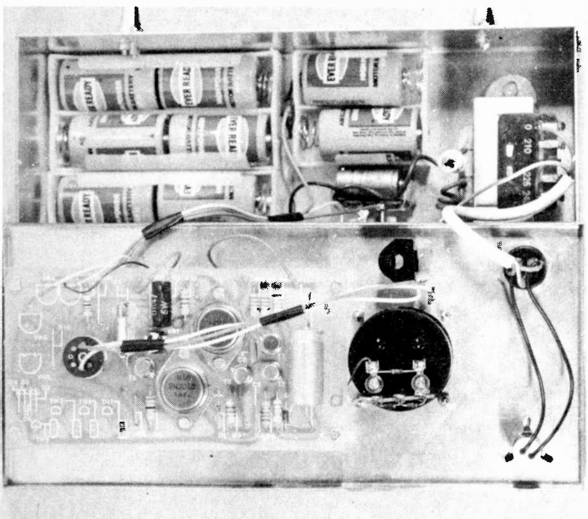
The low voltage heater used in the transducer makes battery operation difficult, the problem being aggravated by the dependence of the sensitivity of GD1 on the heater voltage. If batteries are used directly, stabilisation of the heater supply will be required, but most methods of doing this are very inefficient due to the high power loss in the regulator section of the instrument.

To overcome this a chopper supply has been proposed in Fig. 4, and this circuit will allow the unit to be used from HP11 torch batteries.

To understand the circuit we first must study the power requirements for the gas detector. The heater requires 1·5V and the heater resistance (cold) is approximately 2Ω. In normal use a current of 0·5A is required.

Thus the power requirement is 0·75W.

From this point forward we are only interested in the power reqdirement of the device. Assume



**The portable mains/battery version opened up to show location of the main component parts. Note the use of battery holders and only part of the p.c.b. circuitry**

that the use of a 10V supply is convenient; if the 10V supply is connected across the heater the power dissipated would become

$$\frac{V^2}{R} = \frac{100}{2} = 50W$$

It is quite obvious that if current continued to flow the device would be destroyed.

This problem is overcome by pulsing the supply voltage to reduce the average power dissipation to 0·75W. To calculate the mark/space ratio required to reduce the heater power from 50W to 0·75W use the formula:

$$\text{Mark/space ratio} = \frac{\text{Max peak power (instantaneous)}}{\text{Average power dissipation required}}$$

$$= \frac{50}{0{\cdot}75} = 66 : 1$$

In the circuit of Fig. 4, a mains or battery version designed for portability, the multivibrator comprising TR1, TR2, TR3 is capable of providing a 100 to 1 mark/space ratio. The output of the oscillator appears at the emitter of TR3 which is connected to base of TR4, this transistor acts as a switch which connects the detector to the supply voltage. The oscillator frequency is not critical and runs at a few hundred hertz.

In practice a 0·5Ω resistor is connected in series with the sensor to reduce the peak current and increase circuit flexibility. This somewhat lowers the overall efficiency but is worthwhile. The inclusion of this resistor modifies the drive requirement for the sensor. The equivalent circuit is now a 0·5Ω resistor, the detector and TR4 in series across the supply.

Ignoring TR4 $V_{sat}$ the voltage across the detector now becomes 8V providing a peak power of 32W. This gives a mark/space ratio of 42 : 1. Thus total battery drain, maximum current divided by the mark/space ratio is 0·095A.

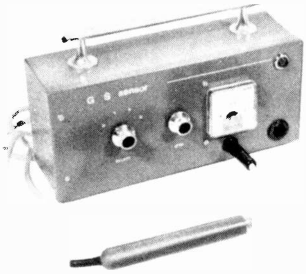
For this current approximately 0·025A should be added to allow for circuit operation. Thus the total requirement is 120mA.

The capacitor C1 supplies the high current pulses required during the time when TR4 is conducting. When TR4 is off C1 charges from the supply transistor TR5.

## BATTERIES

If the completed unit is to be used as a portable instrument it may be powered by heavy duty HP11 batteries. The gas concentration meter can also double as a voltmeter which may be switched to monitor the supply. To allow the sensor to be used as an alarm its performance must be predictable, even if the supply voltage changes. For this reason a power regulator circuit is recommended.

Due to the long mark/space ratio required, a high current consumption is normally drawn by the multivibrator which reduces circuit efficiency. To overcome this problem TR1 is included to give extremely rapid charging of C2. During the time when TR2 is conductive, C2 turns off TR3, the collector of TR3 is therefore at full supply potential. Supply is placed on the base of TR1 via R4, making it non-conductive and R1 is now the feed resistor for TR2.



# PORTABLE GAS/SMOKE DETECTOR

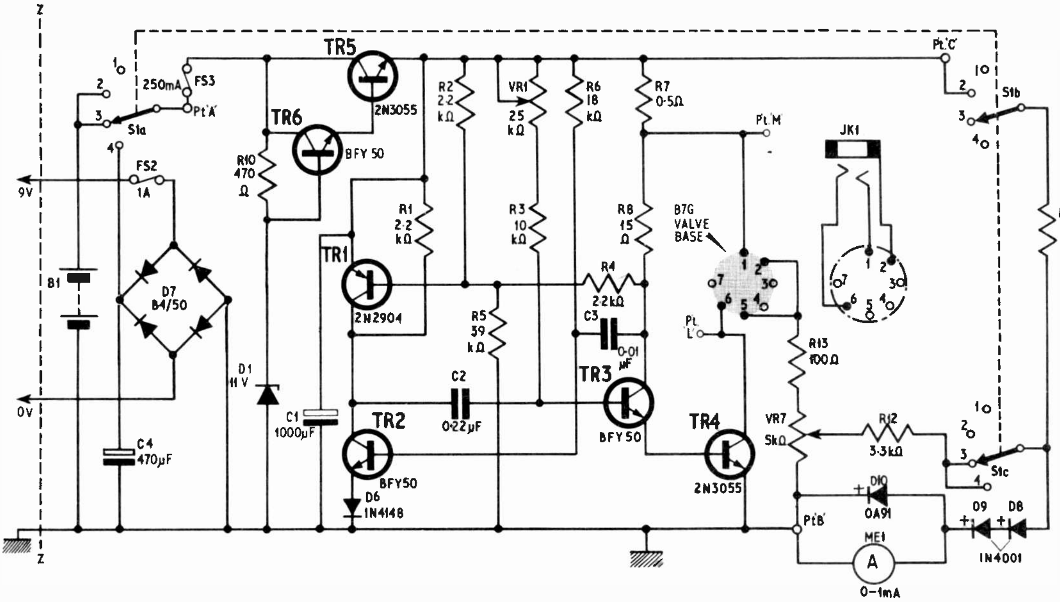



**Fig. 4. The portable battery/mains detector using a plug-in head which connects with the instrument via a stereo jack plug and socket**

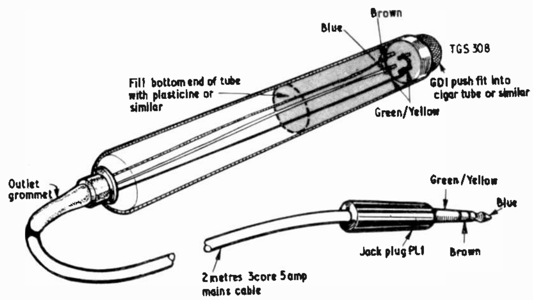



**Fig. 5. Detector head made up from an old cigar tube, mains lead and stereo jack plug**

## COMPONENTS . . .

| | | | |
|---|---|---|---|
| R1 | 2·2kΩ | R7 | 0·5Ω 4W |
| R2 | 2·2kΩ | R8 | 15Ω |
| R3 | 10kΩ | R10 | 470Ω |
| R4 | 2·2kΩ | R11 | 9·1kΩ |
| R5 | 39kΩ | R12 | 3·3kΩ |
| R6 | 18kΩ | R13 | 100Ω |

All $\frac{1}{2}$W unless otherwise specified

**Potentiometers**
VR1 25kΩ pre-set
VR7 5kΩ Lin.

**Capacitors**
C1 100μF, 25V
C2 0·22μF
C3 0·01μF
C4 470μF, 25V

**Diodes**
D1 11V, 400mW Zener
D6 1N4148
D7 B 4/50 Bridge rectifier
D8 1N4001
D9 1N4001
D10 OA91

**Transistors**

| | | | |
|---|---|---|---|
| TR1 | 2N2904 | TR4 | 2N3055 |
| TR2 | BFY50 | TR5 | 2N3055 |
| TR3 | BFY50 | TR6 | BFY50 |

**Miscellaneous**
GD1 TGS308
M1 1mA moving coil meter
S1 3-pole 4-way selector switch
F2 1A mains fuse
F3 250mA fuse
Printed circuit board, batteries and holder, case AB17, 10 × 4·5 × 3in, Bulgin 1·5A chassis plug, socket, knobs, fuseholders, stereo jack PL1 and socket JK1, and power supply section from Fig. 1.

# MASTER PRINTED CIRCUIT BOARD

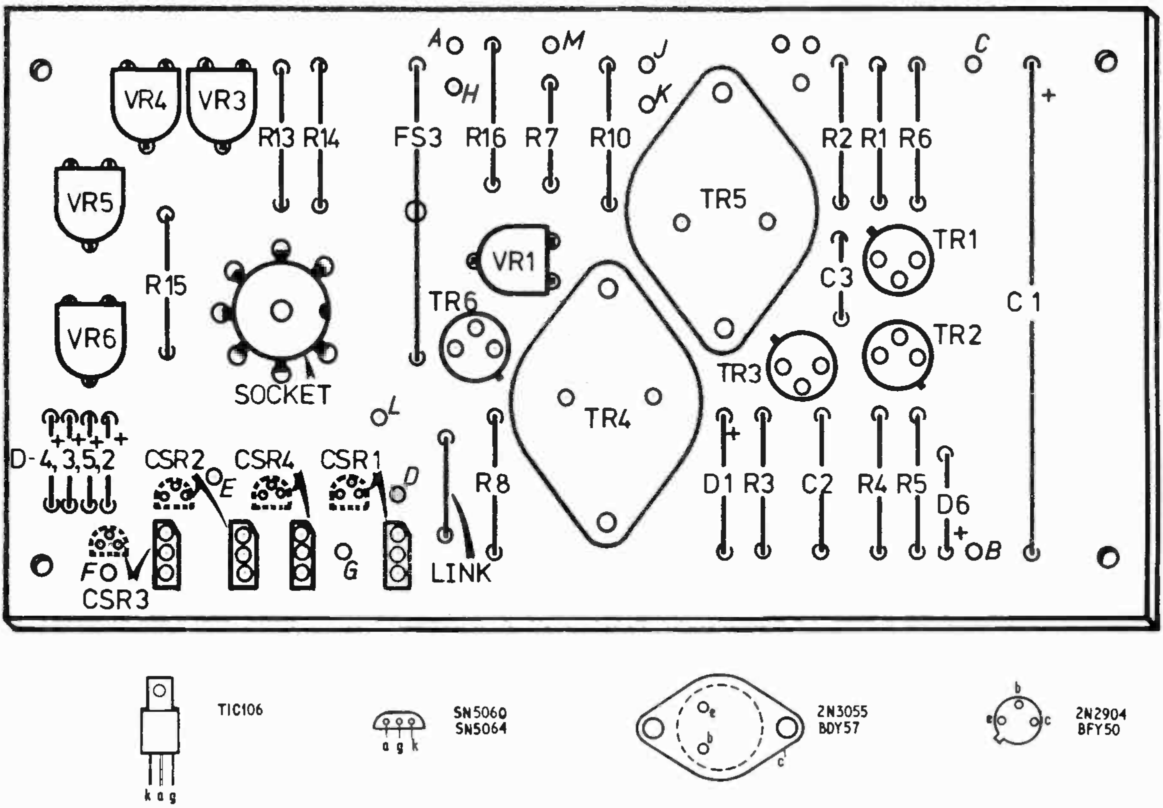



**Fig. 7. Printed circuit board component layout suitable for all versions**

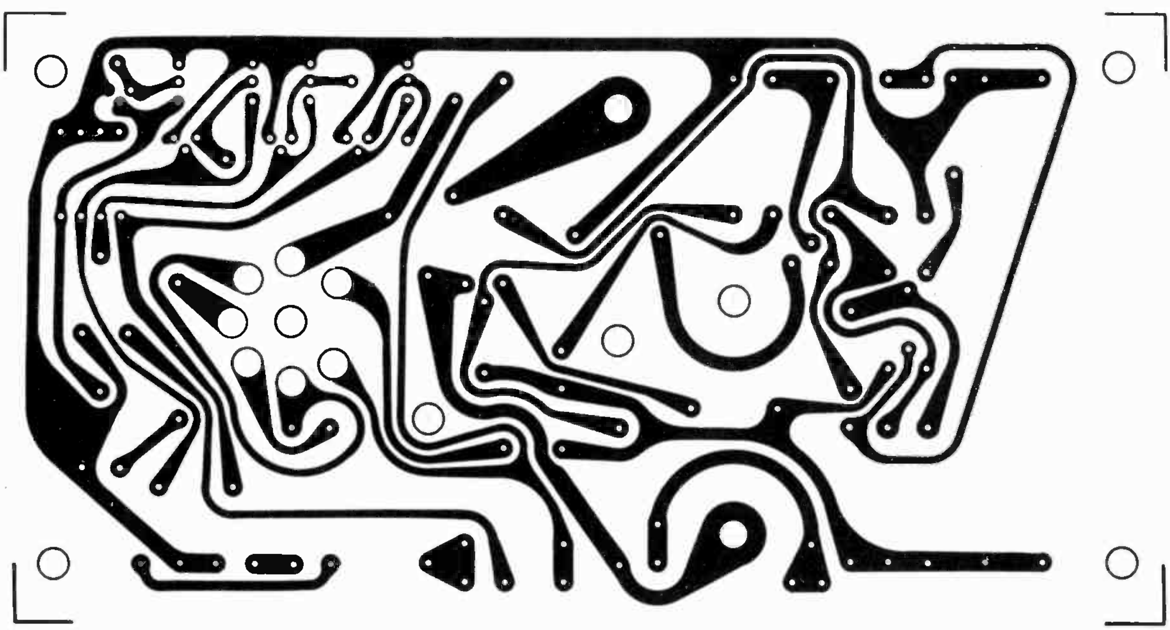


**Fig. 8. Printed circuit master (full size) suitable for all versions of the gas/smoke sensors**

As C2 discharges through R3-VR1, TR3 comes into conduction and the collector voltage falls. This falling voltage via C3 turns off TR2, at the same time the voltage on the base of TR1 is reduced, which causes TR1 to saturate; this connects the left hand side of C2 to the supply line, causing it to rapidly charge. The circuit will remain in this condition until C3 discharges through R6.

The output of the oscillator is taken from the emitter of TR3 to ensure sufficient drive to make TR4 saturate. Waveforms for the circuit are given in Fig. 6 and details of the head mounting are in Fig. 5.

## INDICATION

The meter ME1 is driven from the slider of VR7, the sensitivity attenuator control. Overall sensitivity is set by the value of R13. Two diodes D8, D9, in series with the meter allow a suppressed zero effect to be obtained without attenuation of the signal and D10 provides some degree of overload protection for the meter.

Switch S1 provides four switch functions. Position 1 is off. 2 allows the regulated supply voltage to be measured, normally 9·5V on load. Position 3 allows the instrument to run from the batteries, and position 4 is for use from the mains. Note that it is not possible to turn off mains power without removing the plug from the front panel. Connection to the mains is indicated by the neon lamp LP1.

## CONSTRUCTION

Any well ventilated case may be used to house the circuit of Fig. 2, and the components may be mounted on tag strip. The thyristor CSR1 is suitable for alarm currents up to 0·8A.

The prototype of Fig. 3 is shown built inside an AB17 case, the circuit built on Veroboard, part of which is fixed to the rear of the meter.

A printed circuit layout is shown (Figs. 7 & 8) of the portable version of Fig. 4, for those people who like to make their own p.c.b. The board holds most of the components. The attenuator control (pre-set) should be left off the board, taking two wires from the board to connect to the remote 5kΩ pot on the front panel.

The p.c.b. has room for extra components not listed for this circuit. These are made use of in further versions. In addition, the p.c.b. can accept two sizes of thyristor, the TIC 106 and the 2N5060 to 2N5064 series. The former will switch up to 4A with a sink whilst the latter will only cope with lamp circuits up to about 0·8A. Clearly the constructor may decide which he prefers to use dependent on external loads he might wish to apply.

Wiring details of some of the off-board components is shown in Fig. 5. The jack socket must be of the insulated type to avoid supply to chassis shorts as this may well destroy the detector.

The latter is fitted into a discarded cigar tube and should be a good push fit. A hole drilled in the other end allows the 5A, 3-core cable to enter. A rubber sleeve must be fitted to stop cutting of the wire. As the cigar tube is very light, Plasticine may be added to the inside to give the unit a better balance.

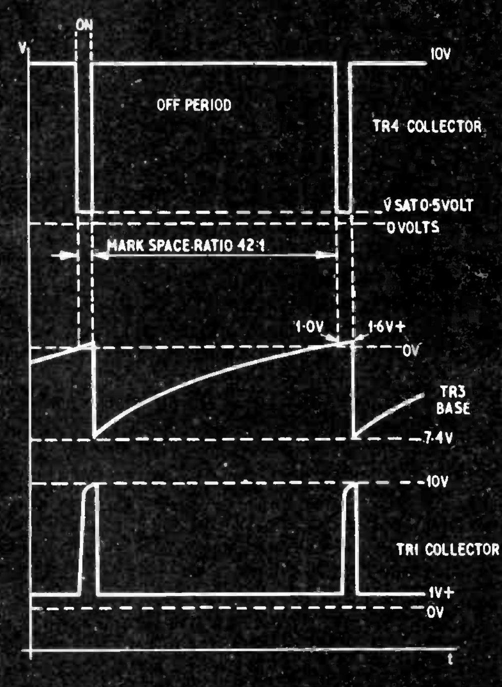
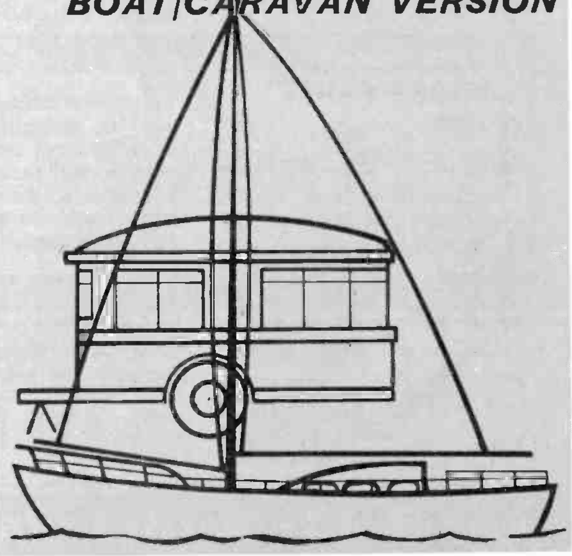



Fig. 6. Waveforms appearing at various points in the circuit of Fig. 4.

Ensure that both the lid and the case are correctly earthed to the earth pin of the mains socket. If required an l.e.d. circuit may be added to the unit, to give warning of inadvertently leaving the device switched on. This will, however, increase battery drain current by approximately 10mA.

**NEXT MONTH:**
***BOAT/CARAVAN VERSION***



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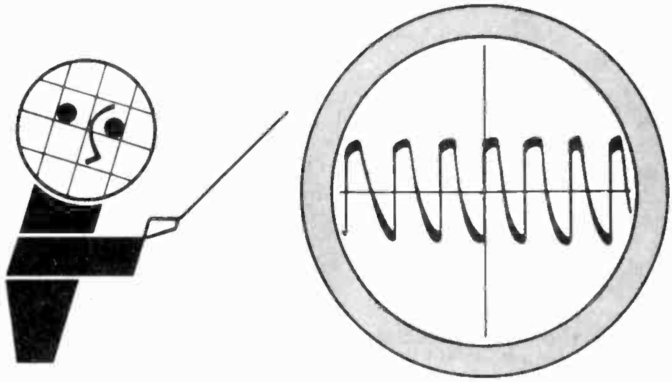

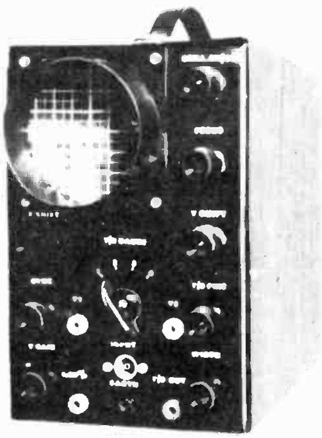

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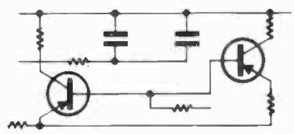

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# INDUSTRY NOTEBOOK

*By Nexus*

## MOBILE THOUGHTS

The Chairman of the Mobile Radio Committee of the Electronic Engineering Association, J. R. Brinkley, as well as being Managing Director of Redifon Telecommunications Ltd., is no mean hand at deploying an argument. At the recent Communications 74 Exhibition and Conference at Brighton he gave some startling statistics on what it costs to run Europe's road transport and how much could be saved if the 90 million vehicles all had two-way radio.

The UK share of this mammoth fleet is 16·5 million vehicles which have an annual running cost, excluding manpower, of £8,000 million. This, says Brinkley, is equal to the total revenue from income tax or twice the national defence budget or three times the cost of the national health service. So even a one per cent saving would yield £80 million and a ten per cent saving £800 million.

He argues that the 200,000 vehicles already fitted with radio-telephones in the UK give them a 20 per cent edge on efficiency compared with unfitted vehicles. In other words four vehicles fitted with radio will do the work of five without. But to date, only one per cent of all vehicles are so fitted and these generally work privately with their own base stations in a small radius of 10–20 miles. What is really needed is a sort of national grid with all vehicles being tied in by radio to the public telephone network.

Such schemes are already being planned in the USA with adequate frequency allocation in the 900MHz region. We use this band partly for TV in Europe but Brinkley sees the present Band III 405-line TV allocation, due to close down in the UK in five years' time, as a promising alternative.

Of course, we already have a public system but costs are relatively high. A mammoth increase in utilisation would bring prices tumbling down. To equip, say, ten per cent of all cars would mean big production lines with consequent economy of scale which would be expected to result in a rental charge per vehicle of £2 a week, plus calls charged on a time basis. With petrol at over 50p a gallon and time in excess of £1 per hour the system could be a bargain for the user.

Meantime, the mobile radio market is still running at 15 per cent growth rate. Pye, the brand leader in the UK, has been pushing exports with a floating exhibition and seminar on the River Rhine taking in France, Switzerland, Germany and the Netherlands. There is no nicer way of doing business and the trip netted over £500,000 of orders confirmed with the prospect of more to come.

## CONSUMER ICs . . .

The Philips Group is determined to consolidate its leading position in consumer i.c.s. No less than 26 new devices, most of them of considerable complexity and all real state-of-the-art are due for production next year and will be in TV, radio, hi-fi and tape equipment from then on.

To get set manufacturers acquainted with the new circuits Philips invited 300 engineers from 13 countries for a full-scale seminar in Eindhoven. Sixteen of the new circuits are for TV and ten for radio/audio equipment.

The designs are truly international and originate from Mullard experts in the UK and from Philips' men in Holland and Germany. Production technology is to be that already proven on the existing range so there should be big yields (therefore, low prices) from the start, but the chips are larger to accommodate many more functions.

The philosophy behind the new circuits is mainly to reduce the number of external peripheral components and the number of factory adjustments. For example, on a typical colour TV, Philips say the number of peripheral components can now be halved from 320 to 160 and the adjustments reduced from 20 to 10.

It's hard to pick out specific examples but typical of the new thinking is a complete recorder using only three i.c.s. One has the pre-amplifier, level control and recording and playback amplifier, another incorporates motor speed control, automatic stop, and erase oscillator, and the third the complete power amplifier.

More circuits are in development including one for search tuning in which a band of frequencies is electronically scanned and each receivable station is given 1·5 seconds playing time so that the listener can have a quick listen to see what programmes are on offer.

## . . . AND AVIONICS

With Philips so strong in consumer electronics it is only too easy to forget the Group's potency in professional equipment and not least in avionics. The Group is planning a major sales drive at the Farnborough Air Show next September with no less than seven companies based in the UK, Holland, France, Sweden and Canada taking part.

The British effort from MEL at Crawley includes airborne weather and ground-mapping radars for civil use and the very advanced tactical radar fitted in Sea King helicopters of the Royal Navy and a number of other navies. On the ground MEL scored a big hit with MADGE, a NATO award-winning portable microwave tactical approach aid and then, of course, there is direct involvement with the Clansman project where MEL is responsible for transmitter/receivers in the range 1·5–30MHz with powers up to 400 Watts.

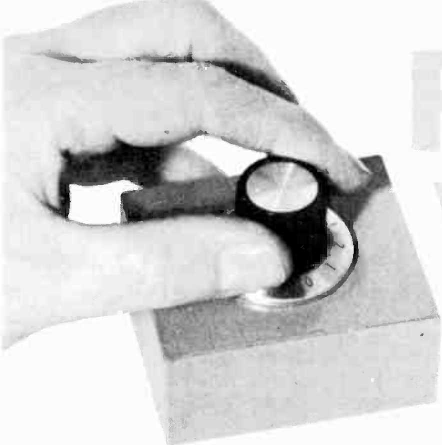
Quite apart from selling individual pieces of equipment Philips has both the economic and technical strength to undertake large turnkey projects. One of these is for Zaire where 40 airfields are involved for a contract price of £35 million.

## ENERGY

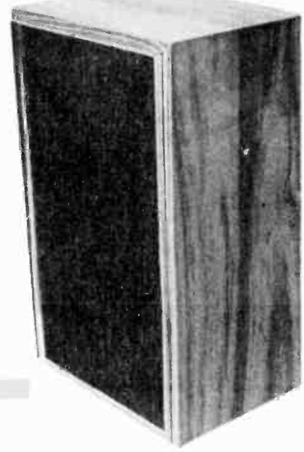
At the turn of the year we were all sick with fear over the energy crisis. Now it seems we have slipped back into easy acceptance that provided we pay over 50p a gallon for petrol and, perhaps, £40 a ton for coal we shall remain mobile and warm and in business. I think this is a poor attitude, probably encouraged by the prospect of North Sea Oil. We should still be looking for economies.

An exciting development is the electric bicycle for which Cambridge Consultants contributed the idea of an electronic throttle working on pulse width modulation to give smooth speed control without recourse to gear changing.

Radius of action is 20 miles (i.e. a 40 mile round trip) before re-charging which costs about 2p. With pump petrol selling at 50p this gives personal mobility at an equivalent of 1,000 m.p.g. with the added bonus that there is no exhaust fume pollution of the atmosphere.



# REMOTE VOLUME CONTROL



**BY R. WHITAKER**

***A WIRED-IN SYSTEM WITH MANY APPLICATIONS***

THIS design was developed to give a method of balancing a stereo amplifier from a distance but in fact it has many other uses. In particular it can be used when testing other circuits with a general purpose amplifier as the amplifier volume control may be placed close to hand. The circuit is remarkably simple and is fairly cheap to construct.

## DESIGN CONSIDERATIONS

The circuit uses a field effect transistor (f.e.t.) in a conventional amplifier stage. The characteristics of an f.e.t. are shown in Fig. 1 and it can be seen that the slope or gradient of the graph of $I_d$ or drain current against $V_{gs}$ or gate voltage varies according to the value of the gate-source voltage $V_{gs}$. This is the basis of the remote operated volume control.

In fact the slope of the graph is called the $g_m$ or the mutual conductance of the f.e.t., a term borrowed from valve technology.

If we look at the basic f.e.t. amplifier circuit shown in Fig. 2 then the voltage gain can be shown to be $g_m \times RL$. Thus by varying $V_{gs}$, $g_m$ is changed and so the gain can be varied.

One way of varying $V_{gs}$ is to make R2 variable since the voltage drop across R2 is in fact the way in which $V_{gs}$ is produced. The current through R2 depends on $V_{gs}$ and this means that $V_{gs}$ can never be made to be $V_p$ the pinch-off voltage of Fig. 1. This means that the volume cannot be faded to zero but only to a very low lovel. To overcome this, a potential divider is used for R2 and in this way $V_{gs}$ can be varied from 0V to $V_p$ or even higher to ensure cutoff.

## THE CIRCUIT

The circuit has only two main design criteria. The first is to decide the working point A of Fig. 1.

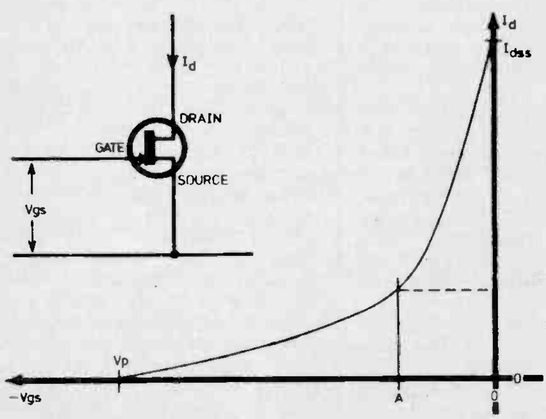



**Fig. 1. The characteristics of an f.e.t. and the circuit symbol of the device**

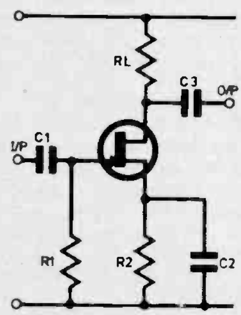



**Fig. 2. A basic f.e.t. amplifier**

## COMPONENTS

**Resistors**

| | | | |
|---|---|---|---|
| R1 | 2·2MΩ Metal Oxide | R3 | 2·2kΩ (5·6kΩ for 2N3819) |
| R2 | 100kΩ Metal Oxide | R4 | 270Ω |
| All ¼ or ⅛W, 5% carbon | | R5 | 56kΩ (6·8kΩ for 2N3819) |

**Capacitors**

| | | | |
|---|---|---|---|
| C1 | 0·01μF | C3 | 100μF |
| C2 | 0·01μF | C4 | 0·01μF |

**Transistors**

TR1 BW42 or 2N3819 (Most n-channel f.e.t.s suit on selection)

**Potentiometer**

VR1 10kΩ linear carbon

**Miscellaneous**

Veroboard, wire, screened cable for feed, cable to VR1, suitable mono or stereo jack plug and socket

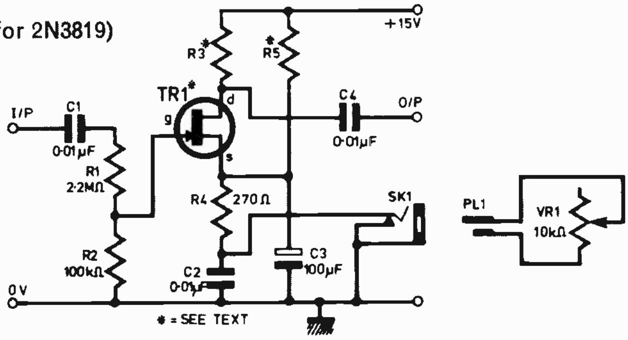
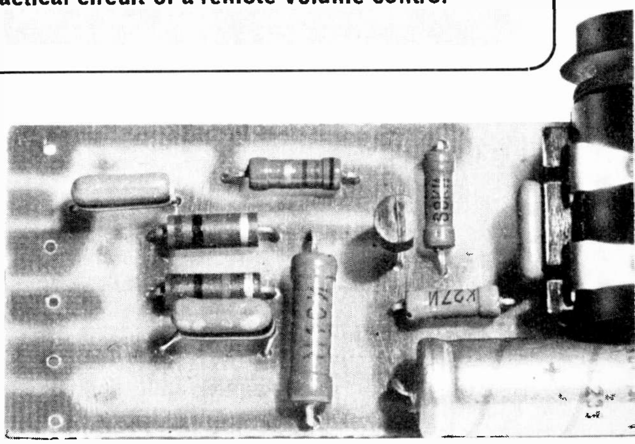



**Fig. 3. Practical circuit of a remote volume control**



The second is to make sure that the potential divider can produce a high enough voltage to turn the f.e.t. off.

Looking at Fig. 3, a practical version of the control circuit, the resistors R1 and R2 form the input impedance of the amplifier and also reduce the amplitude of the input so that there is slow distortion in the circuit. R3 is chosen so that the gain of TR1 makes up for the loss due to R1 and R2 giving a circuit with a voltage gain of one when it is not acting as an attenuator.

Thus the circuit can be inserted directly into a reproduction chain without any loss.

R4 is used to set the maximum drain current (i.e. point A on Fig. 1) and VR1 is used to alter the gain. At VR1 = 0Ω the gain is maximum and at VR1 = 10kΩ the f.e.t is cut off. C2 is used to short circuit high frequencies which may be picked up on the leads to VR1. C3 is a bypass capacitor and its value determines the low frequency gain of the amplifier. R5 together with VR1 and R4 set the maximum voltage at the source of the f.e.t. to ensure it is cut off.

This circuit, using a BW42 *n*-channel f.e.t., has a flat frequency response from below 20Hz to about 10kHz and is 3dB down at 20kHz. It has a high input impedance and a relatively low output impedance. Indeed the author's prototype used two such circuits as a remote stereo volume control. The resistor VR1 was chosen at 10kΩ to give a voltage swing at the source of the f.e.t. of 0·6V to 1·6V since the devices selected had a pinch-off voltage $V_p$ of 1·6V.

In fact f.e.t.s do have a rather large spread of $V_p$ from one device to the next, even of the same type number. 2N3819s could be used, but the ideal thing would be to plot the $V_{gs}$, $I_d$ characteristic for a device which you have and then alter the circuit to suit.

### DESIGN PROCEDURE

The design procedure is simple. First of all the characteristic of the devices to be used is plotted using the circuit shown in Fig. 4. Only one meter is needed really although two are shown.

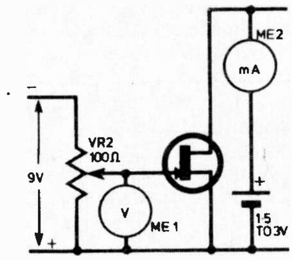



**Fig. 4. Circuit used to determine the $V_p$ of an f.e.t. for use in the remote control, and associated component values**

First set the voltage, then measure the current for several values of voltage. It might be as well to first vary VR2 until no current is read on the meter ME2 then bring VR2 back to just where the current begins to flow. Measure this voltage, it is $V_p$.

Choose a suitable working point A considering that the gain does not vary over straight parts of the graph. Calculate R4 to drop the value of $V_{gs}$ chosen. Select R3 to give the required gain, bearing

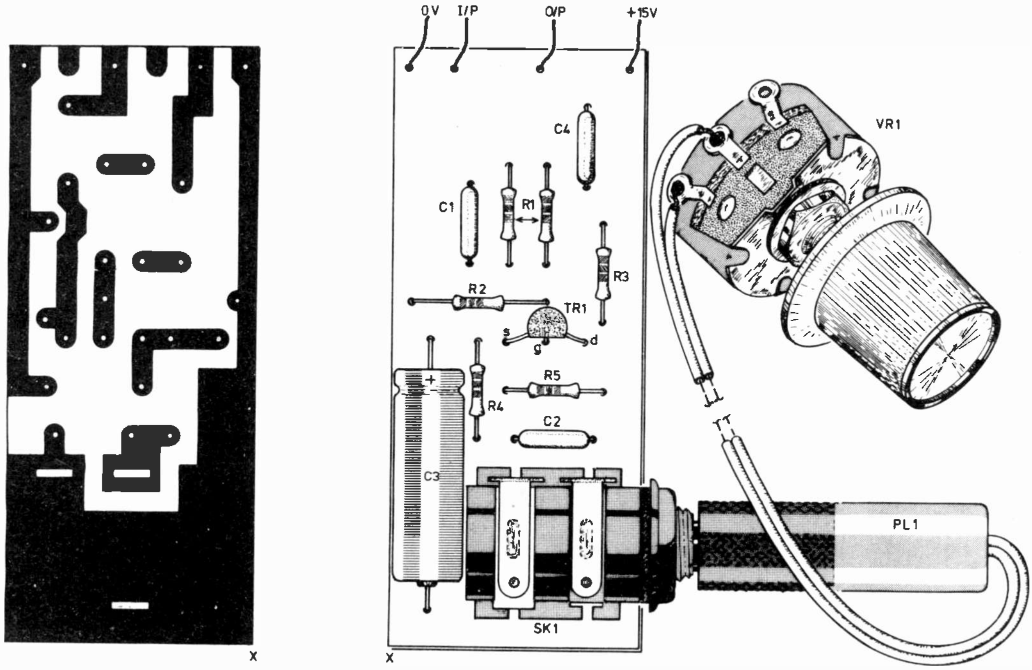



**Fig. 5. Printed circuit pattern (full size) and component layout for the remote volume control**

in mind the earlier comments on unity gain. $g_m$ can be found from the tangent to the graph at the working point, then gain = $g_m \times RL$.

Make certain that RL does not drop so much voltage that there is less than 3V across the drain and source of the f.e.t., remembering that R4 will be dropping some voltage (i.e. $V_{gs}$ chosen).

Since at cut-off the drain current $I_d$ is zero, choose the value of VR1 and R5 to give a voltage greater than $V_p$ at their junction. The only current flowing in them at this time will be that through them. None flows through the f.e.t.

It is suggested that the same values of R1 and R2 as in Fig. 3 be used as they are suitable for inputs of up to 1V r.m.s. Also, use the same capacitor values.

## VOLTAGE CONTROL

The circuit can in fact be voltage controlled by applying a variable voltage from 0·6V to 1·6V in place of VR1. This could form the basis of a talk-over circuit for a discotheque or an automatic fader.

The leads to VR1 can be as long as required and do not have to be screened.

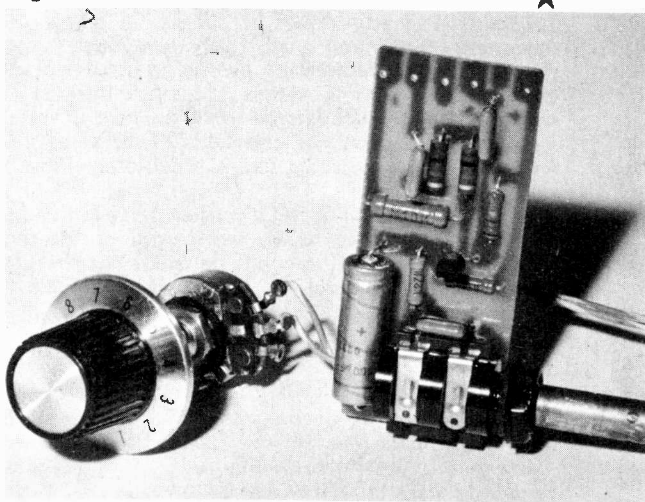
The prototype used a stereo switching jack to connect the control into the amplifier with the two control circuits mounted in the amplifier and powered from its supply. The amplifier controls can be used to preset maximum volume. The jack contacts were arranged so that the gain was 1 when the jack was unplugged.

The circuit works well, but if two are to be used for stereo then it is best to get two matched f.e.t.s.

## CONSTRUCTION

Each circuit was constructed on a printed circuit board, see Fig. 5. Layout is not critical, but the leads to R1 should be screened since the input impedance is high. The f.e.t. should be soldered in last so that it has least chance of being affected by the heat of soldering.

Two values of some components are given in the components list. The first is for use with a BW42 device and the second for a 2N3819. The single values are common to both circuits. The 2N3819 version exhibits a slightly lowered performance, being 3dB down at 25Hz. ★



# PATENTS REVIEW...

## IMPROVING TREBLE CONTROL

In BP 1 337 284 from General Electric Co of New York is a typical British patent specification of USA origin. For legal reasons in the States it is essential for every last nut, bolt and blob of solder to be described in minute detail and for convenience the same text is often used for both countries. This makes for tedious reading and difficulty in sorting out where the novelty of the real invention lies, but it also provides masses of detailed background information.

The GEC patent concerns modifications in treble tone control circuits for audio amplifiers and to highlight the modifications, the inventors first of all describe and draw a conventional audio amplifier (complete with component values) for which no patent protection is claimed.

Although bass tone control, contour or loudness circuit, bass boost circuit and a volume control all operate exactly as in conventional amplifiers, the main difference and invention lies in the treble tone control circuit, see Fig. 1.

The mid-band attenuation has been reduced and the emitter bypass circuit, shown dotted in Fig. 1, is removed. The modified treble control circuit includes capacitors C1, C2 and C3.

When the wiper of the treble control potentiometer is at minimum, capacitor C1 effectively shunts to provide treble cut. When the wiper is at maximum, the shunting effect of C1 is minimised and treble frequencies are boosted. Also, when the wiper is at maximum, C2 passes h.f. audio signals and an additional path for these components is provided, via C3, to boost treble when the volume control is below maximum.

When the treble tone control is turned towards its minimum position, not only is the shunting effect of C1 increased to provide high frequency roll-off but also the treble boosting effect of the capacitors C2 and C3 is reduced.

Graphs are given to show how control of this type can have considerable effect on the upper frequencies, including a 4dB increase between the maximum and minimum treble settings over conventional circuits at 10kHz and a 5dB increase at 20kHz.

### BP 1 337 284

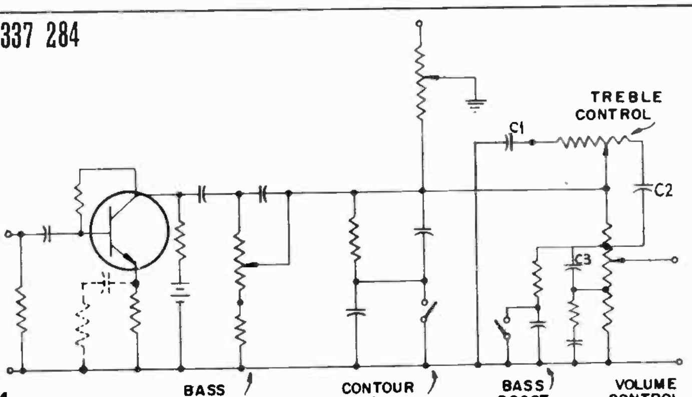



Fig. 1.

## TEMPERATURE SENSITIVE OSCILLATOR

A clever use for a threshold glass switch is described by Standard Telephones and Cables in BP 1 341 172. The switch is constructed by embedding a pair of conductive wires in a bead of vitreous material, the device switching to conduction when a critical voltage is exceeded and returning to a high resistance state when the current is reduced below a critical holding current.

In the simple circuit of Fig. 1 C1 is charged from a constant voltage supply via VR1. When the voltage across the capacitor reaches the switching voltage of the glass switch S1, the capacitor discharges through it. The discharge continues until the current through the switch falls below the critical holding current. The switch then returns to its high resistance state and the next charge/discharge cycle commences.

In the graph of Fig. 2 the voltage waveform across the switch at a given temperature is represented by (A), the switching voltage being $V_1$. The voltage at which the current through the switch falls below the critical holding current varies only slightly with temperature, but the critical voltage varies significantly. Thus if the temperature of the switch is raised the critical voltage falls to $V_2$ (Fig. 2) and the voltage across the switch produces the higher frequency waveform (B).

In practice the error due to changes in value of the R/C components with temperature are small compared to the significant change per degree centigrade.

The circuit may be arranged so that at 37 degrees centigrade (body temperature) the frequency of the waveform is 10kHz. If the output of the circuit is compared with a 10kHz locked frequency signal (e.g. from an oscillator) then an audio frequency signal can be generated as a beat frequency as the temperature of the switch is varied up or down from 37 degrees centigrade. In this and other ways the circuitry may be used to signal changes of temperature around a notional norm, such as the 37 degree centigrade level. The adjustment necessary at resistor VR1 to zero the beat can be used to indicate the temperature change that has occurred.

### BP 1 341 172

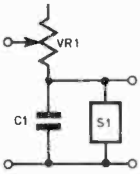



Fig. 1.

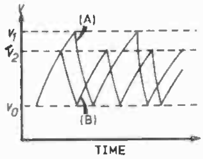



Fig. 2.

Copies of Patents can be obtained from the Patent Office Sales, St. Mary Cray, Orpington, Kent. Price 25p each

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# A complete kit!

The kit comes to you packaged in a heavy-duty polystyrene container. It contains all you need to assemble your Sinclair Cambridge.
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Contents:
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3. Interface chip.
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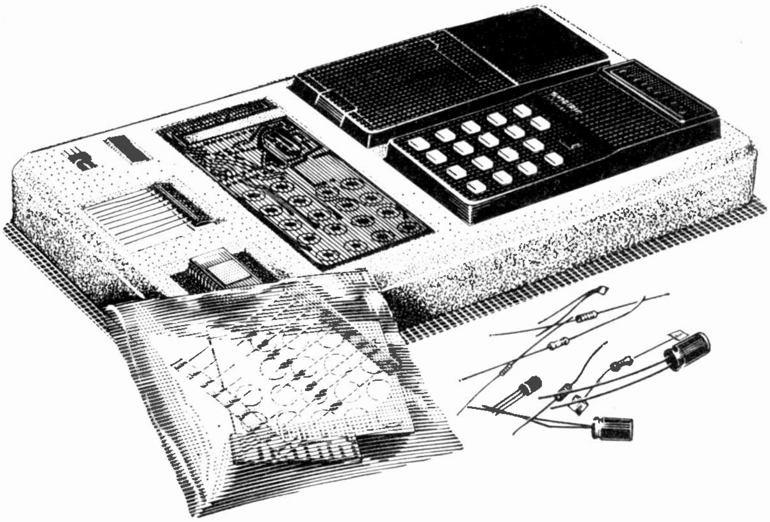

**This valuable book – free!**
If you just use your Sinclair Cambridge for routine arithmetic – for shopping, conversions, percentages, accounting, tallying, and so on – then you'll get more than your money's worth.

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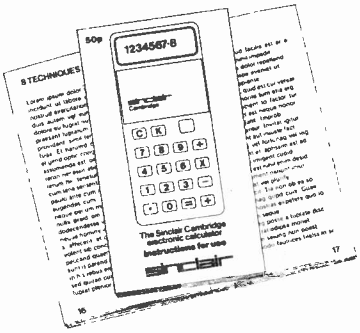


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The reason's simple: only Sinclair – Europe's largest electronic calculator manufacturer – have the necessary combination of skills and scale.

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

But that in itself wouldn't be enough. Sinclair also have a very long experience of producing and marketing electronic kits. You may have used one, and you've almost certainly heard of them – the Sinclair Project 80 stereo modules.

It seemed only logical to combine the knowledge of do-it-yourself kits with the knowledge of small calculator technology.
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**Take advantage of this money-back, no-risks offer today**
The Sinclair Cambridge is fully guaranteed. Return your kit within 10 days, and we'll refund your money without question. All parts are tested and checked before despatch – and we guarantee a correctly-assembled calculator for one year.

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**Price in kit form: £13·59 + £1·36 VAT. (Total: £14·95)**
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# MARKET PLACE

Items mentioned in this feature are usually available from electronic equipment and component retailers advertising in this magazine. However, where a full address is given, enquiries and orders should then be made direct to the firm concerned. All quoted prices are those at the time of going to press.

**Tourist II Car Radio from R&TV Components**

## CAR RADIO KIT

It is unfortunate that this magazine cannot make awards to manufacturers for designs and service to readers' interests. If we did then **Radio & TV Components Ltd.** would certainly be top of our list for service to readers and probably very close to Sinclair's for top honours for design.

Although R&TV have had tremendous success with their unit audio systems and car radio kits, they have decided that because some of their clients are not too hot on soldering a new range of "solderless" units is required.

The first of these items is the Tourist Two car radio which dispenses entirely with soldering in its construction. Instead, all electrical connections are made through press-on tags and it is claimed that the kit can be assembled in less than two hours by any "do-it-yourselfer".

By utilising an integrated circuit and a printed circuit board allied to tested sub-assemblies, construction is simply a matter of fixing the various component assemblies to the chassis using the screws provided, and completing the electrical circuit by means of colour coded press-on tags.

The Tourist Two radio has five pushbuttons which can be tuned to any preselected station. Four of the buttons operate on the medium band and the other on the longwave band. The finished radio will slot into the standard car radio aperture.

The technical features of the kit include permeability tuning and longwave coils to ensure good sensitivity and selectivity on both wave bands. The r.f. sensitivity at 1MHz is claimed to be better than 15$\mu$V and the power output into 3 ohms is claimed to be 4W. The output stage is short circuit proof for added safety.

Both the i.f. module and tuner are pre-aligned and the kit is suitable for 12V positive or negative earth operation.

Complete with step by step instructions, including details for installing in the car, the Tourist car radio is available by post or direct from Radio & TV Components Ltd., 21 High Street, Acton, London, W.3, price £7 plus VAT. Postage and packing is 55p.

Additional extras include a speaker with baffle and fitting strips, £1·65 plus 23p postage and packing, and a matched fully retractable locking aerial, £1·37 plus 20p postage and packing.

## DIGITAL ALARM CLOCK CHIP

Readers who like to experiment with clock circuits may find a new integrated circuit chip available from **Sintel** of particular interest.

Known as the Mostek MK5025ON, the 28-pin device may be used to construct a 24-hour digital alarm clock, with the addition of only a single power supply, display and standard interfacing components.

Special features of the device are that when the "snooze" button is operated it will temporarily turn off the alarm signal to allow an additional 10 minutes' sleep. The "bleep" alarm is generated within the chip and there is no need for an external oscillator circuit.

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**CHANGE IN VAT**

Owing to the change from 10 per cent to 8 per cent in the rate of VAT, occurring as this issue closed for press, it has not been possible to alter all prices shown in advertisements.

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If a low house voltage condition occurs, the a.m./p.m. indicator will flash at a 1Hz rate to signify an incorrect time display.

The 6-digit multiplexed outputs make the chip compatible with gas discharge or l.e.d. displays. An additional facility allows the use of an economical 4-digit display, hours and minutes, to be used if required.

The cost of the MK5025ON is £8·36 including VAT and full technical details can be obtained from Sintel, 53 Aston Street, Oxford, OX4 1EW.

## DISCO CONSOLES

It is well known that noise is debilitating. With many discotheques distortion components generated through poor equipment can contribute to this unmusical sound providing cumulative discomfort.

With this in mind it is nice to record a new range of disco consoles from **Citronic Ltd.**, with a hi fi specification. The Stateline range includes one mono and three stereo units covering a basic range of 75 to 150W r.m.s.

A feature of the consoles is the modular assembly typified in the four and six channel mixer/preamplifiers which can, in fact, be purchased as separates.

The power amplifier module provides a basic 75W r.m.s. which is compounded to provide the high outputs.

Top of the Stateline range is the Texas console which, in its quadruple amplifier configuration, is believed to be the most powerful self-contained disco unit on the U.K. market, giving 300W r.m.s. or approximately 500W music power. The Texas is equipped with two standard or transcription quality record decks and a cassette tape unit. If required an eight-track cartridge player may be incorporated as well. The Iowa, five inches shorter and without the option of quadruple amplifiers, may also include a cartridge unit.

At the lower cost end of the range the Delaware and Kansas units, mono and stereo respectively, have two record decks and give 75W mono or 150W as the stereo equivalent. The Delaware also has a dual-amplifier option.

Other optional extras include the stand, transcription quality record decks and electronic lighting effect control units.

Information and price list of the complete range of Stateline consoles may be obtained from Citronic Ltd., Melksham, Wilts.

## PRINTED CIRCUIT KIT

A new professional printed circuit kit, providing all the necessary tools and equipment for producing good prototype printed circuits quickly, efficiently and at an economic price, has been introduced by **GSPK (Electronics) Ltd.**

Ideal not only for the electronics enthusiast but for engineers and students, it is claimed that a complex circuit board layout can be produced in a few minutes.

The Professional Kit contains six pieces of single sided laminate, a box of etchant, measuring scoop, steel rule, cutting knife, hand drill, etchant dish and printed circuit board marking pen.

Available from GSPK (Electronics) Ltd., Hookstone Park, Harrogate, Yorks, each kit contains full instructions and the recommended retail price is £8·40 including VAT, postage and packing being extra.

**Stateline Iowa Disco Console from Citronic**

# Readout—
## A SELECTION FROM OUR POSTBAG

**Readers requiring a reply to any letter must include a stamped addressed envelope. We regret that we cannot answer any technical queries on the telephone.**

## Professional manner

Sir,—Mr. Kitchen's recent letter under the heading "Good Olde Days" (*Readout*, July), expresses sentiments which have been expressed by every generation on all matters.

Mr. Kitchen obviously enjoyed messing around with, and being bitten by those frightful, hot, glass bottles which imposed appalling restrictions on any constructor, but he must be very naive to think that all the fun has gone. The proof that there are a very large number of constructors, who I assume enjoy their hobby, is the very existence of *Practical Electronics* and many other magazines.

The advantages that transistors and integrated circuits have brought us are numerous: ease of handling, lower dissipation, smaller size, improved performance, etc. These advantages have opened up new areas of design, which were not possible with valves, and present designs cover all facets of everyday life. I would agree that 10 or 20 years ago chassis had to be "bashed out", but I can assure Mr. Kitchen that there are many who still "bash their own chassis".

Construction has been simplified, in some respects, by printed wiring and other methods, and basic circuit design is probably dying, although i.c. manufacturers haven't got all the answers. In its place we build our own "tag-boards" using copper clad insulating board and ferric chloride (far more skilful than buying tag-boards and insulating pillars); and we have application design which requires as much skill as circuit design, as we firstly have to interpret the design data sheets, which use terms like "on-chip address decoding, tri-state outputs, slew rate, propagation delay", and secondly wonder why the 40 legged monster does its nut when we can see nothing in its input (35 nanosecond nasties can be a bit trying!)

I suggest Mr. Kitchen tries constructing a digital clock similar to the one described recently in P.E., but using techniques and components of 20 years ago. If he can get no enjoyment from constructing such a device using i.c.'s and on switch-on finding a mass of numbers rolling round then I pity him.

I think we should be thankful for present day technology in taking the shackles off us and allowing us to construct items which are not only rewarding to design and construct, but which can be useful and built in a professional manner.

Peter Seddon,
Rugby.

## Psycho . . .

Sir,—Regarding Mr. Watson's letter on "Psycho-sensitive semiconductors" and their possible existence (*Readout*, July) I would like to say how interested I was to read these comments, particularly as it takes us out of the superstition that P.K. (psycho kinetics) can only be effected from living being to living being. Though the latter is considered the most common, I am sure it is not the only method of proving the power of P.K., and I add to this the results obtained by Uri Geller, who is able to bend objects without even touching them! O.K., I know this is a matter of controversy among (so-called) scientists at present, but I venture to add that I am willing to accept the evidence.

I would venture to state that mind over matter is a fact, and that it operates at a sub-microscopic level, possibly at atomic level, which results in a cumulative effect to create perceptible consequences. At this time I have certain facts at my disposal which suggest that non-biological material is affected equally well as plant or animal cells, but I have to await certain results for my own satisfaction.

The point Mr. Watson mentions about molecules of magnetic material being affected by mind power may well be true, but I would prefer not to be as specific on this point for one good reason at least. Experimenters in the field of P.K. have so far indicated that they find the effect is not diminished by distance between "transmitter" and "receiver".

As we know from basics, magnetic effects, light and radio waves included, are subject to attenuation on an inverse square law with distance. Hence, one would expect one of two things to happen with distance. Firstly, as in the case of amplitude modulation, definition would be lost with increasing distance, or in the case of f.m. the effect may be sudden loss at a specific distance when carrier was lost into background noise. Secondly, if pulse-width modulation, or mark/space ratio modulation of some kind were used, the effect of distance would be greatly reduced, but again, a point should be reached where intelligibility would cease.

Nature uses a system similar to the latter in conveying information of an analogue type to muscles in the body, and it may be fair to assume a similar principle is involved in P.K. If so, it seems that distance has not defeated any known experiment as yet, unless the results of the Americans' space experiments in P.K. found that there was an attenuation. And it is unlikely that we shall hear much of those experiments . . . particularly if successful!

Meanwhile, it is surely up to all of us keen experimenters to delve deeper into the subject.

Brian H. Baily,
Dorset.

## . . . theory

Sir,—I have just read the letter by Mr. P. Watson in the July issue of P.E. I should like to point out to Mr. Watson that the head of the chlorophyll molecule will probably not be magnetic as it contains an atom of magnesium (Mg) not iron (Fe).

However, there are compounds present in the plant cell which contain an atom of iron, e.g. cytochromes. I do not, however, see the advantage the plant would gain in aligning itself up with the lines of force of the magnetic field. This does not disprove Mr. Watson's theory of a magnetic field interacting with iron containing molecules.

I would now like to put forward my own theory. There is a class of compounds present in plant cells which initiate movements in plants when they are acted on by certain external stimuli, e.g. light and water. These compounds are called auxins and the movements they produce are called tropisms. The plant has no control over these movements, once the auxins have been produced they begin to act. One such tropism known as geotropism occurs in plant roots, in this an auxin is produced in one side of the roots causing them to bend downwards towards the centre of the earth.

It is known that strong magnetic forces radiate from the centre of the earth, could not these magnetic forces cause a concentration in the lower side of plant roots causing them to bend downwards?

P. Crilly,
Reid Kerr College,
Paisley, Scotland

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| AC188 | 12p | BC158 | 12p | BF177 | 26p | MJE521 | 80p | 2N914 | 18p | 2N3708 | 9p |
| AD149 | 43p | BC159 | 14p | BF180 | 33p | MJE2955 | 90p | 2N930 | 18p | 2N3709 | 9p |
| AD161 | 33p | BC169 | 10p | BF181 | 33p | MJE3055 | 65p | 2N1131 | 18p | 2N3773 | 230p |
| AD162 | 33p | BC177 | 15p | BF184 | 22p | MPF102 | 40p | 2N1132 | 18p | 2N3819 | 22p |
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| AF116 | 16p | BC182 | 10p | BF195 | 12p | MPF105 | 36p | 2N1307 | 28p | 2N3905 | 15p |
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|---|---|---|---|
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| 1A | 20p | 25p | 25p |
| 2A | 30p | 45p | 45p |
| 4A | 48p | 60p | 70p |
| 6A | 50p | 78p | 100p |

## SCR-THYRISTORS

| | 30V | 50V | 400V | 600V |
|---|---|---|---|---|
| 0·5A | 25p | 31p | — | — |
| 1A | — | 35p | 48p | 60p |
| 3A | — | 40p | 55p | 65p |
| 7A | — | 60p | 84p | 110p |
| 16A | — | 70p | 100p | 120p |

## TRIACS

| | 30V | 50V | 400V | 500V |
|---|---|---|---|---|
| 800mA | 52p | 58p | — | — |
| 3A | — | 85p | 99p | 120p |
| 6A | — | 88p | 120p | 150p |
| 10A | — | 109p | 154p | 165p |
| 16A | — | 145p | 180p | 200p |

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| BY133 | 20p |
| BYZ10 | 35p |
| BYZ11 | 32p |
| BYZ12 | 30p |
| BYZ13 | 35p |
| 1N4001 | 5p |
| 1N4004 | 7p |
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| PL4004 | 10p |
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| OA70 | 8p |
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| Sinclair Super IC12 6W Amplifier | 2·20 |

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Ex-Pay TV. takes 10p pieces. has 3-digit mechanical counter. coin counter. Sangamo-Weston impulse movement. nylon gearing. switch. etc Only £1·20.

**DEKATRON UNIT**
Contains 2 CV2271 dekatrons. 2 4-digit electromagnetic resettable counters. 2 sealed relays. 2 ECC81. Rs. Cs. etc. £2.

**RESISTORS AND CAPACITORS**
500 assorted resistors £1·35. 2500 £4·70. 150 poly. ceramic. mica. etc capacitors 80p.

**PO AMPLIFIER UNIT**
Contained in steel case 5½in × 5in × 3½in are 2 × GET116 transistors on heat sinks. 3 pot cores. 2 30V zeners. 4 audio transformers. 1% resistors and caps With circuit diagram £1.

**7lb BARGAIN PARCELS**
Hundreds of new components—pots. resistors. capacitors. switches plus PC boards with transistors and diodes and loads of odds and ends. Amazing value at only £2·30.

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Contains mains transformer. 2A thermal cut-out and bridge rectifier Will give 1 7–10·5V output with 2 extra capacitors (supplied) £1·20. Also available as model garage with switch. lamp. jack plug. etc. (used for "Hot Wheels") £1·70.

**MISCELLANEOUS**
Transformer. mains pri. 16-0-16V with 9V tap sec 1½A £2. Post Office 4 digit counters 60p. Balanced armature earpieces. use as mic. or spkr 20Ω impedance 30p. 2N3055 38p. 80 + 80 + 20μF 350V 15p; 10 for £1·15.

All prices shown include VAT and postage (mainland only). S.A.E list

# GREENWELD ELECTRONICS (PE6)

Mail order dept., wholesale/retail shop: **51 Shirley Park Road, Southampton** (Tel. 0703 772501). Other retail shops at: 21 Deptford Broadway SE8 (Tel. 01-692 2009) and 38 Lower Addiscombe Road, Croydon. Callers Welcome.

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**Money saving high performance audio equipment**
**DIRECT FROM OUR OWN FACTORY**

## GUARANTEED TESTED HIGH PERFORMANCE MODULES—now better value than ever

**SA35 £5·45** Carriage free
35W RMS 25–50V
7 transistors, 7 diodes

**SA50 £6.90** Carriage free
50W RMS 25–65V
7 transistors, 7 diodes

**SA100 £10·90**
100W RMS 45–70V
11 transistors, 6 diodes

- ★ 25Hz–25kHz
- ★ 0·2% distortion
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- ★ 500mV into 20K
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- ★ Simple wiring
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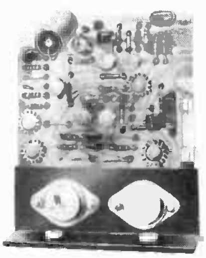
**120 watt module complete with built-in supply—extra heavy duty £19·75** Carr. 60p


THE SA100 MODULE

## POWER SUPPLIES

**UNSTABILISED**

| | | | |
|---|---|---|---|
| PU45 | Suits 2 SA35 or 1 SA50 | £4·90 | Carriage 30p |
| PU70 | Suits 2 SA50 or 2 SA100 | £7·75 | Carriage 40p |

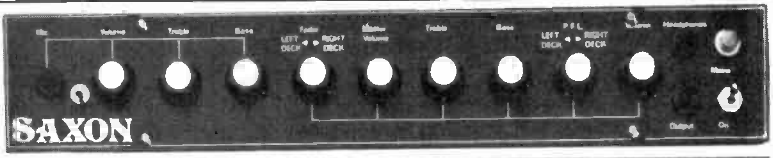
**STABILISED**

| | | | |
|---|---|---|---|
| PS45 | Suits 2 SA35 or 2 SA50 | £3·50 | Carriage free |
| MT45 | Transformer for above | £3·50 | Carriage 30p |
| PS70 | Suits 2 SA100 | £4·90 | Carriage free |
| MT70 | Transformer for above | £4·90 | Carriage 40p |

N.B. PS70 is not suitable for the SA50

## Mk II STEREO DISCO MIXER £19·75
Carr. 30p

This well tried unit mixes two decks, handles any ceramic cartridge, and features mic over-ride plus separate full range bass and treble controls on both mic and deck inputs. Ample headphone power is available for P.F.L. May be used for mono and is mains operated. Fitted with sturdy screening case. Controls: Mic vol, bass, treble. Left/Right fade, deck volume, bass, treble, h/phone select, vol, Mains. Size 17½in × 3in × 4in deep.




## DISCO MODULE £8·00 Carr. 20p

Thousands sold of this extremely popular mono version. A mic input may be fitted using the VA30 (see below). Low consumption from a 9V battery. Features the same high standards of reproduction as the Stereo version. Controls: H/phone select, vol, Left deck vol, Right deck vol, bass, treble, master vol. Size 12¾in × 3in × 2in deep.


## 3-CHANNEL SOUND-LITE £22·50 Carr. 30p

Only SAXON can supply such incredible value for money. This unit features 3kW power handling, full-wave control, bass, middle, treble AND master controls. Twin loudspeaker jacks for "through" connections. It may be used free standing or will panel mount next to either of the above. Also features unique CUT-BACK circuitry for extra wide range response. Size 12in × 3in × 2¼in deep. Professional standards at a price you can afford!

**SINGLE CHANNEL VERSION £7·50** Carr. free — Recently reduced in price due to increasing sales, handles 1kW. Full wave operation

**Add VAT 10% to all orders**

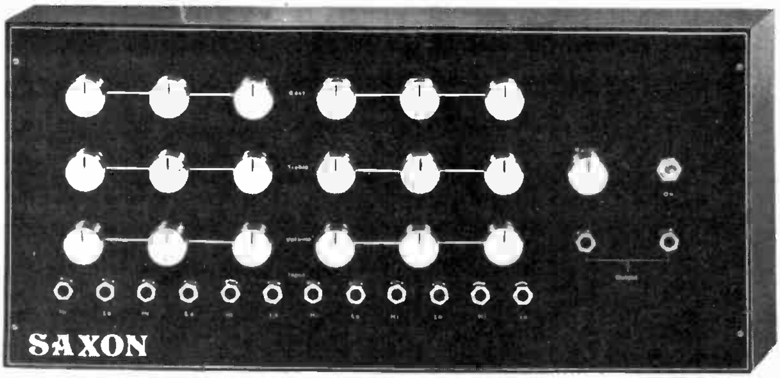

## MULTI-PURPOSE MIXERS

**M4HL £18·50** Carr. 50p — **M6HL £27·50** Carr. 50p

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

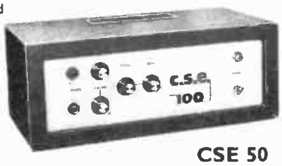
**VA30 CHANNEL MODULE £3·50** Carr. free

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




## SAXON CSE 100 COMPLETE AMPLIFIER £34·90
Carr. free

100W of speech and music—Two separately controlled inputs. Wide range bass and treble controls. Sturdy and attractive vynide case. Twin outputs. Ideal for groups, discos, etc. Fully tested and guaranteed. 50W version identical in appearance.




**CSE 50 £29·50** Carr. free


Four individually controlled FET input stages plus wide range bass and treble controls. 120W of speech and music output from twin loudspeaker sockets. Sturdy case, and an attractive facia make this excellent value for money. Hundreds in use by groups, discos, clubs, etc. 50W version identical in appearance.

**SAXON 100 COMPLETE AMPLIFIER £53·00** Carr. free

**SAXON 50 £37·50** Carr. free

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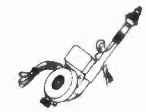
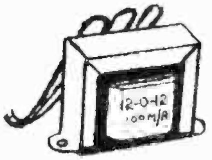
Supplied complete with Fixing Bracket and Control Switch. **£6·75** plus 25p P. & P.




**"CRESCENT BEAT BRITE" SINGLE CHANNEL SOUND TO LIGHT UNIT**
This fantastic little box approx. 4" × 3" × 2½" when connected to the output of a sound source from 1 to 100 watts produces a psychedelic light display of up to 1000 watts. Complete with a sensitive level control the unit is fused and cannot harm your amplifier.
A Bargain at £7·50 plus 10p.

## MIDGET MAINS TRANSFORMER

**Varnish Impregnated**
Size 45mm × 36mm × 31mm




**PRI 240V**

| | | |
|---|---|---|
| Sec | 3·0·3 | 100mA |
| Sec | 6·0·6 | 100mA |
| Sec | 9·0·9 | 100mA |
| Sec | 12·0·12 | 100mA |
| Sec | 20·0·20 | 100mA |

**£1·23** 10p P. & P.

## TRI-VOLT BATTERY ELIMINATOR

Enables you to work your Transistor Radio, Amplifier or Cassette, etc., from the a.c. mains through this compact Eliminator. Just by moving a plug you can select the voltage you require, 6, 7½ or 9 volt. This means all your transistor power pack applications can be handled by this one unit. Approx. size 2⅝in × 2¼in × 3¼in. Our Price £2·75 plus 10p P. & P. Same model suitably wired for the Philips Cassette £3 plus 10p P. & P.

## 7in × 4in LOUDSPEAKER

A top quality speaker ideal where small size is important. Manufactured by E.M.I. for a well-known hi-fi set maker. Size: 7in × 4in. Impedance: 8 ohms. Flux: 38,000. Max. Free range: 90Hz to 12kHz. Power handling: 5W. Unbeatable. Price: £1·60. Free postage on this item.

## AMTRON KITS

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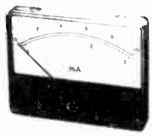
|---|---|---|
| UK65 | Transistor Tester | £1·66 |
| UK92 | Telephone Amp | £8·26 |
| UK115 | Hi-Fi Amp—8W | £4·50 |
| UK130 | Mono Control Unit | £4·15 |
| UK145 | Amp—1·5W | £8·81 |
| UK165 | RIAA Equalised Stereo Amp | £5·30 |
| UK195 | Mini-Amp—2W | £8·66 |
| UK220 | Signal Injector | £2·65 |
| UK230 | AM-FM Acr. Amp | £8·29 |
| UK275 | Mike Pre-Amp | £6·98 |
| UK300 | 4 Channel Radio Control T.X. | £6·61 |
| UK310 | Radio Control Receiver | £8·29 |
| UK515 | MW Radio Receiver | £7·92 |
| UK520 | AM Tuner | £4·60 |
| UK710 | 4 Channel A.F. Mixer | £12·59 |
| UK715 | Photoelectric Cell Switch | £8·97 |
| UK835 | Guitar Pre-Amp | £4·98 |
| UK875 | Cap. Discharge Ignition | £13·19 |
| UK915 | R.F. Amp 12-170MHz | £2·66 |
| UK935 | Wide Band Amp 20Hz to 150MHz | £2·66 |

### TRI-VOLT CAR SUPPLY

Enables you to work your Transistor Radio, Amplifier or Cassette, etc. from the 12 volt car supply. Positive or negative earth. Approx. size = 2in × 3¼in × 1½in. This converter supplies 6, 7½ or 9 volts and is transistor regulated. A real money saving device for **£2·50**. 10p P. & P.

### "C.300" DISCO CONTROL PACK

A control Unit which when connected to twin decks makes a disco of professional quality. We supply a smart front panel which incorporates controls, switch and input sockets. The control module, I.C. construction incorporating mixing, pre-amp and headphone listening amplifier. The power pack enables this unit to work from the standard mains. * Inputs include Mic., Tape/Cassette and Twin Decks. * Controls include Mic., Tape, Each Deck, Mono, **£14**. Stereo, **£17** plus 20p carr.




### 2in. PANEL METERS

Size 59mm × 46mm

| | |
|---|---|
| 0·50μA —ME6 | 0·100mA—ME13 |
| 0·100μA—ME7 | 0·500mA—ME14 |
| 0·500μA—ME8 | 0·1A —ME15 |
| 0·1mA —ME9 | 0·50V a.c. —ME16 |
| 0·5mA —ME10 | 0·300V a.c.—ME17 |
| 0·10mA—ME11 | S meter —ME18 |
| 0·50mA—ME12 | V.U. meter—ME19 |

**£3** each. 10p P. & P.

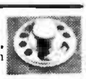
### LOW VOLTAGE AMPLIFIER

5 transistor amplifier complete with volume control, is suitable for 9V d.c. and a.c. supplies. Will give about 1W at 8 ohm output.
With high IMP input this amplifier will work as a record player, baby alarm, etc., amplifier.
**£1·75** plus 13p P. & P.

### 200/250V MAINS RELAY

Heavy duty contacts. 2,500Ω coil. All new and unused D.P.D.T. mains relays **50p** + V.A.T. Carr. Free.
Special quantity price: **£40** per 100 relays.

### MINI LOUDSPEAKERS



2¼in 80 ohm, 50p; 2¼in 40 ohm, 50p. Please include 5p P. & P. on each L.S.

### CRESCENT CATALOGUE

If you construct you should own one. Send 20p inc. carriage.

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### VAT

Please include 8% VAT on goods plus carriage.



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All components can be purchased separately, i.e., semiconductor devices, M.O.S. master oscillators, coils, keyboards, pedal boards, stop tabs, draw bars, key-contacts, etc.

Send 50p for catalogue which includes 5 × 10p vouchers or send your own parts list, enclosing S.A.E. for quotation.

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The SPARKRITE MK.2 is a full capacitive discharge electronic system. Specifically designed to retain the points assembly with all the advantages and none of the disadvantages. No misfire because contact breaker bounce is eliminated electronically by a pulse suppression circuit which prevents the unit firing if the points bounce open at high rpm. Contact breaker burn is eliminated by reducing the current to about 1/50th of norm, thus avoiding arcing. But you can still revert to normal ignition if need be. In seconds. If points go (very unlikely) you can get replacements anywhere. All these advantages.

● Fitted in 15 minutes. ● Up to 20% better fuel consumption. ● Instant all weather starting. ● Cleans plugs – they last 5 times longer without attention. ● Faster acceleration. ● Faster top speeds. ● Coil and battery last longer. ● Efficient fuel burning with less air pollution.


## The kit comprises everything needed

Ready drilled scratch and rust resistant case, metalwork, cables, coil connectors, printed circuit board, top quality 5 year guaranteed transformer and components, full instructions to make positive or negative earth system, and 6 page installation instruction leaflet.
WE SAY IT IS THE BEST SYSTEM AT ANY PRICE!

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AD162 pnp germanium medium power **40p**
AF139 pnp germanium UHF **57p**
BC107 **15p**; BC108 **14p**; BC109 **18p**; } npn
BC167 **15p**; BC168 **14p**; BC169 **13p** each } npn
BC177 **25p**; BC178 **23p**; BC179 **26p**; } pnp
BC257 **14p**; BC258 **12p**; BC259 **14p** } pnp
Standard groupings available
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**DIODES**
OA90, OA91, OA95 each **6p**
OA202 **11p**

**Other semiconductors**
AC128 **17p**; AF117 **37p**
BFY51 **23p**
*Full lists and technical data will be found in Catalogue No. 7.*

### RESISTORS

| Code | Watts | Ohms | 1 to 9 | 10 to 99 (see note below) | 100 up |
|---|---|---|---|---|---|
| C | 1/3 | 4·7–470K | 1·3 | 1·1 | 0·9 nett |
| C | 1/2 | 4·7–10M | 1·3 | 1·1 | 0·9 nett |
| C | 3/4 | 4·7–10M | 1·5 | 1·2 | 0·97 nett |
| C | 1 | 4·7–10M | 3·2 | 2·5 | 1·92 nett |
| MO | 1/2 | 10–1M | 4 | 3·3 | 2·3 nett |
| WW | 1 | 0·22–3·9 | 11 | 10 | 8 nett |
| WW | 3 | 1–10K | 9 | 8 | 6 nett |
| WW | 7 | 1–10K | 11 | 10 | 8 nett |

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

**Values:** All E12 except C 1/3W, C 3/4W, and MO 1/2W.
E12: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades.
E24: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and their decades.

**Tolerances:**
5% except WW1 10%
±0·05 Ω below 10 Ω and MO 1/2W 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.) Prices for 100 up in units of 100 only.**

### MINITRON DIGITAL INDICATORS
3015F Seven segment filament, compatible with standard logic modules. 0–9 and decimal point; 9mm characters in 16 lead DIL, **£1·20**. Now available in 8mA or 15mA per segment rating.
*Suitable BCD decoder driver 7447,* **£1·15**.
3015G showing + or – and 1 and dec. pt. **£1·20**.

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**GIRO ACCOUNT No. 38/671/4002**

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*in cans, plastic sleeved*
1,000mF/25V, **28p**; 5,000mF/25V, **62p**; 1,000mF 50V, **41p**; 2,000mF/50V, **57p**; 5,000mF/50V, **£1·18**; 50,00mF/100V, **£2·91**; 2,200mF/100V, **£1·56**.

**POLYESTER TYPE C280**
*Radial leads for P.C.B. mounting. Working voltage 240V d.c.*
0·01, 0·015, 0·022, 0·033, 0·047, **3p** each; 0·068, 0·1, 0·15, **4p** each; 0·22, **5p**; 0·33, **7p**; 0·47, **8p**; 0·68, **11p**; 1·0, **14p**; 1·5, **21p**; 2·2, **24p**.

**SILVERED MICA**
Working voltage 500V d.c.
Values in pF—2·2 to 820 in 32 stages, **6p** each; 1,000, 1,500, **7p** each; 1,800, **8p**; 2,200, **10p**; 2,700, 3,600, **12p** each; 4,700, 5,000, **15p** each; 6,800, **20p**; 8,200, 10,000, **25p** each.

**TANTALUM BEAD**
0·1, 0·22, 0·47, 1·0mF/35V, **14p** each. 2·2/16V, 2·2/35V, 4·7/16V, 10/6·3V, **14p** each. 4·7/35V, 10/16V, 22/6·3V, **18p** each. 10/25V, 22/16V, 47/6·3V, 100/3V, 6·8/25V, 15/25V, **20p** each.

**POLYCARBONATE TYPE B32540**
Working Voltage 250V.
Values in mF: 0·0047, 0·0068, 0·0082, 0·01, 0·012, 0·015, **3p** each. 0·018, 0·022, 0·027, 0·033, 0·039, 0·047, 0·056, 0·068, 0·082, 0·1, **4p** each.

**CERAMIC PLATE**
Working voltage 50V d.c.
In 26 values from 22pF to 6,800pF, **2p** each.

### ELECTROLYTIC Axial Leads

| uF | 3V | 6·3V | 10V | 16V | 25V | 40V | 63V | 100V |
|---|---|---|---|---|---|---|---|---|
| 0·47 | — | — | — | — | — | — | 11p | 8p |
| 1·0 | — | — | — | — | — | 11p | — | 8p |
| 2·2 | — | — | — | — | 11p | — | 8p | 9p |
| 4·7 | — | — | — | 11p | — | 8p | 9p | 9p |
| 10 | — | — | — | — | 8p | 9p | 8p | 8p |
| 22 | — | — | 8p | — | 9p | 8p | 8p | 10p |
| 47 | 8p | — | 9p | 8p | 8p | 8p | 10p | 13p |
| 100 | 9p | 8p | 8p | 8p | 9p | 10p | 12p | 19p |
| 220 | 8p | 8p | 9p | 10p | 10p | 11p | 17p | 28p |
| 470 | 9p | 10p | 10p | 11p | 13p | 17p | 24p | 45p |
| 1,000 | 11p | 13p | 13p | 17p | 20p | 25p | 41p | — |
| 2,200 | 15p | 18p | 23p | 26p | 37p | 41p | — | — |
| 4,700 | 26p | 30p | 39p | 44p | 58p | — | — | — |
| 10,000 | 42p | 46p | — | — | — | — | — | — |

### POTENTIOMETERS
ROTARY, CARBON TRACK.
*Double wipers for good contact and long working life.*
**P20** SINGLE linear 100 ohms to 4·7M Ω, **14p** each.
**P20** SINGLE log. 4·7k Ω to 2·2M Ω, **14p** each.
**JP20** DUAL GANG linear 4·7k Ω to 2·2M Ω, **48p** each.
**JP20** DUAL GANG log. 4·7k Ω to 2·2M Ω, **48p** each.
**JP20** DUAL GANG log/antilog 10K, 22K, 47K, 1M Ω only, **48p** each.
**JP20** DUAL GANG antilog 10k only **48p**.
2A DP mains switch with any of above **14p** extra.
Decades of 10, 22 and 47 only available in ranges above. **SKELETON CARBON PRESETS 6p** each.

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Linear or log, 4·7k Ω to 1M Ω in all popular values, **30p** each.
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2 circ. screened, side entry, SEP1 **36p**
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3-circuit, screened, side entry, SEP3 **55p**
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Miniature, 3·5mm, 2-circ., unscreened, various colours, P6 **10p**

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| BA5 | 4" | × | 2¼" | × | 2" | 42p |
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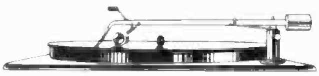

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|---|---|---|---|
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| C6 | 2 | Tuning Gangs, MW/LW VHF | 0·55 |
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| C8 | 10 | Reed Switches | 0·55 |
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| C11 | 5 | Jack Sockets 3 × 3·5m 2 × Standard Switch Type | 0·55 |
| C12 | 30 | Paper Condensers preferred types mixed values | 0·55 |
| C13 | 20 | Electrolytics Trans. types | 0·55 |
| C14 | 1 | Pack assorted Hardware—Nuts/Bolts, Grommets, etc. | 0·55 |
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| C16 | 20 | Assorted Tag Strips & Panels | 0·55 |
| C17 | 10 | Assorted Control Knobs | 0·55 |
| C18 | 4 | Rotary Wave Change Switches | 0·55 |
| C19 | 2 | Relays 6—24V Operating | 0·55 |
| C20 | 1 | Pack Sheets of Copper Laminate approx. 20 sq. ins. | 0·55 |

## PLUGS AND SOCKETS
PLUGS

| | | |
|---|---|---|
| PS 1 | D.I.N. 2 Pin (Speaker) | 0·11 |
| PS 2 | D.I.N. 3 Pin | 0·12 |
| PS 3 | D.I.N. 4 Pin | 0·15 |
| PS 4 | D.I.N. 5 Pin 180° | 0·16 |
| PS 5 | D.I.N. 5 Pin 240° | 0·16 |
| PS 6 | D.I.N. 6 Pin | 0·17 |
| PS 7 | D.I.N. 7 Pin | 0·18 |
| PS 8 | Jack 2·5mm Screened | 0·18 |
| PS 9 | Jack 3·5mm Plastic | 0·12 |
| PS 10 | Jack 3·5mm Screened | 0·18 |
| PS 11 | Jack ¼" Plastic | 0·15 |
| PS 12 | Jack ¼" Screened | 0·22 |
| PS 13 | Jack Stereo Screened | 0·36 |
| PS 14 | Phono | 0·10 |
| PS 15 | Car Aerial | 0·22 |
| PS 16 | Co-Axial | 0·15 |

INLINE SOCKETS

| | | |
|---|---|---|
| PS 21 | D.I.N. 2 Pin (Speaker) | 0·14 |
| PS 22 | D.I.N. 3 Pin | 0·20 |
| PS 23 | D.I.N. 5 Pin 180° | 0·20 |
| PS 24 | D.I.N. 5 Pin 240° | 0·20 |
| PS 25 | Jack 2·5mm Plastic | 0·16 |
| PS 26 | Jack 3·5mm Plastic | 0·16 |
| PS 27 | Jack ¼" Plastic | 0·30 |
| PS 28 | Jack ¼" Screened | 0·35 |
| PS 29 | Jack Stereo Plastic | 0·30 |
| PS 30 | Jack Stereo Screened | 0·38 |
| PS 31 | Phono Screened | 0·18 |
| PS 32 | Car Aerial | 0·22 |
| PS 33 | Co-Axial | 0·22 |

SOCKETS

| | | |
|---|---|---|
| PS 35 | D.I.N. 2 Pin (Speaker) | 0·08 |
| PS 36 | D.I.N. 3 Pin | 0·11 |
| PS 37 | D.I.N. 5 Pin 180° | 0·11 |
| PS 38 | D.I.N. 5 Pin 240° | 0·11 |
| PS 39 | Jack 2·5mm Switched | 0·12 |
| PS 40 | Jack 3·5mm Switched | 0·12 |
| PS 41 | Jack ¼" Switched | 0·20 |
| PS 42 | Jack Stereo Switched | 0·30 |
| PS 43 | Phono Single | 0·08 |
| PS 44 | Phono Double | 0·10 |
| PS 46 | Co-Axial Surface | 0·10 |
| PS 47 | Co-Axial Flush | 0·20 |

## LEADS

| | | | |
|---|---|---|---|
| LS | 1 | Speaker Lead 2 pin D.I.N. plug to open ends approx 3 metres long (coded) | 0·20 |

## CABLES

| | | |
|---|---|---|
| CP 1 | Single Lapped Screen | 0·07 |
| CP 2 | Twin Common Screen | 0·11 |
| CP 3 | Stereo Screened | 0·12 |
| CP 4 | Four Core Common Screen | 0·23 |
| PC 5 | Four Core Individually Screened | 0·30 |
| CP 6 | Microphone Fully Braided Cable | 0·10 |
| CP 7 | Three Core Mains Cable | 0·09 |
| CP 8 | Twin Oval Mains Cable | 0·07 |
| CP 9 | Speaker Cable | 0·05 |
| CP 10 | Low Loss Co-Axial | 0·18 |

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

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|---|---|---|
| VC 1 | Single Less Switch | 0·15 |
| VC 2 | Single D.P. Switch | 0·28 |
| VC 3 | Tandem Less Switch | 0·46 |
| VC 4 | 1K Lin Less Switch | 0·15 |
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100, 220, 470, 1K, 2·2K, 4·7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M, 4·7M

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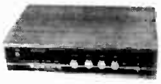

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240V. Primary. Secondary voltages available from selected tappings 4V, 7V, 8V, 10V, 14V, 15V, 17V, 19V, 21V, 25V, 31V, 33V, 40, 50 and 25V-0-25V.

| Type | Amps | Price | P. & P. |
|---|---|---|---|
| MT50/½ | ½ | £1·93 | 30p |
| MT50/1 | 1 | £2·42 | 35p |
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## CARTRIDGES
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J-2006S Stereo/Hi Output £1·75
J-2105 Ceramic/Med Output £1·95
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J-2203S Replacement stylus for above £3·00
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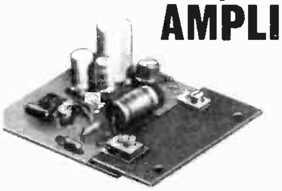
# BI-PAK *QUALITY* COMES TO AUDIO!

## AL10/AL20/AL30 AUDIO AMPLIFIER MODULES



The AL10, AL20 and AL30 units are similar in their appearance and in their general specification. However, careful selection of the plastic power devices has resulted in a range of output powers from 3 to 10 watts R.M.S.
The versatility of their design makes them ideal for use in record players, tape recorders, stereo amplifiers and cassette and cartridge tape players in the car and at home.

| Parameter | Conditions | Performance |
|---|---|---|
| IARMONIC DISTORTION | Po = 3 WATTS f = 1KHz | 0·25% |
| ,OAD IMPEDANCE | — | 8–16 Ω |
| NPUT IMPEDANCE | f = 1KHz | 100 kΩ |
| 'REQUENCY RESPONSE —3dB | Po = 2 WATTS | 50 Hz–25KHz |
| ENSITIVITY for RATED O/P | Vs=25V. Rl=8Ω f=1KHz | 75mV. RMS |
| IMENSIONS | — | 3" × 2½" = 1" |

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

| Parameter | AL10 | AL20 | AL30 |
|---|---|---|---|
| Iaximum Supply Voltage | 25 | 30 | 30 |
| 'ower out for 2% T.H.D. (RL = 8Ω f = 1KHz) | 3 watts RMS Min. | 5 watts RMS Min. | 10 watts RMS Min. |

### AUDIO AMPLIFIER MODULES

AL 10. 3 watts £2·19
AL 20. 5 watts £2·59
AL 30. 10 watts £3·01

### POWER SUPPLIES

'S 12. (Use with AL10, AL20, AL30) 88p
PM 80. (Use with AL60) £3·25
'RONT PANELS PA 12 with Knobs £1·00

### PRE-AMPLIFIERS

PA 12. (Use with AL10 & AL20) £4·35
PA 100. (Use with AL30 & AL60) £13·15

### TRANSFORMERS

T461 (Use with AL10) £1·38 P & P 15p
T538 (Use with AL20, AL30) £1·93 P & P 15p
BMT80 (Use with AL60) £2·15 P & P 25p

### PA12 PRE-AMPLIFIER SPECIFICATION

'he PA12 pre-amplifier has been designed to match into most budget stereo systems. It is compatible with the AL 10, AL 20 and AL 30 audio power amplifiers and it can be supplied from their associated power supplies. There are two stereo inputs, one has been designed for use with *Ceramic cartridges while the auxiliary input will suit most †Magnetic cartridges. Full details are given in the specification table. The four controls are, from left to right: Volume and on/off switch, balance, bass and treble. Size 152mm × 84mm × 35mm.

Frequency response— 20Hz–50KHz (—3dD)
Bass control— ± 12dB at 60Hz
Treble control— ± 14dB at 14KHz
*Input 1. Impedance 1 Meg. ohm Sensitivity 300mV
†Input 2. Impedance 30 K ohms Sensitivity 4mV

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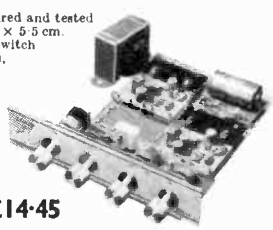
## The STEREO 20



'he "Stereo 20" amplifier is mounted, ready wired and tested on a one-piece chassis measuring 20 cm × 14 cm × 5·5 cm. This compact unit comes complete with on/off switch volume control, balance, bass and treble controls, Transformer, Power supply and Power amps. Attractively printed front panel and matching control knobs. The "Stereo 20" has been designed to fit into most turntable plinths without interfering with the mechanism or, alternatively, into a separate cabinet. Output power 20w peak. Input 1 (Cer.) 00mV into 1M. Freq. res. 25Hz-25kHz. Input 2 (Aux.) 4mV into 30K. Harmonic distortion. Bass control ± 12dB at 60Hz typically 0·25% at 1 watt. Treble con. ± 14dB at 14kHz.

**£14·45**

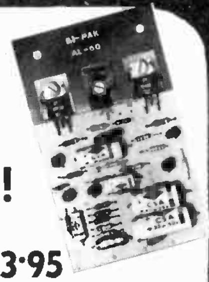
### TC20 TEAK VENEERED CABINET

'or Stereo 20 (front board undrilled) Size 10¼" × 8¾" × 3", £3·95 plus 30p postage.

### SHP80 STEREO HEADPHONES

-16 ohms impedance. Frequency response 20 to 20,000Hz. Stereo/mono switch and volume controls, £4·95

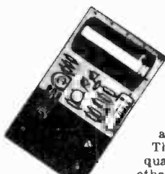
## *NOW* WE GIVE YOU 50w PEAK (25w R.M.S.) *PLUS* THERMAL PROTECTION! The *NEW* AL60 Hi-Fi Audio Amplifier FOR ONLY £3·95



- Max Heat Sink temp 90°C.
- Frequency Response 20Hz to 100KHz
- 0·1% Distortion
- Distortion better than 1% at 1KHz
- Supply voltage 10–35 volts
- Thermal Feedback
- Latest Design Improvements
- Load — 3, 4, 8 or 16 ohms
- Signal to noise ratio 80dB
- Overall size 63mm × 105mm × 13mm

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

## STABILISED POWER MODULE SPM80

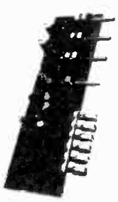


SPM80 is especially designed to power 2 of the AL60 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer BMT80, the unit will provide outputs of up to 1·5 amps at 35 volts. Size: 63mm × 105mm × 30mm.
These units enable you to build Audio Systems of the highest quality at a hitherto unobtainable price. Also ideal for many other applications including:—Disco Systems, Public Address, Intercom Units, etc. Handbook available 10p **PRICE £3·25**

**TRANSFORMER BMT80 £2·15** p. & p. 28p

## STEREO PRE-AMPLIFIER TYPE PA100

Built to a specification and NOT a price, and yet still the greatest value on the market, the PA100 stereo pre-amplifier has been conceived from the latest circuit techniques. Designed for use with the AL60 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise NPN devices for use in the input stages.
Three switched stereo inputs, and rumble and scratch filters are features of the PA100, which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble controls.



**SPECIFICATION**

| | |
|---|---|
| Frequency Response | 20Hz—20KHz ± 1dB |
| Harmonic Distortion | better than 0·1% |
| Inputs: 1. Tape Head | 3·25 mV into 50K Ω |
| 2. Radio, Tuner | 75 mV into 50K Ω |
| 3. Magnetic P.U. | 3 mV into 50K Ω |

All input voltages are for an output of 250mV. Tape and P.U. inputs equalised to RIAA curve within ± 1dB. from 20Hz to 20KHz.

| | |
|---|---|
| Bass Control | ± 15dB at 20Hz |
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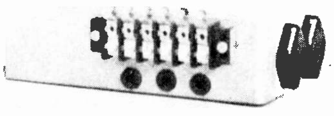

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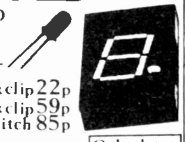

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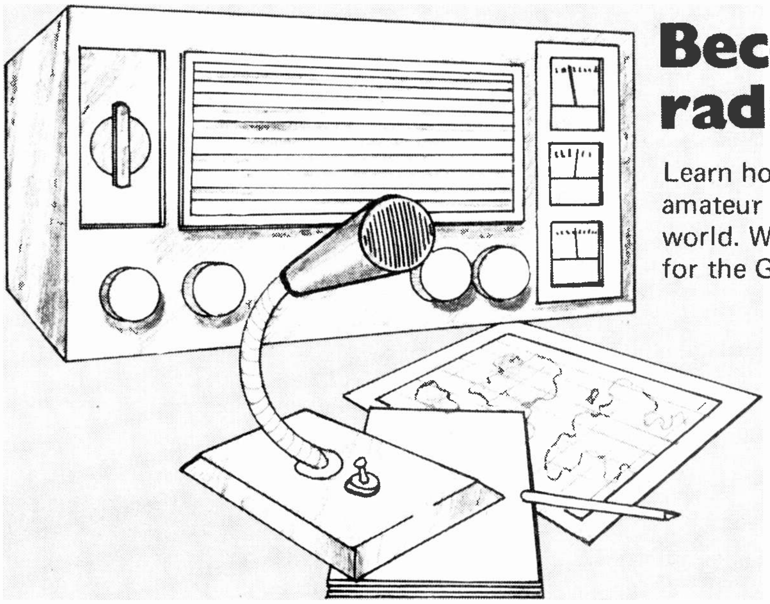

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**Rotary type 45:** Singles (Log and linear) **15p**. Single switched (Log and linear) **21p**. Doubles (Log and linear) **38p**.
**Slider type 58:** Singles (Log and linear) **30p**. Doubles (Log and linear) **50p**.
Presets: 0·1 watt **6p**, 0·2 watt **6p**, 0·3 watt **7½p**. Please specify vertical or horizontal.

## Diodes and Rectifiers

| PIV | 50 | 100 | 200 | 400 | 600 | 800 | 1000 |
|---|---|---|---|---|---|---|---|
| 1·5 | 8p | 9p | 10p | 11p | 12p | 15p | 20p |
| 3 | 15p | 17p | 20p | 22p | 25p | 27p | 30p |
| 10 | | 35p | 40p | 47p | 56p | | |
| 35 | 84p | 92p | £1·18 | £2·15 | £2·52 | £3·65 | £4·20 |

**Cathode Stud Only**
1N3766 (35A 800pv) £3·65 | 1N3786 (35A 1000pv) £4·20

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN34A | 10p | BA141 | 17p | BY237 | 12½p | OA79 | 7p |
| IN914 | 7p | BA142 | 17p | BYZ10 | 35p | OA81 | 8p |
| IN916 | 7p | BA144 | 12p | BYZ11 | 32p | OA85 | 10p |
| AA119 | 7p | BA145 | 17p | BYZ12 | 30p | OA90 | 7p |
| AA129 | 15p | BA154 | 12p | OA9 | 10p | OA91 | 7p |
| BA100 | 15p | BY100 | 15p | OA10 | 20p | OA95 | 7p |
| BA102 | 25p | BY126 | 15p | OA47 | 7½p | OA200 | 7p |
| BA110 | 25p | BY127 | 17½p | OA70 | 7½p | OA202 | 10p |
| BA115 | 7p | BY140 | £1 | OA73 | 10p | OA210 | 27p |

## Integrated Circuits — TTL REDUCTIONS!!

| | £ | | £ | | £ | | £ |
|---|---|---|---|---|---|---|---|
| SN7400 | 0·16 | SN7432 | 0·45 | SN7482 | 0·87 | SN74153 | 1·09 |
| SN7401 | 0·16 | SN7437 | 0·35 | SN7483 | 1·20 | SN74154 | 1·66 |
| SN7401AN | 0·38 | SN7438 | 0·35 | SN7484 | 0·95 | SN74155 | 1·55 |
| | | SN7440 | 0·16 | SN7485 | 1·58 | SN74157 | 1·09 |
| SN7402 | 0·16 | SN7441 | 0·85 | SN7486 | 0·45 | SN74160 | 1·58 |
| SN7403 | 0·16 | SN7442 | 0·85 | SN7490 | 0·65 | SN74161 | 1·58 |
| SN7404 | 0·24 | SN7445 | 1·59 | SN7491 | 1·10 | SN74162 | 1·58 |
| SN7405 | 0·24 | SN7446 | 2·00 | SN7492 | 0·75 | SN74164 | 2·01 |
| SN7406 | 0·45 | SN7447 | 1·30 | SN7493 | 0·65 | SN74165 | 2·01 |
| SN7407 | 0·45 | SN7448 | 1·50 | SN7494 | 0·85 | SN74167 | 4·10 |
| SN7408 | 0·25 | SN7450 | 0·16 | SN7495 | 0·80 | SN74174 | 1·80 |
| SN7409 | 0·33 | SN7451 | 0·16 | SN7496 | 1·00 | SN74175 | 1·29 |
| SN7410 | 0·16 | SN7453 | 0·16 | SN74100 | 2·16 | SN74176 | 1·44 |
| SN7411 | 0·25 | SN7454 | 0·16 | SN74107 | 0·43 | SN74180 | 1·44 |
| SN7412 | 0·28 | SN7460 | 0·16 | SN74118 | 1·00 | SN74181 | 5·18 |
| SN7413 | 0·50 | SN7470 | 0·30 | SN74119 | 1·92 | SN74190 | 1·95 |
| SN7416 | 0·45 | SN7472 | 0·38 | SN74121 | 0·57 | SN74191 | 1·95 |
| SN7417 | 0·30 | SN7473 | 0·44 | SN74122 | 0·80 | SN74192 | 2·05 |
| SN7420 | 0·16 | SN7474 | 0·48 | SN74123 | 0·72 | SN74193 | 2·30 |
| SN7423 | 0·37 | SN7475 | 0·59 | SN74141 | 1·00 | SN74196 | 1·58 |
| SN7425 | 0·37 | SN7476 | 0·45 | SN74145 | 1·44 | SN74197 | 1·58 |
| SN7427 | 0·45 | SN7480 | 0·75 | SN74150 | 1·44 | SN74198 | 3·16 |
| SN7430 | 0·16 | SN7481 | 1·25 | SN74151 | 1·10 | SN74199 | 2·88 |

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Also available ¼ watt @ 70°C Carbon Film Resistors E12. Range: 10Ω to 1mΩ 5% tol., above 470kΩ 10% tol. Price 95p per 100.

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240 Volt Mains to 115 Volts, smart steel-cased units coated in tough resin, fitted with power lead, fuse and 115 Volt American type socket up to 500VA. above 500VA Cable entry.

| VA (Watts) | Price | P. & P. |
|---|---|---|
| 20 .. | £2·52 | £0·30 |
| 200 .. | £5·56 | £0·38 |
| 500 .. | £9·50 | £0·67 |
| 1000 .. | £15·92 | £0·82 |
| 2000 .. | £29·70 | £1·50 |

## NEW!

## 2" & 4" PANEL METERS

| 2" | | 4" | |
|---|---|---|---|
| SIZE: 60mm Wide × 45mm High × 40mm Deep. | | SIZE: 110mm Wide × 82mm High × 43mm Deep. | |
| Movement | I.R. Ohms | Movement | I.R. Ohms |
| 0–50 micro A. | 1250 | 0–50 micro A. | 1400 |
| 0–100 micro A. | 580 | 0–100 micro A. | 730 |
| 0–500 micro A. | 170 | 0–500 micro A. | 200 |
| 0–1 mA | 170 | 0–1 mA | 200 |
| 0–5 mA | 170 | 0–5 mA | 200 |
| 0–10 mA | 6 | 0–10 mA | 6 |
| 0–50 mA | 0·5 | 0–50 mA | 0·5 |
| 0–100 mA | 0·5 | 0–100 mA | 0·5 |
| 0–500 mA | 0·5 | 0–500 mA | 0·5 |
| 0–1 AMP | 0·5 | 0–1 AMP | 0·5 |
| 0–2 AMP | 0·5 | 0–2 AMP | 0·5 |
| 0–25 Volt | 15K | 0–25 Volt | 15K |
| 0–50 Volt | 50K | 0–50 Volt | 50K |
| 0–300 Volt | 300K | 0–300 Volt | 300K |
| "g" Meter | 170 | "g" Meter | 200 |
| VU Meter | 5250 | VU Meter | 5250 |

VU Meters are complete with detectors. Modern wide view can be illustrated. Price 2" £2·95 Post 10p. Price 4" £3·95 Post 10p. Lamps 55p per set.

# TRANSFORMERS

## SAFETY ISOLATING

Prim. 120/240V. Sec. 120/240V. Centre Tap with screen.

| VA (watts) | Ref. No. | Price Cased | Price Open | Post £ |
|---|---|---|---|---|
| 60 | 149 | — | £3·74 | 0·38 |
| 100 | 150 | — | 4·16 | 0·52 |
| 200 | 151 | £9·48 | 7·48 | 0·52 |
| 250 | 152 | 12·05 | 9·57 | 0·65 |
| 350 | 153 | 14·00 | 11·44 | 0·80 |
| 500 | 154 | 15·80 | 13·20 | 1·00 |
| 1000 | 156 | 30·70 | 27·46 | 1·20 |
| 2000 | 158 | 60·95 | 55·44 | |
| 3000 | 159 | 79·53 | 72·49 | |

## 12 & 24 Volts Prim. 200–240V.

| Amps 12V | Amps 24V | Type No. | Price £ | Post £ |
|---|---|---|---|---|
| 0·3 | 0·15 | 242 | 1·34 | 0·22 |
| 0·5 | 0·25 | 111 | 1·34 | 0·22 |
| 1 | 0·5 | 213 | 1·59 | 0·22 |
| 2 | 1 | 71 | 2·09 | 0·22 |
| 4 | 2 | 18 | 2·75 | 0·38 |
| 6 | 3 | 70 | 3·56 | 0·42 |
| 8 | 4 | 108 | 3·96 | 0·52 |
| 10 | 5 | 72 | 4·67 | 0·52 |
| 12 | 6 | 116 | 5·67 | 0·52 |
| 16 | 8 | 17 | 6·64 | 0·52 |
| 20 | 10 | 115 | 10·23 | 0·69 |
| 30 | 15 | 187 | 13·75 | 0·97 |
| 40 | 20 | 232 | 17·25 | 1·06 |
| 60 | 30 | 226 | 22·52 | 1·10 |

## 30 Volts

Prim. 200–240V. Sec. 12, 15, 20, 24, 30V.

| Amps | Type | Price | Post |
|---|---|---|---|
| 0·5 | 112 | £1·58 | £0·22 |
| 1 | 79 | 2·20 | 0·38 |
| 2 | 3 | 3·19 | 0·38 |
| 3 | 20 | 3·96 | 0·42 |
| 4 | 21 | 4·68 | 0·52 |
| 5 | 51 | 5·80 | 0·52 |
| 6 | 117 | 6·93 | 0·52 |
| 8 | 88 | 9·00 | 0·67 |
| 10 | 89 | 10·00 | 0·67 |

## 50 Volts

Prim. 200–240V. Sec. 19, 25, 33, 40, 50V.

| Amps | Type | Price | Post |
|---|---|---|---|
| 0·5 | 102 | £2·11 | £0·30 |
| 1 | 103 | 3·08 | 0·38 |
| 2 | 104 | 4·29 | 0·42 |
| 3 | 105 | 5·77 | 0·52 |
| 4 | 106 | 7·48 | 0·52 |
| 6 | 107 | 11·00 | 0·67 |
| 8 | 118 | 14·19 | 0·97 |
| 10 | 119 | 17·60 | 0·97 |

## 60 Volts

Prim. 200–240V. Sec. 24, 30, 40, 48, 60V.

| Amps | Type | Price | Post |
|---|---|---|---|
| 0·5 | 124 | £2·10 | £0·38 |
| 1 | 126 | 2·97 | 0·38 |
| 2 | 127 | 5·77 | 0·42 |
| 3 | 125 | 7·15 | 0·52 |
| 4 | 123 | 9·35 | 0·67 |
| 5 | 40 | 11·55 | 0·67 |
| 6 | 120 | 13·57 | 0·82 |
| 8 | 121 | 16·00 | 1·00 |
| 10 | 122 | 19·40 | 1·00 |
| 12 | 189 | 21·62 | 1·10 |

## MINIATURE AND EQUIPMENT

Prim. 240V with screen.

| Volts Sec. 1 | Volts Sec. 2 | Milliamps Sec. 1 | Milliamps Sec. 2 | Type No. | Price £ | Post £ |
|---|---|---|---|---|---|---|
| 3-0-3 | — | 200 | — | 238 | 1·23 | 0·10 |
| 0-6 | 0-6 | 500 | 500 | 234 | 1·30 | 0·10 |
| 0-6 | 0-6 | 1000 | 1000 | 212 | 1·68 | 0·22 |
| 9-0-9 | — | 100 | — | 13 | 1·28 | 0·10 |
| 0-9 | 0-9 | 330 | 330 | 235 | 1·43 | 0·10 |
| 0-8-9 | 0-8-9 | 500 | 500 | 207 | 2·28 | 0·22 |
| 0-8-9 | 0-8-9 | 1000 | 1000 | 208 | 3·03 | 0·30 |
| 15-0-15 | — | 40 | — | 240 | 1·23 | 0·10 |
| 0-15 | 0-15 | 200 | 200 | 236 | 1·30 | 0·10 |
| 20-0-20 | — | 30 | — | 241 | 1·23 | 0·10 |
| 0-20 | 0-20 | 150 | 150 | 237 | 1·30 | 0·10 |
| 0-15-20 | 0-15-20 | 500 | 500 | 205 | 2·97 | 0·38 |
| 0-20 | 0-20 | 300 | 300 | 214 | 1·76 | 0·22 |
| 0-20 | — | 3500 | (No screen) | 1116 | 3·00 | 0·40 |
| 20-12-0-12-20 | — | 700 (D/C) | — | 221 | 1·55 | 0·30 |
| 0-15-20 | 0-15-20 | 1000 | 1000 | 206 | 3·80 | 0·38 |
| 0-15-27 | 0-15-27 | 500 | 500 | 203 | 3·08 | 0·38 |
| 0-15-27 | 0-15-27 | 1000 | 1000 | 204 | 3·24 | 0·38 |

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| | 1,000 P.I.V. 55p | 800 P.I.V. £1 | 600 P.I.V. £1 |

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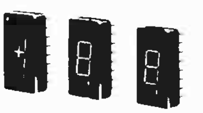
## MINITRON



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| 7402 | 20p | 7447 | £1.45 | 7492 | 82p |
| 7403 | 20p | 7447A | £1.80 | 7493 | 82p |
| 7404 | 20p | 7448 | £1 50 | 74100 | £2.37 |
| 7408 | 25p | 7470 | 33p | 74121 | 45p |
| 7409 | 29p | 7473 | 41p | 74122 | 88p |
| 7410 | 20p | 7474 | 41p | 74141 | £1.10 |
| 7413 | 31p | 7475 | 63p | 74154 | £1.82 |
| 7420 | 20p | 7476 | 44p | 74192 | £2.15 |
| 7430 | 20p | 7486 | 49p | 74193 | £2.53 |
| 7441 | 81p | 7489 | £4.75 | 74196 | £1.73 |

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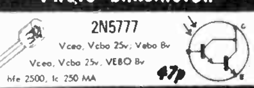
Vceo, Vcbo 25v, Vebo 8v
hfe 2500, Ic 250 MA



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| | Seven Segment | Overflow (± 1) |
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All Common Anode; Left Hand Decimal Point
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LIQUID CRYSTAL DISPLAY complete with socket and removable reflective backing. Ref AN4132R 13mm character height. Can be directly driven by National Semiconductors Alarm Clock chip MM5316.

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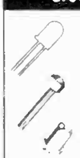


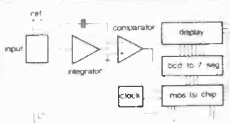
0.125" dia TIL209 Type:
Red 24p each, Yellow 99p each;
Green 41p each, White 35p each.

0.125" dia
Red (LED2) 26p ea.
Green (LED4) 69p ea.
0.175" dia green (LED5) 75p ea.

0.2" dia MLED 650/750/850 Type:
Red 28p each
Green 45p each
Yellow 99p each

T092 style MLED 500 still only 17p (RED)

## 3½ DECADE DIGITAL VOLTMETER INTEGRATED CIRCUIT

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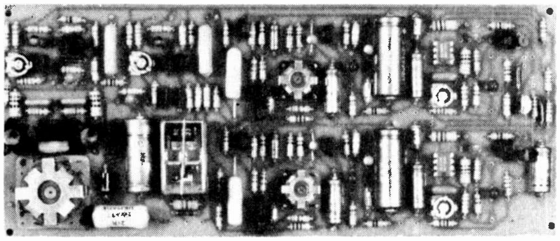


# PHONOSONICS

## PCB's AND KITS

**HI-FI TAPE LINK**
(PE Mar./Apr. 73). S/c s. i c s. Rs. Cs. Relay and pc-base. Pot Cores and pc-bases. Sw s. Pots. Panel Lamp—Mono £13·31. Stereo £21·95 PSU £3·62 Main Circuit PCB (3½in × 9in) Stereo (also holds relay and cores). £2·50 Sub-assembly PCB (2½in × 6½in). Stereo 88p.

**BIOLOGICAL AMPLIFIER**
(PE Jan Feb 73) P/A Set—S/c s i c s. Rs. Cs. Pots. PCB. £3·46. Output Stages—S/c's. Rs. Cs. Pots. Rotary Sw's and PCBs for Alphaphone. Cardio. Freq-Meter. Vis-Feed. £4·96. Audio Amps PC7 £5·20; EA1000. £3·30.

**ENLARGER EXPOSURE METER AND THERMOMETER**
(PE Sept 73) S c s. Thermistor. LDR Rs Pots PCB. £3·90.

**ELECTRONIC PIANO**
(PE Sept 72 Jan 73) Details in lists

**GEMINI STEREO AMPLIFIER**
(PE Nov 70/Mar 71) Stereo Sets and PCBs Pre-amp—Rs. Cs. Pots. Sw s—with ¼W MO Rs £14·18—with ¼W CF Rs. £10·40. PCB as published. £2·20. Main Amp—Rs Cs. Pots. £5·88. PCB (3½in × 5in). £1·28 Power supply—Rs. Cs. Pot. £4·56. PCB (2in × 4in). 65p.

**AUDIO MILLIVOLTMETER**
(PE Feb 74). S/c's. Rs Cs. Pots. Sw s PCBs. £5·17.

**PROGRAMME SHEETS**
For Sound Synthesiser and Rhythm Generator Now available

**8 WATT AMPLIFIER**
(PW Nov Dec 72) Pre-amp—S/c s. Rs Cs Pots. Sw—Mono. £2·50; Stereo. £6·03. PCB (3½in × 7½in) (Stereo) also holds rotary or slider pots. and Sw. £1·66. Main Amp—S/c s. Rs. Cs. Pot—Mono. £4·18. Stereo. £8·36. PCB (2½in × 3in) (Mono) 72p. PSU. £3·90.

**SOUND SYNTHESISER**
(PE Feb. 73/Feb. 74)
**RHYTHM GENERATOR**
(PE Mar./June 74)
**SOUND BENDER**
(PE May 74)
*Details of all these in List*

**REVERBERATION UNIT**
(PW Nov./Dec. 72) S/c s. Rs. Cs T/former—with Rotary Pots. £6·44. PCB (2in × 11½in). £1·40. Spring unit excluded

**LOUDHAILER AND SIREN**
(PW Dec 72) Pre-amp and Siren Generator—S c s. Rs Cs. Pot. PCB (2½in × 2½in). £2·20. While Stocks Last Main Amp Module PC5. £6·25.

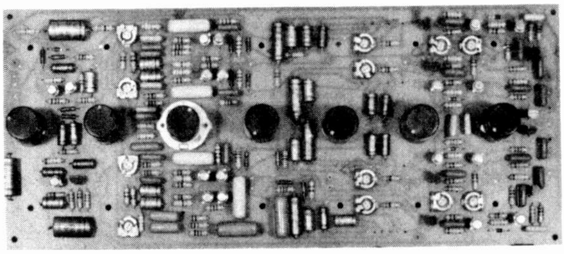
**MISCELLANEOUS PCBs (While Stocks Last)**
LOGICAL RADIO CONTROL (PE Dec. 71/Jan 72) PCB 2B . 50p.
MODEL SERVO CONTROL (PE Feb./Mar 72) PCB. Fail-safe. 33p.
DIGICAL PSU PCB (PE Aug 72). 50p. OSCILLOSCOPE P/A PCB (PE Aug 72) 33p.
GEMINI STEREO TUNER PCB (PE Apr 72) £1·50. TRIFFID PCB (PE Feb. 73). 60p.
(The above PCBs are as published)
CALLERCORD (PE July 72) Main Control PCB (4in × 7½in)

**PHOTOPRINT PROCESS CONTROL**
(PE Jan./Feb. 72). For Colour and B & W—finds exposure. controls timing. stabilises mains voltage. S/c's. SCR. LDR. Rs. Cs. Pots. Relay. Keyswitch. T/fmr. £8·85. PCB (3½ × 5½in) also holds pots. Sw relay. £1·60.

**RONDO**
(PE Sept 73/Feb 74) Details in List

**PROJECT Q4**
(PW Oct 73/Jan 74) Multisystem Quadraphonic Decoder. S/c's. I/c's Rs Cs. Pots. Makeswitches. £13·74. PSU. £3·17. Set of PCBs. £2·60.

**PHASING UNIT**
(PE Sept 73) S/c's. Rs. Cs. Pots. PCB (1½in × 2½in). £2·20.



**AURORA**
(PE Apr./Aug 71) Multichannel Sound Controlled Light. S/c s (Excl SCRs). Rs. Cs. Pots. Cores—Pre-amp. Sync Generator and 4 Chans. £10·97; 4 extra chans. £8·35. Reg PSU. £4·32. PCB (4½in × 10½in) for Pre-amp and 4 Chans (also holds pots). £2·50. PCB (4½in × 5in) for Sync Gen PSU. 8 cores. 8 SCRs. £1·25.

**AURORA AUXILIARY CONTROL UNIT**
2 Variable Frequency Strobe Generators and 4 Variable Amplitude Frequency Generators S/c's. Rs. Cs. Pots. PCB (3½in × 5½in). £4·87.

**SEMICONDUCTOR TESTER**
(PE Oct 73) S/c s. Rs Cs Pots Makeswitches Sub-assembly PCB. £6·04.

**ULTRASONIC TRANSMITTER-RECEIVER**
(PE May 72) S/c's. Rs. Cs. Pot. Relay. Dual PCB (2in × 5½in). £4·40. Transducers excluded

**VIBRASONIC GUITAR PRE-AMP**
(PW Sept 70) Incl Mic P/A. 2-Guitar P/A. Trem and Tone Controls. Master Volume S/c's. Rs. Cs. LDR. Rotary Pots. Lamps. Coupling T/fmr. £7·64. PCB (3½in × 10½in) also holds pots. £1·92. Power Supply. £3·90. While stocks last

**TAPE NOISE LIMITER**
(PE Feb 72) S/c's. Rs. Cs. Pot. Sw. PCB (1½in × 3in). £2·30. Reg PSU and PCB (1½in × 2½in). £3·40.

**VERSATILE LIGHT EFFECTS UNIT**
Single Channel Sound Controlled Light with built-in variable strobe (PE Jun 72) S/c's. Rs. Cs. Pots. T/fmrs. Keyswitch. £11·28. PCB (3½in × 7½in) also holds pots and switch. £1·70. SCRs excluded While stocks last

**VOICE OPERATED FADER**
(PE Dec 73) S/c's. Rs Cs. Pot. PCB (1½in × 3½in). £2·95.

**WIND AND RAIN EFFECTS**
(PE Oct 73) S c s (incl special noise diode). Rs. Cs. Pots. £1·95.

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¼W and ½W
CARBON FILM
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¼W 5% 4E7 to 1M
½W 5% 4E7
to 2M2 then 10% to
10M
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ERITH 30737

**SEMICONDUCTORS**

| | | | |
|---|---|---|---|
| AC128 | 20p | 2N2905 | 27p |
| AC176 | 20p | 2N2907 | 22p |
| AO161 | 40p | 2N3702 | 12p |
| BC107 | 13p | 2N3703 | 12p |
| BC108 | 13p | 2N3704 | 12p |
| BC109 | 13p | 2N3819 | 35p |
| BC147 | 12p | 2N3823E | 39p |
| BC148 | 12p | 2N4871 | 36p |
| BC149 | 12p | | |
| BC157 | 12p | | |
| BC158 | 12p | | |
| BC159 | 12p | | |
| BC182L | 12p | | |
| BC204 | 14p | | |
| BC209c | 14p | | |
| BC212L | 15p | | |
| BCY71 | 22p | | |
| BFY50 | 22p | | |
| BFY52 | 23p | | |
| BSY95A | 12p | | |
| MJE2955 | 110p | | |
| MJE3055 | 75p | | |
| NKT0033 | 112p | | |
| OC28 | 65p | | |
| OC71 | 14p | | |
| OC84 | 25p | | |
| ORP12 | 55p | | |
| TIS43 | 30p | | |
| 2N706 | 13p | | |
| 2N914 | 22p | | |
| 2N1304 | 22p | | |
| 2N2219 | 27p | | |

**DIODES**

| | |
|---|---|
| 1N916 | 4p |
| 1N4001 | 6p |
| 1N4002 | 7p |
| 1N4004 | 8p |
| 1N4005 | 8p |
| BA145 | 23p |
| OA91 | 7p |
| OA200 | 8p |
| 1GP7 | 12p |
| 1SJ50 | 11p |

**ELECTROLYTIC (µF/V)**

| | | | |
|---|---|---|---|
| 0 47 63 | 6p | 100 10 | 6p |
| 1 0 63 | 6p | 100 25 | 6p |
| 2 2 63 | 6p | 100 40 | 7p |
| 4 7 35 | 6p | 100 63 | 12p |
| 4 7 63 | 6p | 150 16 | 8p |
| 6 8 40 | 6p | 150 63 | 12p |
| 10 25 | 6p | 220 10 | 6p |
| 10 63 | 6p | 220 16 | 6p |
| 15 40 | 6p | 220 25 | 10p |
| 22 10 | 6p | 220 40 | 14p |
| 22 25 | 6p | 220 63 | 21p |
| 33 6 3 | 6p | 330 10 | 6p |
| 33 16 | 6p | 470 6 3 | 6p |
| 33 40 | 6p | 470 10 | 10p |
| 33 50 | 6p | 470 25 | 14p |
| 47 25 | 6p | 470 40 | 20p |
| 47 40 | 6p | 500 64 | 46p |
| 47 63 | 7p | 680 6 3 | 10p |
| 50 6 4 | 6p | 680 25 | 20p |
| | | 680 40 | 25p |
| | | 1000 10 | 14p |
| | | 1000 16 | 25p |
| | | 1000 25 | 25p |
| | | 1000 40 | 40p |
| | | 2200 25 | 45p |
| | | 2200 40 | 50p |
| | | 2800 100 | 350p |
| | | 3300 63 | 133p |
| | | 3300 100 | 350p |
| | | 4700 16 | 60p |
| | | 4700 25 | 75p |
| | | 4700 40 | 93p |

**INTEGRATED CIRCUITS**

| | | | |
|---|---|---|---|
| 709 TO5 | 40p | 7447 | 175p |
| 723 TO5 | 95p | 7473 | 44p |
| 741 8P DIL | 40p | 7489 | 432p |
| 747 14P DIL | 115p | 7815 TO220 | 220p |
| 748 TO5 | 63p | CA3046 | 69p |
| 7400 | 20p | PA263 | 168p |
| 7402 | 20p | SG3402N | 169p |
| 7420 | 20p | | |

**POLYESTER (µF)**

| | |
|---|---|
| 0 01 | 3p |
| 0 015 | 3p |
| 0 022 | 3p |
| 0 033 | 3½p |
| 0 047 | 3½p |
| 0 068 | 3½p |
| 0 1 | 4p |
| 0 15 | 5p |
| 0 22 | 5p |
| 0 33 | 7p |
| 0 47 | 9p |
| 0 68 | 11p |
| 1 0 | 14p |

**TANTALUM BEAD (µF/V)**

| | |
|---|---|
| 0 1 35 | 12p |
| 0 22 35 | 12p |
| 0 47 35 | 12p |
| 1 0 35 | 12p |
| 1 5 35 | 16p |
| 2 2 35 | 12p |
| 4 7 35 | 12p |
| 10 16 | 12p |
| 10 25 | 16p |
| 15 6 3 | 16p |
| 22 16 | 16p |
| 47 6 3 | 16p |
| 100 3 | 16p |

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| IN645 | 0·16 |
| 1N725A | 0·20 |
| 1N914 | 0·06 |
| 1N4007 | 0·12 |
| 1S113 | 0·25 |
| 1S131 | 0·13 |
| 1S202 | 0·23 |
| 2G371 | 0·40 |
| 2G381 | 0·22 |
| 2G414 | 0·30 |
| 2G417 | 0·25 |
| 2N404 | 0·22 |
| 2N697 | 0·15 |
| 2N698 | 0·30 |
| 2N706 | 0·10 |
| 2N706A | 0·12 |
| 2N708 | 0·15 |
| 2N709 | 0·40 |
| 2N1091 | 0·55 |
| 2N1131 | 0·25 |
| 2N1132 | 0·25 |
| 2N1302 | 0·18 |
| 2N1303 | 0·18 |
| 2N1304 | 0·22 |
| 2N1305 | 0·22 |
| 2N1306 | 0·28 |
| 2N1307 | 0·28 |
| 2N1308 | 0·28 |
| 2N2147 | 0·75 |
| 2N2148 | 0·60 |
| 2N2160 | 1·00 |
| 2N2218 | 0·23 |
| 2N2219 | 0·25 |
| 2N2369A | 0·16 |
| 2N2444 | 1·99 |
| 2N2613 | 0·28 |
| 2N2646 | 0·50 |
| 2N2904 | 0·20 |
| 2N2904A | 0·25 |
| 2N2906 | 0·20 |
| 2N2907 | 0·23 |
| 2N2924 | 0·18 |
| 2N2925 | 0·15 |
| 2N2926 | 0·10 |
| 2N3054 | 0·50 |
| 2N3055 | 0·60 |
| 2N3702 | 0·11 |
| 2N3705 | 0·15 |
| 2N3706 | 0·11 |
| 2N3707 | 0·18 |
| 2N3709 | 0·10 |
| 2N3710 | 0·11 |
| 2N3711 | 0·11 |
| 2N3819 | 0·35 |
| 2N4289 | 0·20 |
| 2N5027 | 0·53 |
| 2N5088 | 0·23 |
| 2S301 | 0·59 |
| 2S304 | 1·15 |
| 2S501 | 0·75 |
| 2S703 | 1·00 |
| AA129 | 0·20 |
| AAZ12 | 0·75 |
| AAZ13 | 0·10 |
| AC107 | 0·35 |
| AC126 | 0·25 |
| AC127 | 0·25 |
| AC128 | 0·20 |
| AC187 | 0·20 |
| AC188 | 0·20 |
| ACY17 | 0·35 |
| ACY18 | 0·27 |
| ACY19 | 0·27 |
| ACY20 | 0·23 |
| ACY21 | 0·23 |
| ACY22 | 0·16 |
| ACY27 | 0·25 |
| ACY28 | 0·25 |
| ACY39 | 0·65 |
| ACY40 | 0·23 |
| ACY41 | 0·23 |
| ACY44 | 0·33 |
| AD140 | 0·50 |
| AD149 | 0·50 |
| AD161 | 0·39 |
| AD162 | 0·39 |
| AF106 | 0·30 |
| AF114 | 0·25 |
| AF115 | 0·25 |
| AF116 | 0·25 |
| AF117 | 0·20 |
| AF118 | 0·50 |
| AF119 | 0·20 |
| AF124 | 0·30 |
| AF125 | 0·30 |
| AF126 | 0·30 |
| AF127 | 0·30 |
| AF139 | 0·33 |
| AF178 | 0·55 |
| AF179 | 0·65 |
| AF180 | 0·55 |
| AF181 | 0·50 |
| AF186 | 0·40 |
| AFY19 | 1·13 |

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|---|---|
| FAZ11 | 1·15 |
| AFZ12 | 2·00 |
| ASY26 | 0·25 |
| ASY27 | 0·30 |
| ASY28 | 0·25 |
| ASY29 | 0·30 |
| ASY36 | 0·25 |
| ASY50 | 0·20 |
| ASY51 | 0·40 |
| ASY53 | 0·20 |
| ASY55 | 0·20 |
| ASY62 | 0·25 |
| ASY66 | 0·33 |
| ASZ21 | 1·00 |
| ASZ23 | 0·75 |
| AU101 | 1·50 |
| AUY10 | 1·00 |
| BC107 | 0·12 |
| BC108 | 0·12 |
| BC109 | 0·12 |
| BC113 | 0·16 |
| BC115 | 0·20 |
| BC116 | 0·20 |
| BC116A | 0·23 |
| BC118 | 0·20 |
| BC121 | 0·20 |
| BC122 | 0·20 |
| BC125 | 0·68 |
| BC126 | 0·65 |
| BC140 | 0·55 |
| BC147 | 0·12 |
| BC148 | 0·10 |
| BC149 | 0·12 |
| BC157 | 0·14 |
| BC158 | 0·12 |
| BC160 | 0·63 |
| BC169 | 0·14 |
| BCY31 | 0·45 |
| BCY32 | 1·20 |
| BCY33 | 0·38 |
| BCY34 | 0·45 |
| BCY38 | 0·55 |
| BCY39 | 1·00 |
| BCY40 | 0·80 |
| BCY42 | 0·30 |
| BCY70 | 0·15 |
| BCY71 | 0·20 |
| BCZ10 | 0·60 |
| BCZ11 | 0·65 |
| BD121 | 1·00 |
| BD123 | 1·00 |
| BD124 | 0·80 |
| BDY11 | 1·45 |
| BF115 | 0·22 |
| BF117 | 0·50 |
| BF167 | 0·25 |
| BF173 | 0·28 |
| BF181 | 0·35 |
| BF184 | 0·22 |
| BF185 | 0·22 |
| BF194 | 0·13 |
| BF195 | 0·13 |
| BF196 | 0·15 |
| BF197 | 0·15 |
| BF861 | 0·25 |
| BF898 | 0·25 |
| BFX12 | 0·20 |
| BFX13 | 0·25 |
| BFX29 | 0·28 |
| BFX30 | 0·28 |
| BFX35 | 0·98 |
| BFX63 | 0·50 |
| BFX84 | 0·25 |
| BFX85 | 0·28 |
| BFX86 | 0·25 |
| BFX87 | 0·25 |
| BFX88 | 0·22 |
| BFY10 | 1·00 |
| BFY11 | 0·50 |
| BFY17 | 0·40 |
| BFY18 | 0·45 |
| BFY19 | 0·55 |
| BFY24 | 0·45 |
| BFY44 | 1·00 |
| BFY50 | 0·20 |
| BFY51 | 0·20 |
| BFY52 | 0·20 |
| BFY53 | 0·17 |
| BFY64 | 0·45 |
| BFY90 | 0·75 |
| BSX27 | 0·50 |
| BSX60 | 0·98 |
| BSX76 | 0·18 |
| BSY26 | 0·17 |
| BSY27 | 0·20 |
| BSY51 | 0·50 |
| BSY95A | 0·12 |
| BSY95 | 0·12 |
| BT102/500R | 0·75 |
| BTY42 | 0·98 |
| BTY79/100R | 0·75 |
| BTY79/400R | 1·10 |
| BY100 | 0·15 |
| BY126 | 0·14 |
| BY127 | 0·15 |
| BY182 | 0·85 |

| | £p |
|---|---|
| BY213 | 0·25 |
| BYZ10 | 0·45 |
| BYZ11 | 0·40 |
| BYZ12 | 0·40 |
| BYZ13 | 0·35 |
| BYZ15 | 1·25 |
| BYZ16 | 0·60 |
| BZY88 | 0·10 |
| C111 | 0·55 |
| CRS1/05 | 0·30 |
| CRS1/40 | 0·45 |
| CS4B | 1·90 |
| CS10B | 3·50 |
| DD000 | 0·15 |
| DD003 | 0·15 |
| DD006 | 0·25 |
| DD007 | 0·40 |
| DD008 | 0·38 |
| GD3 | 0·33 |
| GD4 | 0·10 |
| GD5 | 0·33 |
| GD8 | 0·25 |
| GD12 | 0·10 |
| GET102 | 0·50 |
| GET103 | 0·40 |
| GET113 | 0·35 |
| GET114 | 0·30 |
| GET115 | 0·75 |
| GET116 | 0·85 |
| GET120 | 0·50 |
| GET872 | 0·30 |
| GET875 | 0·40 |
| GET880 | 0·55 |
| GET881 | 0·25 |
| GET882 | 0·35 |
| GET885 | 0·40 |
| GEX44 | 0·08 |
| GEX45/1 | 0·45 |
| GEX941 | 0·45 |
| GJ3M | 0·50 |
| GJ4M | 0·50 |
| GJ5M | 0·25 |
| GJ7M | 0·50 |
| HG1005 | 0·50 |
| HS100A | 0·20 |
| MAT100 | 0·20 |
| MAT101 | 0·25 |
| MAT120 | 0·20 |
| MAT121 | 0·25 |
| MJE520 | 0·65 |
| MJE2955 | 1·10 |
| MJE3055 | 0·75 |
| MJE340 | 0·50 |
| MPF102 | 0·40 |
| MPF103 | 0·30 |
| MPF104 | 0·35 |
| MPF105 | 0·46 |
| NKT128 | 0·45 |
| NKT129 | 0·30 |
| NKT211 | 0·25 |
| NKT213 | 0·25 |
| NKT214 | 0·24 |
| NKT216 | 0·40 |
| NKT217 | 0·45 |
| NKT218 | 1·13 |
| NKT219 | 0·33 |
| NKT222 | 0·30 |
| NKT224 | 0·25 |
| NKT251 | 0·24 |
| NKT271 | 0·20 |
| NKT272 | 0·20 |
| NKT273 | 0·20 |
| NKT274 | 0·20 |
| NKT275 | 0·25 |
| NKT277 | 0·20 |
| NKT278 | 0·25 |
| NKT301 | 0·65 |
| NKT304 | 0·75 |
| NKT403 | 0·70 |
| NKT404 | 0·60 |
| NKT678 | 0·30 |
| NKT713 | 0·30 |
| NKT773 | 0·25 |
| NKT777 | 0·33 |
| O78B | 0·33 |
| OA5 | 0·60 |
| OA6 | 0·12 |
| OA47 | 0·08 |
| OA70 | 0·10 |
| OA71 | 0·20 |
| OA73 | 0·15 |
| OA74 | 0·15 |
| OA79 | 0·10 |
| OA81 | 0·10 |
| OA85 | 0·15 |
| OA86 | 0·15 |
| OA90 | 0·07 |
| OA91 | 0·07 |
| OA95 | 0·07 |
| OA200 | 0·08 |
| OA202 | 0·10 |
| OA210 | 0·20 |
| OA211 | 0·25 |
| OAZ200 | 0·50 |
| OAZ201 | 0·45 |
| OAZ202 | 0·45 |
| OAZ203 | 0·45 |
| OAZ204 | 0·45 |

| | £p |
|---|---|
| OAZ205 | 0·45 |
| OAZ206 | 0·45 |
| OAZ207 | 0·45 |
| OAZ208 | 0·40 |
| OAZ209 | 0·40 |
| OAZ210 | 0·40 |
| OAZ211 | 0·40 |
| OAZ222 | 0·45 |
| OAZ223 | 0·45 |
| OAZ224 | 0·45 |
| OAZ241 | 0·25 |
| OAZ242 | 0·15 |
| OAZ244 | 0·25 |
| OAZ246 | 0·15 |
| OAZ290 | 0·33 |
| OC16 | 1·00 |
| OC16T | 1·00 |
| OC19 | 0·50 |
| OC20 | 2·00 |
| OC22 | 1·00 |
| OC23 | 1·25 |
| OC24 | 1·10 |
| OC25 | 0·40 |
| OC26 | 0·40 |
| OC28 | 0·70 |
| OC29 | 0·65 |
| OC30 | 0·40 |
| OC35 | 0·55 |
| OC36 | 0·65 |
| OC41 | 0·35 |
| OC42 | 0·40 |
| OC43 | 0·70 |
| OC44 | 0·18 |
| OC44M | 0·17 |
| OC45 | 0·18 |
| OC45M | 0·18 |
| OC46 | 0·27 |
| OC57 | 0·60 |
| OC58 | 0·60 |
| OC59 | 0·60 |
| OC66 | 0·50 |
| OC70 | 0·18 |
| OC71 | 0·15 |
| OC72 | 0·25 |
| OC73 | 0·50 |
| OC74 | 0·30 |
| OC75 | 0·30 |
| OC76 | 0·30 |
| OC77 | 0·55 |
| OC78 | 0·25 |
| OC79 | 0·30 |
| OC81 | 0·28 |
| OC81D | 0·28 |
| OC81M | 0·20 |
| OC81DM | 0·18 |
| OC81Z | 0·45 |
| OC82 | 0·28 |
| OC82D | 0·25 |
| OC83 | 0·25 |
| OC84 | 0·30 |
| OC114 | 0·38 |
| OC122 | 1·00 |
| OC123 | 1·10 |
| OC139 | 0·40 |
| OC140 | 0·65 |
| OC141 | 0·80 |
| OC169 | 0·20 |
| OC170 | 0·25 |
| OC171 | 0·30 |
| OC200 | 0·55 |
| OC201 | 0·80 |
| OC202 | 0·90 |
| OC203 | 0·55 |
| OC204 | 0·65 |
| OC205 | 1·00 |
| OC206 | 1·10 |
| OC207 | 1·00 |
| OC460 | 0·20 |
| OC470 | 0·30 |
| OCP71 | 1·00 |
| ORP12 | 0·55 |
| ORP60 | 0·45 |
| ORP61 | 0·48 |
| SX68 | 0·20 |
| SX631 | 0·45 |
| SX635 | 0·55 |
| SX640 | 0·75 |
| SX641 | 0·75 |
| SX642 | 0·60 |
| SX644 | 0·85 |
| SX645 | 0·85 |
| TIC44 | 0·29 |
| V15/30P | 0·75 |
| V30/201P | 0·75 |
| V60/201 | 0·50 |
| V60/201P | 0·75 |
| XA101 | 0·10 |
| XA102 | 0·18 |
| XA151 | 0·15 |
| XA152 | 0·15 |
| XA161 | 0·25 |
| XA162 | 0·25 |
| XB101 | 0·48 |
| XB102 | 0·30 |
| XB103 | 0·35 |
| XB113 | 0·30 |
| XB121 | 0·43 |

| | £p |
|---|---|
| ZS170 | 0·10 |
| ZS271 | 0·16 |
| ZT21 | 0·25 |
| ZT43 | 0·25 |
| ZTX107 | 0·12 |
| ZTX108 | 0·10 |
| ZTX300 | 0·14 |
| ZTX304 | 0·24 |
| ZTX500 | 0·15 |
| ZTX503 | 0·16 |
| ZTX531 | 0·25 |

**INTEGRATED CIRCUITS**

| | |
|---|---|
| 7400 | 0·30 |
| 7401 | 0·20 |
| 7402 | 0·20 |
| 7403 | 0·20 |
| 7404 | 0·20 |
| 7405 | 0·20 |
| 7406 | 0·40 |
| 7407 | 0·40 |
| 7408 | 0·25 |
| 7409 | 0·33 |
| 7410 | 0·20 |
| 7411 | 0·23 |
| 7412 | 0·28 |
| 7413 | 0·30 |
| 7416 | 0·30 |
| 7417 | 0·30 |
| 7420 | 0·20 |
| 7422 | 0·28 |
| 7423 | 0·40 |
| 7425 | 0·37 |
| 7427 | 0·37 |
| 7428 | 0·43 |
| 7430 | 0·20 |
| 7432 | 0·37 |
| 7433 | 0·48 |
| 7437 | 0·48 |
| 7438 | 0·48 |
| 7440 | 0·20 |
| 7441AN | 0·85 |
| 7442 | 0·85 |
| 7450 | 0·20 |
| 7451 | 0·20 |
| 7453 | 0·20 |
| 7454 | 0·20 |
| 7460 | 0·20 |
| 7470 | 0·33 |
| 7472 | 0·33 |
| 7473 | 0·44 |
| 7474 | 0·48 |
| 7475 | 0·59 |
| 7476 | 0·45 |
| 7480 | 0·50 |
| 7482 | 0·87 |
| 7483 | 1·20 |
| 7484 | 1·00 |
| 7486 | 0·50 |
| 7490 | 0·75 |
| 7491A | 1·10 |
| 7492 | 0·75 |
| 7493 | 0·75 |
| 7494 | 0·85 |
| 7495 | 0·85 |
| 7496 | 1·00 |
| 7497 | 4·32 |
| 74100 | 2·16 |
| 74107 | 0·51 |
| 74110 | 0·57 |
| 74111 | 0·86 |
| 74118 | 1·00 |
| 74119 | 1·92 |
| 74121 | 0·57 |
| 74122 | 0·80 |
| 74123 | 1·44 |
| 74141 | 1·00 |
| 74145 | 1·44 |
| 74150 | 2·30 |
| 74151 | 1·15 |
| 74154 | 2·30 |
| 74155 | 1·15 |
| 74156 | 1·15 |
| 74157 | 1·09 |
| 74170 | 2·88 |
| 74174 | 1·80 |
| 74175 | 1·29 |
| 74176 | 1·44 |
| 74190 | 2·30 |
| 74191 | 2·30 |
| 74192 | 2·30 |
| 74193 | 2·30 |
| 74194 | 1·72 |
| 74195 | 1·44 |
| 74196 | 1·58 |
| 74197 | 1·58 |
| 74198 | 2·16 |
| 74199 | 2·88 |

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**INPUT 230/240V a.c. 50/60 OUTPUT VARIABLE 0–260V** All Types

**SHROUDED TYPE**

0·5 KVA (2½ amp) (MAX) £10·00
1 KVA (5 amp) (MAX) £14·70
2 KVA (10 amp) (MAX) £28·10
3 KVA (15 amp) (MAX) £31·25
4 KVA (20 amp) (MAX) £72·50
37·5 amp (MAX) £102·50
200 watt (1 amp) £9·00
CARRIAGE AND PACKING EXTRA
OPEN TYPE 1 amp (panel mount) £9·00

## L.T. TRANSFORMERS

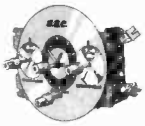
All primaries 220–240V

| Type No. | Sec. Taps | Price Post |
|---|---|---|
| 1 | 30, 32, 34, 36V at 5A | £6·90 + 45p |
| 2 | 30, 40, 50V at 5A | £9·15 + 60p |
| 3 | 10, 17, 18V at 10A | £7·20 + 50p |
| 4 | 6, 12V at 20A | £8·60 + 60p |
| 5 | 17, 18, 20V at 20A | £9·15 + 60p |
| 6 | 6, 12, 20V at 20A | £8·65 + 60p |
| 7 | 12, 20, 24V at 10A | £6·75 + 50p |
| 8 | 4, 6, 24, 32V at 12A | £8·60 + 60p |
| 9 | 6 and 12V at 10A | £4·30 + 40p |

## 300 VA ISOLATING TRANSFORMER

115/230-230/230 volts. Screened. Primary two separate 0-115V for 115 or 230 volt. Secondary two 115V at 150 VA each for 115 or 230 volt output. Can be used in series or parallel connections. Fully tropicalised. Length 13·5 cm. Width 11 cm. Height 13·5 cm. Weight 15 lb.
**SPECIAL OFFER PRICE £5.** Carr. 80p.

## A.C. MAINS TIMER UNIT

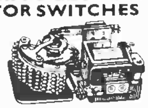


Based on an electric clock, with 25 amp. single pole switch, which can be preset for any period up to 12 hrs. ahead to switch on for any length of time, from 10 mins. to 6 hrs. then switch off. An additional 60 min. audible timer is also incorporated. Ideal for Tape Recorders, Lights, Electric Blankets, etc. Attractive satin copper finish. Size 135 mm × 130 mm × 60 mm. Price £2. Post 20p. (Total incl. VAT and Post £2·38).

## PROGRAMME TIMERS

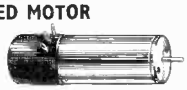
230/240V a.c. 15 r.p.m. Motors. Each cam operates a c/o micro switch. Ideal for lighting effects, animated displays, etc.Ex equipment tested.
4 cam model. £2·50 post 30p.
6 cam model. £3·25 post 30p.
12 cam model. £4·00 post 35p.
6 cam model. 3 r.p.m. £3·25 post 30p.

## MINIATURE UNISELECTOR SWITCHES



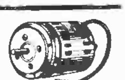
2 Bank, 11 position, 24 volt D.C. operation, full wiper with ancillary contacts. NEW Price £2·50. Post 20p. As above but with 5 Bank, 11 position. Price £3·50. Post 20p.

## CONSTANT SPEED, PRECISION MADE 6 VOLT D.C. GOVERNED MOTOR



2,750 r.p.m. Length 2 11/16 in. dia. 1/16 in. shaft 1/16 in. No load 40mA. Ideal for portable recorders, etc. £1·50. Post 15p.

## A.C. MOTOR 'Mfg. by AEI.'

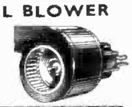


Smooth running, powerful, continuously rated, reversible motor. 230/250V a.c., 50 cycle 1/50 H.P., RPM 900, 0·25A. £3·50 post 50p.

## 230V FAN ASSEMBLY

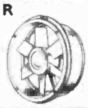
Continuously rated, removable aluminium blades. Price £1. Post 20p.

## PRECISION CENTRIFUGAL BLOWER



Mfg. Airflow Developments Ltd. Heavy Duty continuously rated, smooth running, 230/240V a.c. motor. Size: 16 × 14cm (case only). OAL 15cm. Aperture 6 × 6cm. £6·50. Post 50p.

## 230/240 VOLT A.C. EXTRACTOR FAN KIT



Comprising of impeller, continuously rated motor, motor housing and fixings as illustrated. Price £1·75. Post 25p. (Total incl. VAT and Post £2·16).

## STROBE! STROBE! STROBE!

Build a Strobe Unit, using the latest type Xenon white light flash tube. Solid state timing and triggering circuit. 230/250V a.c. operation.

**EXPERIMENTERS' ECONOMY KIT**
Speed adjustable 1 to 30 flash per sec. All electronic components including Xenon Tube and instructions £6·30. Post 30p.

**INDUSTRIAL KIT**
Ideally suitable for schools, laboratories, etc. Speed adjustable 1-80 f.p.s. Approx. ½ output of Hy-Lyght. Price £14·00. Post 50p.

**HY-LYGHT STROBE MK III**
For use in large rooms, halls and utilises a silica tube, printed circuit. Speed adjustable 0-20 f.p.s. Light output greater than many (so called 4 Joule) strobes. £14. Post 50p.

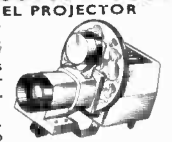
### *THE 'SUPER' HY-LYGHT KIT*

Approx. four times the light output of our well proven Hy-Lyght strobe.
- Variable speed from 1-13 flash per sec.
- Reactor control circuit producing an intense white light. ONLY £22. Post 75p.

**ROBUST, FULLY VENTILATED METAL CASE.** For Hy-Lyght Kit including reflector £5·75. Post 25p.
Super Hy-Lyght case including reflector £8. Post 60p.

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

## COLOUR WHEEL PROJECTOR



Complete with oil-filled colour wheel. 100 watt lamp. 200/240V AC. Features extremely efficient optical system. £18·50. Post 50p.
6 INCH COLOUR WHEEL
As used for Disco lighting effects, etc. Price £4·50. Post 30p.

## BIG BLACK LIGHT

400Watt. Mercury vapour ultra violet lamp. Powerful source of u.v. Innumerable industrial applications also ideal for stage, display, discos, etc. P.F. ballast is essential with these bulbs. Price of matched ballast and bulb £16. Post £1.
Spare bulb £7. Post 40p.

**BLACK LIGHT FLUORESCENT U.V. TUBES**
**4ft 40 watt.** Price £5·50. Post 30p. **2ft 20 watt,** £4·25. Post 25p. (For use in standard bi-pin fittings.)
MINI. **12in 8 watt,** £1·60. Post 15p. **9in 6 watt,** £1·30. Post 15p. Complete ballast unit and holders for 9in and 12in tube, £1·70. Post 25p. (9in and 12in measures approx.)

## 24 VOLT DC SOLENOIDS

**UNIT** containing 1 heavy duty solenoid approx. 25lb pull 1 inch travel. Two × approx. 1lb pull ½ inch travel. 6 approx. 4oz. pull ½ inch travel. One 24 volt d.c., 1 heavy duty single make relay. Price £2·50 P+p 60p.
**ABSOLUTE BARGAIN.**

## INSULATION TESTERS *NEW!*

Test to I.E.E. Spec. Rugged metal construction, suitable for bench or field work, constant speed clutch. Size L.8in. W.4in. H.6in, weight 6lb. 1,000V, 1,000 megohms, £34. Post 60p. 500V, 500 megohms, £28. Post 60p.

## TRIACS

**GENERAL ELECTRIC POWER-GLAS TRIACS**
10 amp. Glass passivated plastic triac. Latest device from U.S.A. Long term reliability. Type SC146D 10 amp, 400 PIV, £1, Post 5p. Type SC146E 10 amp, 500 PIV, £1·30. Post 5p. (Inclusive of data and application sheet.) Suitable Diac 18p.

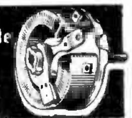
**HIGH VISIBILITY PANEL MOUNTING LED's.** 0·25 inch mounting, 0·16 inch lens. Typical parameters 2V, 20M amps all type. Supplied complete with snap in mountings and data. Red 4 for £1, Green 3 for £1, Yellow 3 for £1. Post 5p. (in order) (£1).

**LED READOUTS**

7 series, L/H d.p. one-third high character. 14 pin D.I.L. Available in RED or GREEN. Price £1·65. Post 10p. 4 for £6. Post paid.

All prices are subject to 8% VAT. (8p in the £)
To all orders add 8% VAT to total value of goods including carriage/packaging.

## Superior Quality Precision Made NEW POWER RHEOSTATS



New ceramic construction, vitreous enamel embedded winding, heavy duty brush assembly, continuously rated.
**25 WATT** 10/25/50/100/150/500/1k/ohm £1·15. Post 10p.
**50 WATT** 1/5/10/25/50/100/250/500/1·5k/ohm £1·60. Post 10p.
**100 WATT** 1/5/10/25/50/100/250/500/1k/1·5k/2·5k/3·5k/5k ohm £2·35. Post 15p.
**Black Silver, Skirted knob** calibrated in Nos. 1-9. 1¼in. dia. brass bush. Ideal for above Rheostats, 22p each.

## RELAYS SIEMENS, PLESSEY, Etc. MINIATURE RELAYS

| Col. (1) Coil ohms / Col. (2) Working d.c. volts / Col. 3 Contracts / Col. (4) Price | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| | 58 | 5–9 | 6 c/o | 80p |
| | 150 | 4–9 | 2 c/o | 70p* |
| | 185 | 8–12 | 6M | 60p* |
| | 308 | 9–14 | 4 c/o | 75p* |
| | 410 | 12–20 | 4 c/o | 80p* |
| | 700 | 16–24 | 4M 2B | 60p* |
| | 700 | 16–24 | 4 c/o | 80p* |
| | 700 | 6–12 | 1 c/o HD | 70p* |
| | 700 | 20–30 | 6 c/o | 50p* |
| | 2,500 | 31–43 | 2 c/o HD | 60p* |
| | 2,500 | 36–45 | 6M | 60p |
| | 9,000 | 40–70 | 2 c/o | 60p* |
| | 15k | 85–110 | 6M | 60p* |

HD = Heavy duty
*Incl. Base
All prices incl. P. & P.

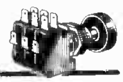
**6 VOLT D.C.** 1 make contacts **35p.** Post 5p.
**6 VOLT D.C.** 2 make contacts **75p.** Post 5p.
**9 VOLT D.C. RELAY**
3 c/o 5 amp contacts. 70 ohm coil. **75p.** Post 5p.
**12 VOLT D.C. RELAY**
3 c/o 5 amp contacts. 120 ohm coil. **75p.** Post 5p.
**24 VOLT D.C.** 3 c/o **75p.** Post 5p.
**DIAMOND 'H' Heavy Duty**
230/240V a.c. 2 c/o, 25 amp RES. at 250V a.c. **£2.** Post 10p.

## CLARE-ELLIOTT TYPE RP7641 G8

Miniature relay. 675 ohm coil. 24 Volt D.C. 2 c/o. **70p** post paid.
**100 VOLT A.C.** 2 c/o sealed type, octal base **£1.** Post 10p.
**24 VOLT A.C.** Mfg. by ITT.2 h.d. c/o contacts. **55p.** Post 5p.
**240 VOLT A.C. RELAY.** Mfg. by ITT. 240V A.C. 10 amp h.d. c/o contacts. Octal plug in base. Price **75p.** Post 5p.
**220/240 VOLT A.C. RELAY**
3 c/o 5 amp contacts. Sealed. Incl. 11-pin base **£1·25.** Post 10p.
**HEAVY DUTY A.C. SEALED RELAYS**
110V. 2 c/o. 20 amp contacts. **£1·25.** Post 10p.

**DRY REED RELAYS**
Mfg. by ERG, 12 volt d.c. encapsulated.
Single c/o **65p,** post paid. Two c/o **85p,** post paid.
**STC** 280 ohm coil 6/12V d.c. 3 make metal shrouded. **60p** post paid.
Other types available, state your requirement.

**"HONEYWELL" PUSH BUTTON, PANEL MOUNTING MICRO SWITCH ASSEMBLY**

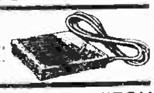


Each bank comprises a c/o rated at 10 amps 240V. A.C. Black knob 1in. Fixing hole ⅜ in. ONE bank **30p;** TWO bank **40p;** THREE bank **50p.** Quote for quantity.

## VERY SPECIAL OFFER

**MINIATURE ROLLER MICRO SWITCH.** 5 amp. c/o contacts. Mfg. BONNELLA. NEW. Price 10 for **£1·50.** Post 10p. (Min. order 10).
AS above WITHOUT ROLLER. 20 for **£2.** Post 10p.

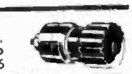
## FOOT SWITCH



Suitable for Motors, Drills, etc., etc. 5 amp. 250 volt. Price **75p.** Post 15p.

**600 WATT DIMMER SWITCH**
Easily fitted. Fully guaranteed by makers. Will control up to 600W of lighting except fluorescent at mains voltage. Complete with simple instructions. **£2·75.** Post 25p.

**INSULATED TERMINALS**



Available in black, red, white, yellow, blue and green. New. **12p** each incl. P. & P. Minimum order 6

**METERS NEW!** 2½in. Flush round. Available in D.C. Amps 1, 5, 10, 15, 20 or A.C. Amps 1, 5, 10, 15, 20. Voltmeter 0-300V A.C. All types **£2.** Post 15p.

All Mail Orders—Callers—Ample Parking
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**Phone 01-995 1560**
Showroom open Mon.-Fri.

# SERVICE TRADING CO.

*Personal callers only. Open Sat.*
**9 LITTLE NEWPORT STREET LONDON WC2H 7JJ**
**Phone 01-437 0576**

# SCS FOR QUALITY COMPONENTS

## MOTOROLA

| | | Each |
|---|---|---|
| F.M. Multiplex Stereo Decoder | MC1310P | 2·93 |
| Four Channel SQ Decoder | MC1312P | 2·24 |
| OP Power Transistor | 2N3055 | 0·65 |
| OP Power Transistor | MJE3055 | 0·68 |

## SIGNETICS

| | | |
|---|---|---|
| I/C Timer | NE555V | 0·80 |
| Dual I/C Timer | NE556A | 1·40 |
| High Phased Locked Loop | NE560B | 4·20 |
| High Phased Locked Loop with AM Demod | NE561B | 4·20 |
| High Phased Locked Loop with Open VCO | NE562B | 4·20 |
| Precision Phased Locked Loop | NE565A | 2·90 |
| Function Generator | NE566V | 1·55 |
| Tone Decoder | NE567V | 2·90 |

## G.I.M.

| | | |
|---|---|---|
| Eight Digit Calculator Chip | C500 | 11·00 |
| Eight Digit Calculator Chip | C550 | 9·50 |
| 3½ Decade DVM Chip | AY-5-3510 | 6·40 |
| Decade Counter, Latch, Driver | AY-5-4007D | 8·35 |
| **Organ Circuits:** | | |
| 7 Stage Generator | AY-1-0212 | 5·55 |
| 7 Stage Divider | AY-1-5050 | 2·35 |
| 4 Stage Divider | AY-1-5051 | 1·20 |
| 5 Stage Divider | AY-1-6721/5 | 1·30 |
| 6 Stage Divider | AY-1-6721/6 | 1·45 |
| **Static Shift Registers:** | | |
| Static Shift Register | SL-6-2064 | 2·90 |
| Static Shift Register | SL6-4032 | 4·00 |
| Static Shift Register | SL5-2128 | 3·45 |
| Static Shift Register | SL7-2128 | 3·80 |
| Static Shift Register | SL7-4056 | 3·45 |
| Static Shift Register | SS-6-8211 | 3·30 |
| Static Shift Register | SS-6-8212 | 2·15 |

## FERRANTI

| | | |
|---|---|---|
| Radio Receiver | ZN414 | 1·20 |

## ELECTRONIC CALCULATOR

Details of the Offer:

1 eight-digit calculator i.c. (General Instrument Microelectronics Type C500); plus 8 seven-segment l.e.d. alpha-numeric displays (Monsanto, Type MAN3).

Data sheets are supplied.

Price for the "package" offer: £14 plus VAT.

Data information supplied with each device.

Write for free catalogue of our large stocks of Ferranti, Motorola, G.I., Monsanto, Mullard, Signetics and R.C.A. components.

On total add 20p postage and packing + VAT on total of order.

## S.C.S.

**P.O. Box No. 26 (Dept. PE), Wembley, Middx. HA0 1SD, England**



# Trannies

**4 Bush House, Bush Fair, Harlow, Essex.**

- ★ PRICES INCLUSIVE OF V.A.T.
- ★ Retail Shop open 9 to 5.30 Mon. to Sat.
- ★ Post & Package 15p.
- ★ 1974 Catalogue 20p.

| SEMICONDUCTORS | | | | BRIDGE RECTIFIERS | |
|---|---|---|---|---|---|
| AC126 | 14p | OC44 | 16p | | |
| AC127 | 16p | OC45 | 10p | 1 Amp | |
| AC128 | 15p | OC71 | 11p | 100V | 22p |
| AC141K | 26p | OC81 | 12p | 200V | 24p |
| AC142K | 26p | 2N706 | 14p | 600V | 27p |
| AC176 | 18p | 2N1131 | 24p | **THYRISTORS** | |
| AC187 | 24p | 2N1132 | 28p | | |
| AC188 | 24p | 2N2904 | 20p | 1 Amp | |
| AC187K | 23p | 2N2926 | 11p | 50V | 29p |
| AC188K | 23p | 2N3053 | 26p | 100V | 32p |
| AD149 | 49p | 2N3054 | 55p | 200V | 34p |
| AD161 | 33p | 2N3055 | 49p | 400V | 44p |
| AD162 | 40p | 2N3702 | 14p | 3 Amp | |
| AF114 | 20p | 2N3703 | 13p | 50V | 39p |
| AF115 | 20p | 2N3704 | 14p | 100V | 44p |
| AF116 | 20p | 2N3705 | 13p | 200V | 48p |
| AF117 | 20p | 2N3706 | 12p | 400V | 66p |
| BC107 | 13p | 2N3707 | 13p | 5 Amp | |
| BC108 | 12p | 2N3708 | 11p | 50V | 46p |
| BC109 | 13p | 2N3709 | 12p | 100V | 57p |
| BC147 | 13p | 2N3710 | 12p | 200V | 66p |
| BC148 | 13p | 2N3711 | 12p | 400V | 77p |
| BC149 | 13p | 2N3819 | 35p | **TRIACS** | |
| BC182 | 13p | 40361 | 55p | 2 Amp | |
| BC183 | 11p | 40362 | 55p | 100V | 33p |
| BC184 | 14p | 40636 | 69p | 200V | 55p |
| BC212 | 13p | 1N914 | 8p | 400V | 77p |
| BC213 | 13p | 1N916 | 8p | 6 Amp | |
| BC214 | 13p | 1N4001 | 7p | 100V | 66p |
| BD131 | 68p | 1N4002 | 8p | 200V | 88p |
| BD132 | 90p | 1N4003 | 10p | 400V | 99p |
| BF194 | 16p | 1N4004 | 10p | 10 Amp | |
| BF195 | 17p | 1N4006 | 15p | 100V | 99p |
| BF244 | 27p | 1N4148 | 6p | 200V | 1·32 |
| BFY50 | 18p | 1N5400 | 16p | 400V | 1·43 |
| BFY51 | 18p | 1N5401 | 17p | **400mW ZENER** | |
| BFY52 | 17p | 1N5402 | 19p | | |
| MP8111 | 36p | 1N5404 | 24p | **DIODES** | |
| OC28 | 50p | 1N5406 | 28p | 3·3 to 33 | |
| OC26 | 50p | | | volt 11p each | |

See advertisement in Practical Wireless for full range of TTL integrated circuits

## TRANNIES DISCO UNIT

Includes

- ★ DJ 100W discotheque amp. with full mixing and PFL facilities. £94·75.
- ★ Stereo headphone with boom microphone. £9·90.
- ★ Trannies disco console with 2 Garrard SP25 Mk. IV turntables. £59·00
- ★ Pair 50W Speakers £47·00

OR COMPLETE SYSTEM £189·97, carriage £5·00. Terms available, no deposit, £10·16 monthly for 24 months.

We stock a full range of Disco Equipment. Send for list or pay a visit.

## £1 BARGAIN PACKS

- £1 10 Silicon NPN Power transistors (like 2N3055). Below spec.
- £1 30 Plastic FET's unmarked untested, similar to 2N3819 (random test showed good yield)
- £1 20 TO5 transistors NPN or PNP, state which, 2 to 5 amp u/tested.
- £1 20 TO18 transistors PNP like BC178, BC179, etc U/tested.
- £1 30 Plastic Power NPN transistor TO220 case like 2N3055. U/tested
- £1 10 General Purpose fully tested FET's.
- £1 200 mixed capacitors.
- £1 500 mixed resistors

☆ Any 5 packs £4·50 ☆

Post/package 10p per pack

## Resistors

| | |
|---|---|
| ¼ watt 5% carbon .......... | 1p |
| ½ watt 5% carbon .......... | 1p |
| 1 watt 10% carbon .......... | 3p |
| range 10 ohms to 4·7 megohms. | |
| ½ watt m/o 2% .............. | 4p |
| range 10 ohms to 1 megohms. | |

## VEROBOARD

| | 0·1 | 0·15 |
|---|---|---|
| 2½ × 3¾ | 24p | 19p |
| 2½ × 5 | 27p | 23p |
| 3¾ × 3¾ | 27p | 23p |
| 3¾ × 5 | 31p | 31p |
| 17 × 2½ | 82p | 63p |
| 17 × 3¾ | £1·10 | 87p |
| 17 × 5 (Plain) | | 90p |
| Pin insertion tool | 57p | 57p |
| Spot face cutter | 46p | 46p |
| Pk. 36 Pins | 20p | 20p |

## Electrolytic Capacitors

| 6·3 VOLT | |
|---|---|
| 68µF | 6½p |
| 150µF | 6½p |
| 470µF | 11p |
| 680µF | 13p |
| 1500µF | 18p |
| 2200µF | 18p |
| 3300µF | 26p |

| 10 VOLT | |
|---|---|
| 47µF | 6½p |
| 100µF | 6½p |
| 220µF | 8p |
| 330µF | 10p |
| 470µF | 10p |
| 1000µF | 11p |
| 1500µF | 20p |
| 2200µF | 24p |

| 16 VOLT | |
|---|---|
| 15µF | 6½p |
| 33µF | 6½p |
| 150µF | 6½p |
| 150µF | 8p |
| 220µF | 9p |
| 680µF | 17p |
| 1000µF | 17p |
| 1500µF | 25p |
| 2000µF | 43p |

| 25 VOLT | |
|---|---|
| 10µF | 6½p |
| 22µF | 6½p |
| 47µF | 6½p |
| 100µF | 8p |
| 150µF | 8p |
| 220µF | 10p |
| 470µF | 13p |
| 680µF | 20p |
| 1000µF | 22p |
| 2200µF | 39p |
| 5000µF | 68p |

| 40 VOLT | |
|---|---|
| 6·8µF | 6½p |
| 15µF | 6½p |
| 33µF | 6½p |
| 47µF | 6½p |
| 100µF | 9p |
| 68µF | 10p |
| 220µF | 11p |
| 470µF | 19p |
| 680µF | 25p |
| 1000µF | 25p |
| 2200µF | 44p |

| 63 VOLT | |
|---|---|
| 1µF | 6½p |
| 2·2µF | 6½p |
| 4·7µF | 6½p |
| 6·8µF | 6½p |
| 10µF | 6½p |
| 22µF | 6½p |
| 68µF | 10p |
| 100µF | 11p |
| 150µF | 13p |
| 220µF | 19p |
| 330µF | 22p |
| 470µF | 26p |
| 1000µF | 44p |

## VOLUME CONTROLS

**Potentiometers**

Carbon track 500Ω to 2·2MΩ Log or Linear.
Single 13p. Dual gang (stereo) 44p.
Single type with D.P. switch 13p extra.

## CARBON SKELETON PRESETS

Small high quality type (linear only). All valves 100·5 meg ohms.

- −1 watt 6p each
- −2·5 watt 6½p each

## VISIT OUR RETAIL SHOP AT BUSH FAIR

Monday to Saturday 9 to 5.30.

## SLIDE SWITCH

SPST 11p each. D.P.D.T 13p each.

## MINIATURE NEON LAMPS

240V or 110V 1·4 5p 5 plus 4½p each.

## Mullard Polyester Capacitors

**C280 SERIES**

250V P.C. mounting: 0·01µF, 0·015, 0·022 3½p. 0·033, 0·047, 0·068 4p. 0·1 4½p. 0·15, 0·22 5½p. 0·33 7p. 0·47 9½p. 0·68 12p. 1µF 14p. 1·5µF 22p. 2·2µF 27p.

**C296 SERIES**

400V: 0·001µF, 0·0015, 0·0022, 0·0033, 0·0047 3p. 0·0068, 0·01, 0·015, 0·022, 0·033 3½p. 0·047, 0·068, 0·1 4½p. 0·15 6½p. 0·22 8½p. 0·33 12p. 0·47 14½p.
160V: 0·01µF, 0·015, 0·022, 0·033, 0·047, 0·068 3½p. 0·1 4p. 0·15 4p. 0·1 4½p. 0·15, 0·22 5½p. 0·33 7p. 0·47 9½p. 0·68 12p. 1µF 14½p. 1·5µF 22p. 2·2µF 24p.

ERSIN Multicore 5 CORE SOLDER

## for fast, easy reliable soldering

Ersin Multicore Solder contains 5 cores of non-corrosive flux, instantly cleaning heavily oxidised surfaces. No extra flux is required.

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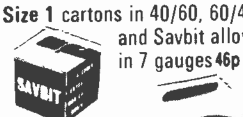
**Size 5** Savbit alloy 18 swg. **30p** (illustrated).
**Size 19A** 60/40 alloy 18 swg. **30p**
**Size 15** 60/40 alloy 22 swg. **34p**

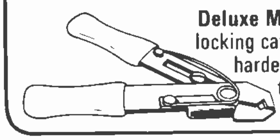
### IDEAL FOR HOME CONSTRUCTORS

**Size 1** cartons in 40/60, 60/40 and Savbit alloys in 7 gauges **46p**



**Size 12 REEL** for Service Engineers and Electricians. 18 swg Savbit alloy. **£1·46**

### BIB WIRE STRIPPER AND CUTTER



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

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**SOLARTRON** Precision Laboratory Oscilloscope type CD 643. D.C.—15 MHz. 5" Flat face tube. **£45 each** Carr. £1·50

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

**20 Hz to 200 kHz WB. SINE and SQUARE GENERATOR.** Four ranges. Independent amplitude controls, thermistor stabilised. Ready to use, 9V supply required. **£7·85** each. P. & P. 25p (Not cased, not calibrated.)

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**£1 WORTH OF "UFS".** Six brand new capacitors all between 15V and 100V. Total capacitance not less than 7,000mF. P. & P. 45p.

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A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohm. Frequency response 12Hz–30KHz ±3dB. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8–15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high × 6" wide × 7½" deep. AC 200/250V. **PRICE £12·00.** P. & P. 50p.

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A.C. mains 200–240V. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up: 2 × ECL86 Triode Pentodes, 1 × EZ80 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate "Balance" control fitted at the rear of the chassis. Input sensitivity is approximately 300m/v for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11"w × 4"d. Overall height including valves 5". Ready built & tested to a high standard. **PRICE £10·40.** P. & P. 50p.

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5in 3 ohm **£1·25**, P. & P. 15p. 7in × 4in 3 ohm **£1·40**, P. & P. 20p. 10in × 6in 3 or 15 ohm **£3·10**, P. & P. 30p. E.M.I. 8in × 5in 3 ohm with high flux magnet, **£1·70**, P. & P. 20p. E.M.I. 13½in × 8in with high flux ceramic magnet with parasitic tweeter 3, 8 or 15 ohm, **£3·50**, P. & P. 30p. E.M.I. 13in × 8in 3 or 8 or 15 ohm with two inbuilt tweeters and crossover network, **£4·65**, P. & P. 30p.

EMI CERAMIC MAGNET HEAVY DUTY TWEETER Approx. 3½in. Av. 3 or 8 or 15 ohms, **£1·25**, P. & P. 20p.

## SPECIAL OFFER!

**LIMITED NUMBER OF BRAND NEW ELAC 10in TWIN CONE LOUDSPEAKERS.** With large ceramic magnet and plasticised cone surround. 8 ohm impedance. **£3·70**, P. & P. 35p.

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### HI-FI LOUDSPEAKER SYSTEMS

Beautifully made teak finish enclosure with most attractive Tygan-Vynair front. Size 16in high × 10½in wide × 6in deep. Fitted with E.M.I. Ceramic Magnet 13in × 8in bass unit, two H.F. tweeter units and crossover. Max. power handling 10W. Available 3, 8 or 15 ohm impedance.

**Our Price £9·25** Carr. 75p.

CABINET AVAIL. SEPARATELY **£4·95.** Carr. 65p. Also available in 8 ohm with EMI 13in × 8in. bass speaker with parasitic tweeter. **£7·15.** Carr. 75p.

## 3-VALVE AUDIO AMPLIFIER HA34 MK II

Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½"w × 4"d × 4½"h. Incorporates ECC83 EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only **£6.** P. & P. 45p.

**HSL "FOUR" AMPLIFIER KIT.** Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. **£5·00.** P. & P. 45p.

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Limited number of BSR C123 Auto Changer De Luxe with lightweight tubular arm and stereo cartridge. **Brand new. ONLY £8·00** + P. & P. 60p.

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made by Evershed and Vignoles Ltd. Measures from 0·1 ohm to 200,000 ohms in 2 switched ranges. Used but in perfect condition. Complete with test probes, leather carrying case and 4½ volt standard battery. Only **£7·00** + P. & P. 40p.

## HARVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT

**NEW FURTHER IMPROVED MODEL WITH HIGHER OUTPUT AND INCORPORATING HIGH QUALITY READY DRILLED PRINTED CIRCUIT BOARD WITH COMPONENT IDENTIFICATION CLEARLY MARKED FOR EASIER CONSTRUCTION**

A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. (Very simple to modify to suit magnetic cartridge—instructions included). Output stage for any speakers from 5 to 15 ohms. Compact design, all parts supplied including drilled metal work, high quality ready drilled printed circuit board, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Power output 14W r.m.s. per channel into 5 ohms. Frequency response ± 3dB 12–30,000Hz. Sensitivity better than 80mV into 1MΩ. Full power bandwidth ± 3dB 12–15,000Hz. Bass boost approx. to ± 12dB. Treble cut approx. to −16dB. Negative feedback 18dB over main amp. Power requirements 35V at 1·0 amp. Overall size—12" wide × 8" deep × 2½" high.
Fully detailed 7-page construction manual and parts list free with kit or send 18p plus large S.A.E.
**PRICES** AMP. KIT, **£11·55** P. & P. 25p. (Mag. input components 33p extra). POWER PACK KIT, **£3.50** P.&P. 35p. CABINET, **£3·50** P. & P. 35p.
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A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3–15Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet **15p** plus S.A.E. (Free with parts). **All parts sold separately.** ONLY **£9·00.** P. & P. 60p. Also avail. ready built & tested **£13.** P. & P. 70p.

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30-14,500 cps. Double cone woofer and tweeter loudspeaker. Baker ceramic magnet assembly, flux density 145,000 gauss. BASS RESONANCE 40 cps 20 watt RMS.

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| AC176 | 20p |
| AC153/176K | 52p |
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| AC187/188K | 40p |
| ACY17 | 27p |
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| ACY19 | 20p |
| ACY20 | 20p |
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| ACY22 | 10p |
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| AD161 | 44p |
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| AF115 | 27p |
| AF116 | 25p |
| AF117 | 25p |
| AF118 | 44p |
| AF124 | 25p |
| AF125 | 24p |
| AF126 | 24p |
| AF139 | 47p |
| AF186 | 40p |
| AF239 | 52p |
| AF279 | 58p |
| ASY26 | 25p |
| ASY27 | 30p |
| ASY28 | 22p |
| ASY29 | 30p |
| BA138 | 15p |
| BB103 | 20p |
| BB104 | 34p |
| BB105 | 28p |
| BC107 | 16p |
| BC107/BC177 | 36p |
| BC108 | 16p |
| BC108/BC178 | 32p |
| BC109 | 18p |
| BC109/BC179 | 38p |
| BC109C | 18p |
| BC117 | 15p |
| BC140 | 30p |
| BC147 | 12p |
| BC148 | 11p |
| BC149 | 12p |
| BC157 | 13p |
| BC158 | 12p |
| BC159 | 13p |
| BC147/157 | 25p |
| BC148/158 | 23p |
| BC149/159 | 25p |
| BC167 | 11p |
| BC168 | 10p |
| BC169 | 11p |
| BC169C | 12p |
| BC177 | 20p |
| BC178 | 16p |
| BC179 | 20p |
| BC182 | 14p |
| BC182L | 14p |
| BC183 | 13p |
| BC183L | 14p |
| BC184 | 17p |
| BC184L | 16p |
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| BDY20 | 81p |
| BF115 | 23p |
| BF163 | 35p |
| BF167 | 25p |
| BF173 | 29p |
| BF177 | 25p |
| BF178 | 31p |
| BF180 | 35p |
| BF194 | 15p |
| BF195 | 15p |
| BF196 | 15p |
| BF200 | 35p |
| BF254 | 14p |
| BF255 | 15p |
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| BFX87 | 30p |
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| BPX29 | £1·40 |
| BPX66 | £1·50 |
| BR100 | 20p |
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| CD4009AE | £1·16 |
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| CD4012AE | 55p |
| CD4013AE | £1·11 |
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| CD4017AE | £2·92 |
| CD4018AE | £2·92 |
| CD4020AE | £3·25 |
| CD4024AE | £2·09 |
| CD4027AE | £1·73 |
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| Type | Price |
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| CRS3/40AF | £1·53 |
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| D10 (NTGD10) | 40p |
| HP5082 | 29p |
| HS822-33 | 46p |
| HT841-33 | £2·24 |
| HT861-33 | £2·90 |
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| IRT84 | £2·24 |
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| MC1305P | £2·80 |
| MC1307P | £1·65 |
| MC1310P | £2·80 |
| MC1330P | 80p |
| MC1352P | £2·00 |
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| MC4024P | £2·20 |
| MC4044P | £2·20 |
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| MFC6030 | £1·63 |
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| MJE371 | 68p |
| MJE520 | 85p |
| MJE521 | 82p |
| MJE2955 | £1·06 |
| MJE3055 | 68p |
| MJ480 | 97p |
| MJ481 | £1·25 |
| MJ491 | £1·35 |
| MJ802 | £4·12 |
| MJ802/MJ4502 | £8·56 |
| MJ900 | £1·80 |
| MJ1000 | £1·50 |
| MJ4502 | £4·44 |
| MLM309K | £1·90 |
| MPF102 | 37p |
| MPF103 (2N5457) | 49p |
| MP104 (2N5458) | 49p |
| MPF105 (2N5459) | 46p |
| NE555V | 78p |
| NKT0033 | 96p |
| NKT211 | 25p |
| NKT212 | 25p |
| NKT213 | 25p |
| NKT216 | 46p |
| NKT217 | 50p |
| NKT218 | 25p |
| NKT223 | 27p |
| NKT271 | 18p |
| NKT274 | 18p |
| NKT275 | 20p |
| NKT279A | 12p |
| NKT281 | 29p |
| NKT351 | 75p |
| NKT401 | 78p |
| NKT402 | 83p |
| NKT403 | 71p |
| NKT404 | 68p |
| NKT405 | 87p |
| NKT406 | 89p |
| NMC409 | £1·00 |
| NMC469 | 66p |
| NMC505 | £3·00 |
| NTGD10 | 40p |
| OA10(NTGD10) | 40p |
| OA47 | 8p |
| OA79 | 8p |
| OA90 | 6p |
| OA91 | 5p |
| OA95 | 5p |
| OA200 | 6p |
| OA202 | 7p |
| OC25 | 45p |
| OC28 | 78p |
| OC29 | 79p |
| OC35 | 96p |

| Type | Price |
|---|---|
| OC36 | 69p |
| OC41 | 40p |
| OC42 | 40p |
| OC44 | 20p |
| OC45 | 20p |
| OC71 | 20p |
| OC72 | 20p |
| OC75 | 25p |
| OC76 | 25p |
| OC77 | 40p |
| OC81 | 20p |
| OC81D | 20p |
| OC83 | 23p |
| OC84 | 25p |
| OC139 | 25p |
| OC170 | 25p |
| OC171 | 30p |
| OCP71M | 42p |
| ORP12 | 50p |
| ORP60 | 50p |
| ORP61 | 50p |
| ORP69 | 50p |
| PM7A2 | £1·85 |
| PM7A6 | £2·50 |
| PN70 | 10p |
| PN71 | 10p |
| PN107 | 8p |
| PN108 | 8p |
| PN109 | 8p |
| PN3619 (2N3819) | 20p |
| SL103A | 50p |
| SL403A (Rectifier) | 60p |
| SL803A | 80p |
| ST2 | 20p |
| TAA263 | £1·12 |
| TAA293 | 97p |
| TAA310 | £1·25 |
| TAA320 | 75p |
| TAA861 | 45p |
| TAD100 | £1·97 |
| TAD110 | £1·97 |
| TBA810S | £1·68 |
| TIL112 | £2·00 |
| TIL209 | 30p |
| TIP31A | 60p |
| TIP32A | 70p |
| TIP41A | 85p |
| TIP42A | £1·00 |
| TIS43 | 30p |
| TR1 | 20p |
| VA1039 | 15p |
| VA1040 | 15p |
| VA1066s | 15p |
| VA1077 | 15p |
| W005 | 25p |
| W01 | 28p |
| W02 | 26p |
| W04 | 27p |
| W06 | 32p |
| W08 | 41p |
| ZTX107 | 12p |
| ZTX108 | 11p |
| ZTX300 | 13p |
| ZTX302 | 18p |
| ZTX303 | 15p |
| ZTX304 | 23p |
| ZTX314 | 11p |
| ZTX320 | 30p |
| ZTX330 | 18p |
| ZTX500 | 14p |
| ZTX501 | 15p |
| ZTX502 | 18p |
| ZTX503 | 17p |
| ZTX504 | 45p |
| 1N914 | 4p |
| 1N3754 | 20p |
| 1N4001 | 4p |
| 1N4002 | 4p |
| 1N4003 | 5p |
| 1N4004 | 7p |
| 1N4005 | 7p |
| 1N4006 | 8p |
| 1N4007 | 9p |
| 1N4148 | 4p |
| 1N5400 | 14p |
| 1N5404 | 18p |
| 1N5408 | 25p |
| 1S44 | 4p |
| 1S920 | 7p |
| 1S940 | 8p |
| 2N404 | 23p |
| 2N696 | 15p |
| 2N697 | 17p |

| Type | Price |
|---|---|
| 2N698 | 30p |
| 2N706 | 10p |
| 2N706A | 12p |
| 2N708 | 18p |
| 2N911 | 50p |
| 2N914 | 20p |
| 2N918 | 42p |
| 2N929 | 25p |
| 2N930 | 28p |
| 2N1131 | 24p |
| 2N1132 | 24p |
| 2N1302 | 17p |
| 2N1303 | 17p |
| 2N1304 | 24p |
| 2N1305 | 24p |
| 2N1306 | 30p |
| 2N1307 | 30p |
| 2N1308 | 34p |
| 2N1309 | 34p |
| 2N1559(CR1/401C) | 71p |
| 2N1613 | 15p |
| 2N1711 | 15p |
| 2N1893 | 54p |
| 2N2218 | 33p |
| 2N2218A | 44p |
| 2N2219 | 38p |
| 2N2219A | 53p |
| 2N2368 | 17p |
| 2N2369 | 17p |
| 2N2369A | 17p |
| 2N2484 | 42p |
| 2N2646 | 45p |
| 2N2904 | 44p |
| 2N2904A | 49p |
| 2N2905 | 65p |
| 2N2905A | 75p |
| 2N2924 | 18p |
| 2N2925 | 20p |
| 2N2926 | 10p |
| 2N3053 | 24p |
| 2N3054 | 65p |
| 2N3055 | 65p |
| 2N3228 | £1·10 |
| 2N3391A | 29p |
| 2N3525 | £1·04 |
| 2N3702 | 14p |
| 2N3703 | 12p |
| 2N3704 | 12p |
| 2N3705 | 12p |
| 2N3706 | 12p |
| 2N3707 | 12p |
| 2N3708 | 12p |
| 2N3709 | 12p |
| 2N3710 | 12p |
| 2N3711 | 12p |
| 2N3773 | £2·50 |
| 2N3819 | 28p |
| 2N3820 | 60p |
| 2N3823E | 20p |
| 2N3826 | 30p |
| 2N3866 | £1·10 |
| 2N3904 | 28p |
| 2N3906 | 28p |
| 2N4058 | 15p |
| 2N4060 | 13p |
| 2N4061 | 13p |
| 2N4062 | 13p |
| 2N4441 | 70p |
| 2N4444 | £2·20 |
| 2N4871 | 44p |
| 2N4990 | 68p |
| 2N4991 | 48p |
| 2N5245 | 45p |
| 2N5457 (MPF103) | 48p |
| 2N5458 (MPF104) | 49p |
| 2N5459 (MPF105) | 48p |
| 2N5756 | £1·20 |
| 2N5777 | 45p |
| 2N6027 (D13T1) | 45p |
| 3N84 | £1·30 |
| 3N128 | 73p |
| 3N140 | 82p |
| 3N152 | 92p |
| 741/TO5 | 45p |
| 741/8DIL | 34p |
| 723/TO5 | £1·02 |
| 723/14DIL | £1·02 |
| 747/14DIL | 48p |
| 748/14DIL | 39p |
| 3015F | £1·40 |

| Type | Price |
|---|---|
| 3015G | £2·00 |
| 7400 | 24p |
| 7401 | 24p |
| 7042 | 24p |
| 7403 | 24p |
| 7404 | 30p |
| 7405 | 30p |
| 7408 | 30p |
| 7409 | 30p |
| 7410 | 24p |
| 7413 | 36p |
| 7420 | 24p |
| 7425 | 36p |
| 7430 | 24p |
| 7440 | 29p |
| 7442 | £1·39 |
| 7443 | £1·74 |
| 7444 | £1·74 |
| 7445 | £2·47 |
| 7446 | £1·74 |
| 7447 | £1·50 |
| 7450 | 24p |
| 7451 | 24p |
| 7453 | 24p |
| 7454 | 24p |
| 7460 | 24p |
| 7470 | 54p |
| 7472 | 36p |
| 7473 | 54p |
| 7474 | 55p |
| 7475 | 54p |
| 7476 | 54p |
| 7480 | 80p |
| 7482 | £1·04 |
| 7483 | £1·58 |
| 7486 | 39p |
| 7490 | 84p |
| 7491A | £1·54 |
| 7492 | £1·02 |
| 7493 | 90p |
| 7494 | £1·38 |
| 7495 | 96p |
| 7496 | £1·78 |
| 74100 | £1·97 |
| 74107 | 62p |
| 74121 | 51p |
| 74141 | £1·20 |
| 74150 | £4·02 |
| 74151 | £1·32 |
| 74153 | £1·82 |
| 74154 | £2·40 |
| 74155 | £1·88 |
| 74156 | £1·88 |
| 74190 | £2·16 |
| 74191 | £2·16 |
| 74192 | £2·09 |
| 74193 | £2·09 |
| 74196 | £1·80 |
| 74197 | £1·80 |
| 40250 | 68p |
| 40309 | 40p |
| 40310 | 60p |
| 40311 | 42p |
| 40312 | 62p |
| 40320 | 42p |
| 40360 | 56p |
| 40361 | 45p |
| 40362 | 45p |
| 40406 | 52p |
| 40407 | 40p |
| 40408 | 54p |
| 40409 | 62p |
| 40410 | 62p |
| 40430 | £1·13 |
| 40468A | 44p |
| 40511 | £1·92 |
| 40575 | £1·54 |
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| 40603 | 70p |
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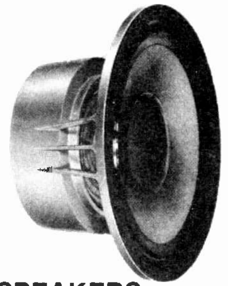

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## THE Firm for speakers!

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|---|---|
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| Baker Group 35 3, 8 or 15 ohm | £6·50 |
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| Coral 8in d/cone roll surr 8 ohm | £3·11 |
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| Eagle HT15 horn tweeter | £3·80 |
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| Eagle MHT10 horn tweeter | £3·80 |
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| Eagle FR65 | £7·15 |
| Eagle FR8 | £9·50 |
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| Elac 6½in 6RM220 d/cone | £2·65 |
| Elac 4in tweeter TW4 | £1·21 |
| Elac 10in d/cone 10RM239 8 ohm | £2·65 |
| Elac 8in 8CS175 3 ohm | £2·50 |
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| Fane Pop 25/2 25W 12in | £6·95 |
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|---|---|
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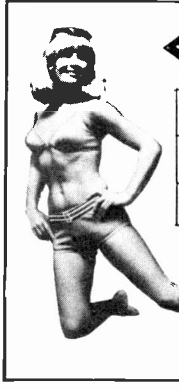

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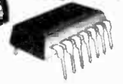

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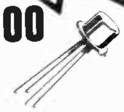

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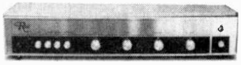

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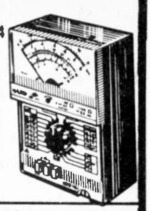

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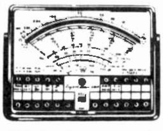

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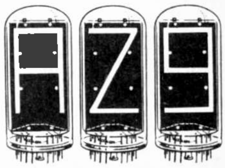

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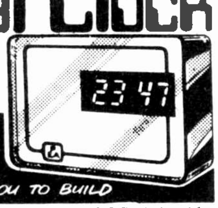


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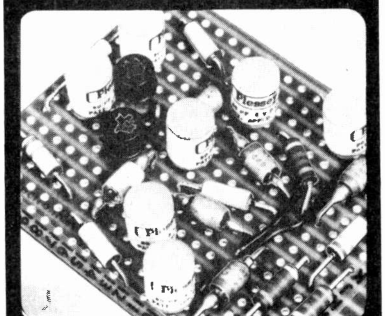

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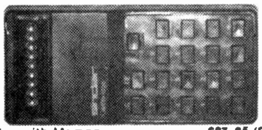

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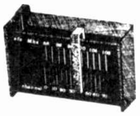

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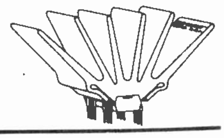

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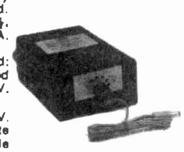

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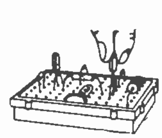
## S–DECS AND T–DECS



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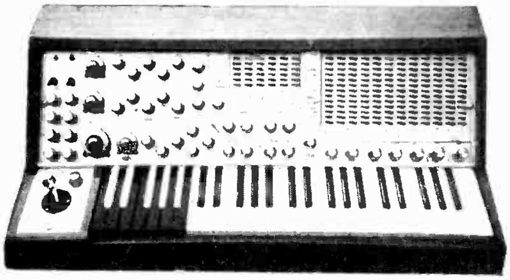

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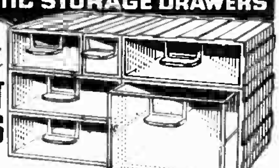

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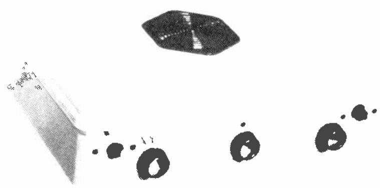

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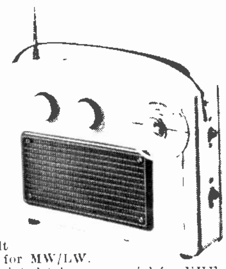
## NEW ROAMER NINE WITH V.H.F. INCLUDING AIRCRAFT



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 controls. Attractive all white case with red grille and carrying strap. Size 9¼in × 7in × 2¼in approx. Parts price list and plans 30p (FREE with parts).

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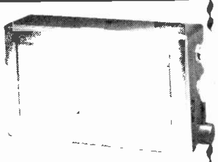

3 Tunable wavebands. MW/LW and Trawler Band. 7 stages, 5 transistors and 2 diodes, supersensitive ferrite rod aerial, attractive Black and Gold Case. Size 5½in × 1¼in × 3½in approx. Plans and parts price list 15p (FREE with parts).

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P.P. & Ins. 26p
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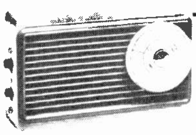

Wavebands, transistors and speaker as Pocket Five. Larger Case with Red Speaker Grille and Tuning Dial. Plans and parts price list 15p (FREE with parts).

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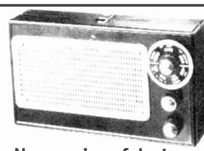

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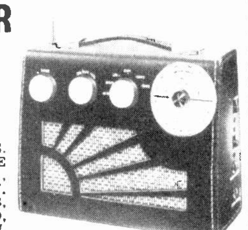

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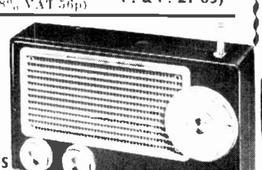

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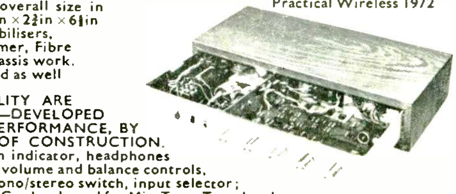

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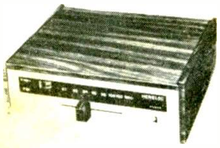

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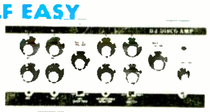

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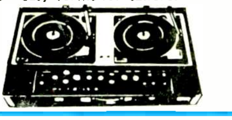

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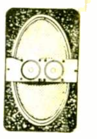

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