PRACTICAL
# ELECTRONICS
APRIL 1972
20p

# PE GEMINI STEREO TUNER


ALSO INSIDE:

**Double Fluorescent Lamp Inverter • I.C. Signal Injector**

# ADCOLA Soldering Instruments add to your efficiency

## THE NEW 'INVADER'

## ADCOLA L.646

for Factory Bench Line Assembly

A precision instrument—supplied with standard 3/16" (4.75 mm) diameter, detachable copper chisel-face bit*.

Standard temp. 360°c at 23 watts.

Special temps. from 250°c—410°c.

**PRICE £1·85**


***Additional Stock Bits**
(illustrated) available

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B 38 $\frac{1}{8}$ — 3.2 mm CHISEL FACE

B 14 $\frac{3}{32}$ — 2.4 mm CHISEL FACE

B 24 $\frac{3}{16}$ — 4.75 mm SCREWDRIVER FACE

B 12 $\frac{3}{16}$" — 4.75 mm EYELET BIT

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Don't take chances. We don't. All our ADCOLA Soldering Instruments are of impeccable quality. You can depend on ADCOLA day after day. That's why they're so popular. You get consistent good service ... reliability ... from our famous thermally controlled ADCOLA Element and the tough steel construction of this ideal production tool.

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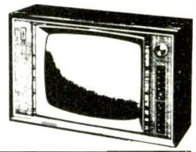
# TV's 19" NOW £11·95



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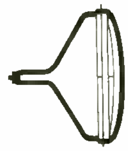

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**Transistors 15p.** each. Post free. AC126, AC128, AF114, AF117, OC45, OC71, OC81, OC81D.

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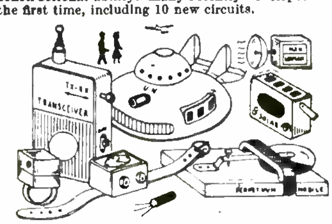

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(1) Crystal Set with biased Detector. (2) Crystal Set with voltage-quadrupler detector. (3) Crystal Set with Dynamic Loudspeaker. (4) Crystal Tuner with Audio Amplifier. (5) Carrier Power Conversion Receiver. (6) Split-Load Neutralised Double Reflex. (7) Matchbox or Photocell Radio. (8) "TRI-FLEXON" Triple Reflex with self-adjusting regeneration (Patent Pending). (9) Solar Battery Loudspeaker Radio. The smallest 3 designs yet offered to the Home Constructor anywhere in the World. 3 Subminiature Radio Receivers based on the "Triflexon" circuit. Let us know if you know of a smaller design published anywhere. (10) Postage Stamp Radio. Size only 1·62in x 0·95in x 0·25in. (11) Wristwatch Radio 1·15in x 0·80in x 0·55in. (12) Ring Radio 0·70in x 0·70in x 0·55in. (13) Bacteria-powered Radio. Runs on sugar or bread. (14) Radio Control Tone Receiver. (15) Transistor P/P Amplifier. (16) Intercom. (17) 1-valve Amplifier. (18) Reliable Burglar Alarm. (19) Light-Seeking Animal, Guided Missile. (20) Perpetual Motion Machine. (21) Metal Detector. (22) Transistor Tester. (23) Human Body Radiation Detector. (24) Man/Woman Discriminator. (25) Signal Injector. (26) Pocket Transceiver (Licence required). (27) Constant Volume intercom. (28) Remote Control of Models by Induction. (29) Inductive-Loop Transmitter. (30) Pocket Triple Reflex Radio. (31) Wristwatch Transmitter/Wire-less Microphone. (32) Rain Alarm. (33) Ultrasonic Switch/Alarm. (34) Stereo Pre-amplifier. (35) Quality Stereo Push-Pull Amplifier. (36) Light-Beam Telephone "Photophone". (37) Light-Beam Transmitter. (38) Silent TV Sound Adaptor. (39) Ultrasonic Transmitter. (40) Thyristor Drill Speed Controller. Plus 10 Photoelectric Circuits, Simple Alarms, Long Range Alarms, Projector Modulators, etc.

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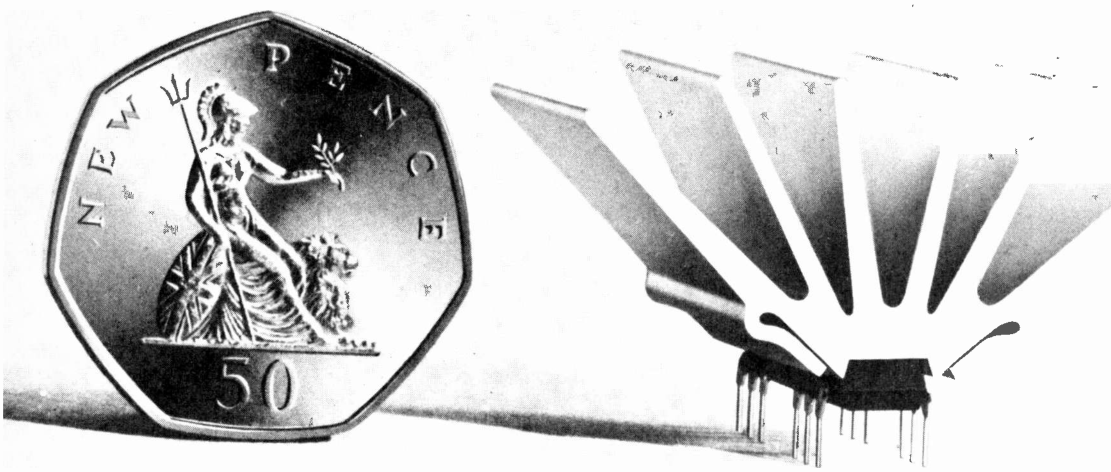
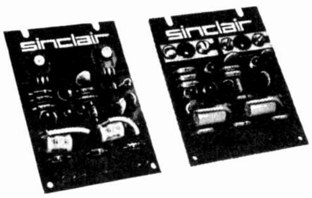

NEW PENCE
50



# from a simple amplifier to a complete stereo tuner amplifier with Project 60 modules

## Z.30 & Z.50 power amplifiers



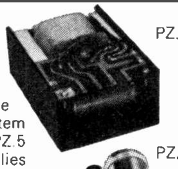

The Z.30 and Z.50 are of advanced design using silicon epitaxial planar transistors to achieve unsurpassed standards of performance. Total harmonic distortion is an incredibly low 0.02% at full output and all lower outputs. Whether you use Z.30 or Z.50 amplifiers in your Project 60 system will depend on personal preference, but they are the same size and may be used with other units in the Project 60 range equally well.

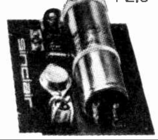
**SPECIFICATIONS** ***(Z.50 units are interchangeable with Z.30s in all applications).***
**Power Outputs**
**Z.30** 15 watts R.M.S. into 8 ohms using 35 volts: 20 watts R.M.S. into 3 ohms using 30 volts.
**Z.50** 40 watts R.M.S. into 3 ohms using 40 volts: 30 watts R.M.S. into 8 ohms using 50 volts.
**Frequency response:** 30 to 300,000Hz ±1dB.
**Distortion:** 0.02% into 8 ohms.
**Signal to noise ratio:** better than 70dB unweighted.
**Input sensitivity:** 250mV into 100 Kohms.
For speakers from 3 to 15 ohms impedance.
**Size:** 14 x 80 x 57 mm.

**Z.30**
*Built, tested and guaranteed with circuits and instructions manual.* **£4.48**

**Z.50**
*Built, tested and guaranteed with circuits and instructions manual.* **£5.48**

## Power Supply Units




Designed special for use with the Project 60 system of your choice. Use PZ.5 for normal Z.30 assemblies and PZ.6 where a stabilised supply is essential.

**PZ.5** *30 volts unstabilised* **£4.98**
**PZ.6** *35 volts stabilised* **£7.98**
**PZ.8** *45 volts stabilised (less mains transformer)* **£7.98**
**PZ.8** *mains transformer* **£5.98**

## The Sinclair Guarantee

*If within 3 months of purchasing Project 60 modules directly from us, you are dissatisfied with them, we will refund your money at once. Each module is guaranteed to work perfectly and should any defect arise in normal use we will service it at once and without any cost to you whatsoever provided that it is returned to us within 2 years of the purchase date. There will be a small charge for service thereafter. No charge for postage by surface mail. Air-mail charged at cost.*

## Project 60 Stereo F.M. Tuner

***First in the world to use the phase lock loop principle***

The phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio. Now, Sinclair have applied the principle to an F.M. tuner with fantastically good results. Other original features include varicap diode tuning, printed circuit coils, an I.C. in the specially designed stereo decoder and squelch circuit for silent tuning between stations. Good reception is possible in difficult areas, and often a few inches of wire are enough for an aerial. In terms of a high fidelity this tuner has a lower level of distortion than any other tuner we know. Stereo broadcasts are received automatically as the tuning control is rotated, a panel indicator lighting up as the stereo signal is tuned in. This tuner can also be used to advantage with any other high fidelity system.

**SPECIFICATIONS—Number of transistors:** 16 plus 20 in I.C. **Tuning range:** 87.5 to 108 MHz. **Capture ratio:** 1.5dB. **Sensitivity:** 2µV for 30dB quieting: 7µV for lock-in over full deviation. **Squelch level:** 20µV. **A.F.C. range:** ±200 KHz. **Signal to noise ratio:** >65dB. **Audio frequency response:** 10 Hz – 15 KHz (±1dB). **Total harmonic distortion:** 0.15% for 30% modulation. **Stereo decoder operating level:** 2µV. **Cross talk:** 40dB. **Output voltage:** 2 x 150mV R.M.S. **Operating voltage:** 25-30 VDC. **Indicators:** Power on/tuning/stereo.
**Size:** 93 x 40 x 207 mm.

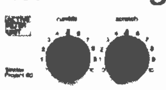
*Built and tested. Post free.* **£25**

## Stereo 60 Pre-amp/control unit

Designed for Project 60 range but suitable for use with any high quality power amplifier. Again silicon epitaxial planar transistors are used throughout, achieving a really high signal-to-noise ratio and excellent tracking between channels. Input selection is by means of push buttons and accurate equalisation is provided for all the usual inputs.

**SPECIFICATIONS—Input sensitivities:** Radio – up to 3mV. Mag. p.u. 3mV: correct to R.I.A.A curve ±1dB: 20 to 25,000 Hz. Ceramic p.u. – up to 3mV: Aux – up to 3mV. **Output:** 250mV. **Signal to noise ratio:** better than 70dB. **Channel matching:** within 1dB. **Tone controls:** TREBLE + 15 to —15dB at 10 KHz: BASS + 15 to —15dB at 100Hz. **Front panel:** brushed aluminium with black knobs and controls. **Size:** 66 x 40 x 207mm.
*Built tested and guaranteed.* **£9.98**

## A.F.U. High & Low Pass Filter Unit



For use between Stereo 60 unit and two Z.30s or Z.50s, and is easily mounted. It is unique in that the cut-off frequencies are continuously variable, and as attenuation in the rejected band is rapid (12dB/octave), there is less loss of the wanted signal than has previously been possible. Amplitude and phase distortion are negligible. The A.F.U. is suitable for use with any other amplifier system. Two filter stages – rumble (high pass) and scratch (low pass). Supply voltage – 15 to 35V. Current – 3mA. H.F. cut-off (–3dB) variable from 28KHz to 5KHz. L.F. cut-off (–3dB) variable from 25Hz to 100Hz. Distortion at 1 KHz (35V. supply ( 0.02% at rated output. **Size:** 66 x 40 x 90 mm. *Built tested and guaranteed.* **£5.98**

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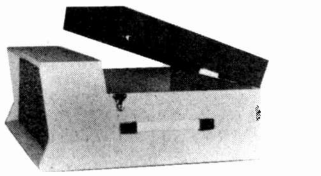
## BSR LATEST SUPERSLIM STEREO & MONO

Plays 12", 10" or 7" records. Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. AC 200/250v. Size 13½ × 11¾in. Above motor board 3¼in. below motor board 2½in.

with STEREO and MONO XTAL **£7·75** Post 25p.

RCS DE-LUXE 3 WATT AMPLIFIER. Ready made tested. 2-stage with triode pentode valve, 3 watts output. Tone and volume controls. Isolated mains transformer. Knobs, with high performance loudspeaker. Response 50-12,000 cps. Sensitivity 200mV. **£4** Post 25p.

## R.C.S. PORTABLE PLAYER CABINET



Really smart appearance with space for R.C.S. Amplifiers and most modern autochangers. Size 18 × 15 8in. Metal fittings. Carrying handle. Two tone rexine covered. Popular Colours. **£4** Post 25p

GARRARD SINGLE PLAY TA Mk II. Ideal Discotheque or Hi-Fi. Stereo/Mono. **£10**

GARRARD PLAYERS with Sonotone 9TA Cartridges. Stereo Diamond and Mono Sapphire. SP25 Mk III £16. Model 3500 Stereo and Mono Autochanger £14. Post 25p.

BSR JUNIOR SINGLE PLAYER. Turntable, 4-speed motor and separate pick-up. **£4·50**

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**£5·75** POST 25p

Comprising a fine example of a Woofer 10¾ × 6¼in. with a massive Ceramic Magnet, 44oz. Gauss 13,000 lines. Aluminium Cone centre to improve middle and top response. Also the E.M.I. Tweeter 3¼in. square has a special lightweight paper cone and magnet flux 10,000 lines.

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| Impedance Standard | 8 ohms |
| Maximum power | 12 watts |
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| Bass Resonance | 45 cps |

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Mullard Ferrite Rod 8 × ⅜in. 20p. 6 × ¼in. 25p.

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

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BRITISH AERIALITE AERAXIAL-AIR SPACED 40 yd. £1·40; 60 yd. £2.

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WIRE-WOUND 3-WATT POTS. Small type with small knob. Values 10Ω to 25 K. Carbon 30 K to 1 meg. **25p**

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200/250 v. A.C. Leaflet S.A.E. **£2·35** Post 15p

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

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

## 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" × 1½" × ¾". Response 25 c.p.s. to 25 Kc/s, 26 db gain. For use with valve or transistor equipment. Full instructions supplied. Details S.A.E. **90p** Post 10p

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NEON PANEL INDICATORS 250V AC/DC Red or Amber 20p.
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WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt, 10 ohms to 100K 10p each; 2½ watt, 1 ohm to 8·2 ohms 10p.

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Cut out ready for Garrard or B.S.R. Will play with cover in position. Latest design. Covered in black leatherette. Antimagnetic. 12½ × 14¼ × 7½in. high. **£5.50** Post 25p

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| MINIATURE 200 v. 20 mA., 6.3 v. 1 a. 2½ × 2½ × 2in. | 75p |
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1 amp., 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60. £2·25
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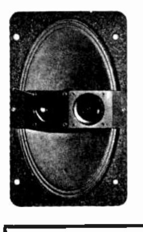


With twin tweeters. And crossover. 10 watt. State 3 or 8 or 15 ohm. As illustrated. **£4** Post 15p

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

Recommended Teak Cabinet Size 16 × 10 × 9in. Post 25p. **£5**

## 10W MINI-MODULE £3·25 LOUDSPEAKER KIT

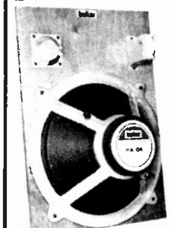
Post 25p

Triple speaker system combining on ready cut baffle. ½ in. chipboard 15 in. 8½ in. Separate Bass, Middle and Treble loudspeakers and crossover condenser. The heavy duty 5 in. Bass Woofer unit has a low resonance cone. The Mid-Range unit is specially designed to add drive to the middle register and the tweeter recreates the top end of the musical spectrum. Total response 20-15,000 cps. Full instructions for 8 ohm matching.

TEAK VENEERED BOOKSHELF ENCLOSURE. 16 × 10 × 9in. Modern design, with Fluted Wood Front. Highly recommended. **£5** Post 25p

ALL MODELS "BAKER SPEAKERS" IN STOCK

## BAKER 12in MAJOR £9



30-14,500 c.p.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.p.s. Rated 20 watts. State 3 or 8 or 15 ohm. Post Free.

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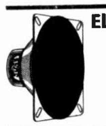
| 3 or 8 or 15 ohm | 3 or 8 or 15 ohm | 8 or 15 ohm |

TEAK HI-FI SPEAKER CABINETS. Fluted wood front.
For 12in. dia. speaker 20 × 13 × 9in. £9 Post 25p
For 13 × 8in. speaker 16 × 10 × 9in. £5 Post 25p
For 10 × 6in. speaker 16 × 8 × 6in. £4 Post 25p
LOUDSPEAKER CABINET WADDING 18in. wide, 15p ft

## GOODMANS 6½in. HI-FI WOOFER

8 ohm, 10 watt. Large ceramic magnet. Special Cambric cone surround. Frequency response 30–12,000 cps. Ideal P.A. Columns. Hi-Fi Enclosure Systems, etc. **£4**

## ELAC CONE TWEETER



The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 cps to 18,000 cps. Size 3½ × 3½ × 2in. deep. Rating 10 watt. 3 ohm or 15 ohm models. **£1·90** Post 10p

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TWO-WAY 3,000 c.p.s. CROSSOVERS 3 or 8 or 15 ohm 95p.
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5in. WOOFER. 8 w. max. 20-10,000 cps. 8 or 15 ohm £1·80.
ELAC 10in. 10w. Twin Cone. De Luxe Ceramic 8 ohm £4.
RICHARD ALLAN TWIN CONE LOUDSPEAKERS 8in. dia. 4 watt; 10in. dia. 5 watt; 12 in. dia. 6 watt. 3 or 8 or 15 ohm models £2 each. Post 15p.
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SPEAKER COVERING MATERIALS. Samples Large S.A.E.
GOODMANS OUTPUT TRANSFORMER 5 WATT MULTI RATIO EL84, etc., 3, 8 and 15 ohms 80p. Post 20p.

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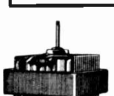

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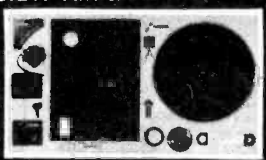
# Connoisseur

## B.D.1 Turntable Kit



The B.D.1 well known for its superb performance and quality two speed working through a flexible belt drive system is now available in kit form. Construction is simplicity itself with no soldering required. Now it's so easy to own the best.

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| 5¾″ 900′ | 1·12 | — | 1·01 | 1·10 | 0·94 | — |
| 7″ 1200′ | 1·32 | — | 1·26 | 1·41 | 1·19 | — |
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| 3″ 210′ | 0·35 | — | 0·35 | — | 0·32 | 0·30 |
| 4″ 450′ | 0·65 | — | 0·77 | — | 0·55 | — |
| 5″ 900′ | 0·97 | 1·21 | 1·05 | 1·10 | 0·96 | 0·99 |
| 5¾″ 1200′ | 1·22 | 1·36 | 1·25 | 1·37 | 1·17 | 1·24 |
| 7″ 1800′ | 1·69 | 1·99 | 1·80 | 1·94 | 1·71 | 1·79 |
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| 4″ 600′ | 0·84 | — | 0·82 | 0·94 | 0·89 | — |
| 5″ 1200′ | 1·29 | 1·36 | 1·26 | 1·49 | 1·44 | 1·24 |
| 5¾″ 1800′ | 1·83 | 2·01 | 1·82 | 1·99 | 1·87 | 1·79 |
| 7″ 2400′ | 2·57 | 2·44 | 2·27 | 2·89 | 2·69 | 2·25 |
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| 5″ 1800′ | — | 1·99 | 1·82 | — | — | 1·79 |
| 5¾″ 2400′ | — | 2·44 | 2·24 | — | — | 2·19 |
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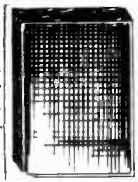

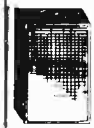

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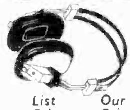

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| BP72=SN7472 | 0·29 | 0·26 | 0·24 | BP182=SN74182 | 0·97 | 0·94 | 0·88 |
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Cathode current: 0·35 Nom mA d.c.

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- **Normal supply Voltage 9-24V.**
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- **Overall Size 2" × 3" × 1".**
- **Typical Total Harmonic distortion at 1 watt less than 1%.**

* *Supply voltage (Vs) = 24V 15ohm load.*

*Module Tested and Guaranteed*

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| BP933 | Dual 4-input expander | 13p | 12p | 11p |
| BP935 | Expandable Hex Inverter | 13p | 12p | 11p |
| BP936 | Hex Inverter | 13p | 12p | 11p |
| BP944 | Dual 4-input NAND expandable buffer without pull-up | 13p | 12p | 11p |
| BP945 | Master-slave JK or RS | 25p | 24p | 22p |
| BP946 | Quad, 2-input NAND | 12p | 11p | 10p |
| BP948 | Master-slave JK or RS | 25p | 24p | 22p |
| BP951 | Monostable | 65p | 60p | 55p |
| BP962 | Triple 3-input NAND | 12p | 11p | 10p |
| BP9093 | Dual Master-slave JK with separate clock | 40p | 38p | 35p |
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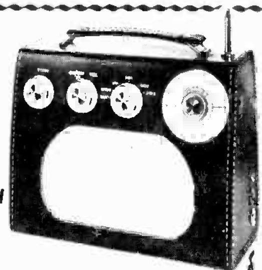

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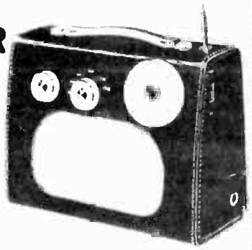

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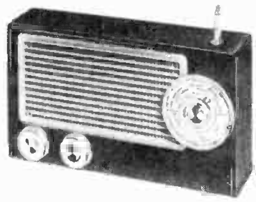

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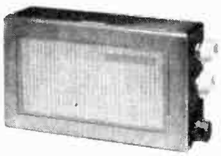

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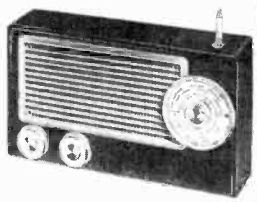

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VOL. 8 No. 4
April 1972

# PRACTICAL ELECTRONICS

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## JARGON

IN common usage, "jargon" appears to have become relegated to a term of disparagement. Complaints concerning the use of jargon are generally intended as motions of censure for some supposed grammatical or lingual offence. True the Concise Oxford Dictionary gives some rather unflattering definitions for jargon: "Unintelligible words . . . barbarous or debased language . . ." Other authorities assert that the much abused word jargon is a perfectly correct and proper synonym for a private or technical language. It follows, of course, that a technical language is likely to be unintelligible to those unfamiliar with the subject concerned. But who can with reason argue that technical language is improper or out of place in a technical journal, for example?

Every profession and trade, just like every branch of science and art, has its own private language, or jargon. Contrary to some beliefs jargon is not always an invention to bar or confuse the uninitiated. Usually it serves a very practical purpose: it facilitates verbal and written communication and, since it is generally succinct and incapable of misinterpretation, allows for economy in speech no less than in print.

Electronics, being a fast growing technology, has, not surprisingly, built up its own large vocabulary of technical terms. Some of these have a very homely ring about them, since they have been "borrowed" from the common language. They are well used to describe unequivocally the prevailing state of some given circuit or its mode of operation. Many terms have been specially coined, and they often create a vivid mental picture of the circuit action they describe. Yet other well known technical terms are formed from abbreviations or from the initial letters of complicated descriptions relating to materials or manufacturing processes. A custom that is quite widespread in ordinary everyday affairs, as well.

Without the use of this convenient terminology detailed explanations of circuit operation would become rambling, verbose discourses, tiresome to the reader and a strain upon his mental digestive system. This is, perhaps, nowhere better demonstrated than in the case of logic design where complex systems can be built up from a large number of basic circuit blocks interconnected in various configurations, but with much pattern repetition.

A knowledge and understanding of this special vocabulary (or call it jargon, if you will) is an indispensable part of training and education in electronics. It is the common language used and recognised by all those involved professionally, in trade and industry; it should be equally familiar to private constructors and students. It certainly should not be disparaged. F.E.B.

## THIS MONTH



*Our May issue will be published on Friday, April 14.*

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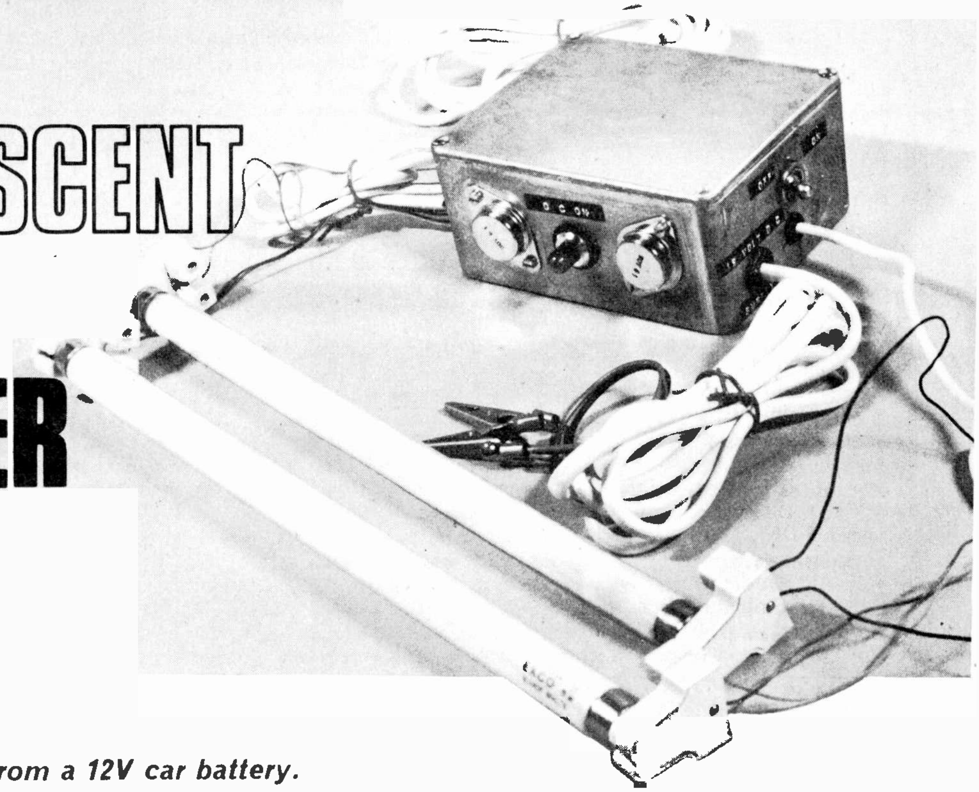
# DOUBLE FLUORESCENT LAMP INVERTER

BY C.J. MILLS



***Lights two 8W lamps from a 12V car battery. Ideal for campers or for emergency lighting***

In this article designs for both a push-pull inverter to supply two 12in, 8 watt fluorescent lamps and a simpler unit to drive an 8 watt lamp will be given. Both units will operate from a 12V d.c. supply.

The use of a high frequency of oscillation for the inverters (20–30kHz) provides several advantages. It gives a more efficient operation of the lamp and it permits the use of smaller and more convenient types of transformer such as the Ferroxcube pot cores. Also, as this frequency is above the audio range, there are no annoying whistles from the units.

## PUSH-PULL INVERTER

Now that high frequency planar power transistors are available at reasonable prices, the construction of high frequency power inverters becomes attractive because of the small size of transformer required.

As planar transistors are more prone to failure under reverse bias conditions than others, inverter switching circuits have to be modified to prevent this by the inclusion of high speed diodes in the bias circuit.

In Fig. 1 is shown the circuit of a 20 watt inverter suitable for driving two 8 watt fluorescent lamps or one 13 watt lamp. There is also a 230V d.c. outlet which can be used for powering a shaver.

To understand the circuit action, assume that TR1 is off and TR2 on and ignore the effect of the starting bias network. TR2 obtains its base current from the feedback winding L1 via C6 and will stay on until this capacitor is discharged.

When the discharge current drops below the holding base current of TR2 its collector current drops and it is switched off while TR1 is switched on by transformer action. The reversed feedback voltage now holds TR1 on until the capacitor is again discharged and the cycle is completed. The timing of the on periods depends on the exponential discharge of the capacitors and therefore the CR time constant controls the frequency of operation. With this circuit a good square wave output can be obtained at frequencies up to 50kHz and the low saturation voltage of the transistors result in low dissipation and high efficiency operation.

The secondary circuit has to provide three separate heater supplies and sufficient volts to strike the fluorescent lamps. The current for the lamp LP2 is limited by the choke L6 which integrates the square wave input voltage to give a triangular wave. LP2 is supplied through a capacitor giving a differentiated wave form.

The result of these wave changes is a more efficient loading of T1.

## SHAVER SUPPLY

To obtain a 250V d.c. supply for an a.c./d.c. shaver, the voltage from L5 is switched via S2 to a bridge rectifier. Small capacitors are added at the output to boost this voltage.

# COMPONENTS . . .

DOUBLE LAMP INVERTER

**Resistors**
- R1 1k Ω
- R2 220 Ω
- R3 22 Ω
- R4 18 Ω
- R5 220 Ω
- R6 22 Ω
- R7 1k Ω
- All ¼W, 10% carbon

**Capacitors**
- C1 0·047μF
- C2 1,000pF 300V
- C3 4,700pF 300V
- C4 0·68μF 300V
- C5 4,700pF 300V
- C6 0·18μF

**Transistors**
- TR1, TR2 BD123 (2 off)

**Diodes**
- D1, D2 IN916 (2 off)
- D3-D6 Silicon Bridge Rectifier 400V 2A

**Switches**
- S1 5A single pole on/off toggle
- S2 Single pole changeover

**Transformer**
- T1 35mm Ferroxcube type FX2242

**Choke**
- L6 25mm Ferroxcube type FX2240

**Miscellaneous**
- Diecast box 4¾in × 3¾in × 2in, LP1—miniature mains neon, LP2, LP3—8W miniature fluorescent lamps (2 off), wire (see text).

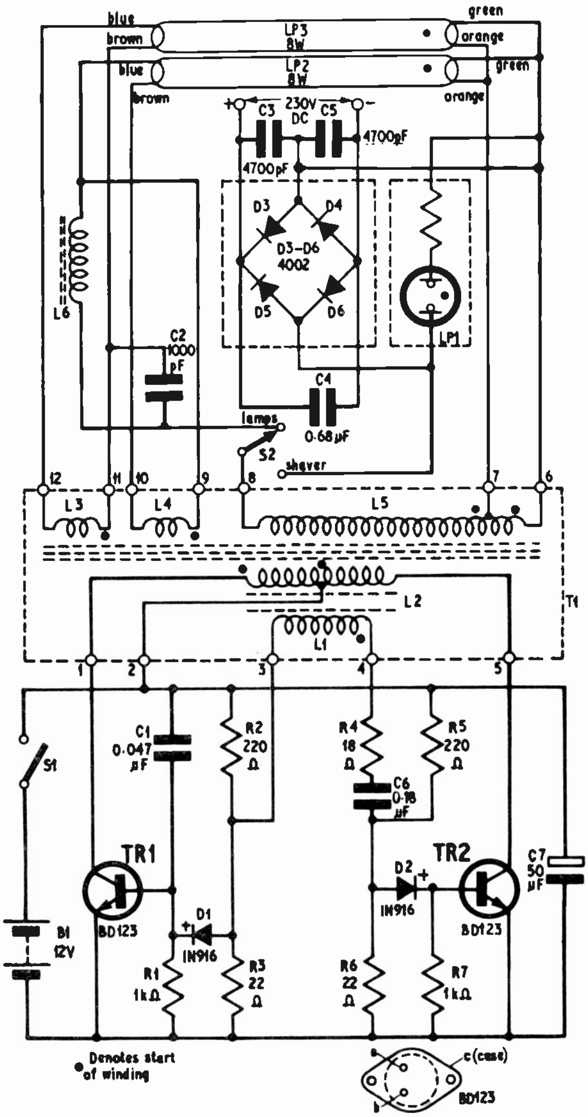



Fig. 1. Circuit diagram of 20 watt inverter

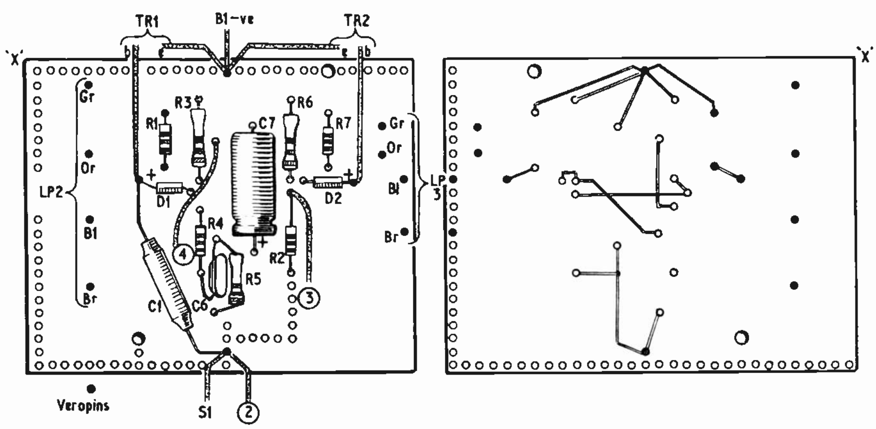



Fig. 2. Assembly and wiring details of component board

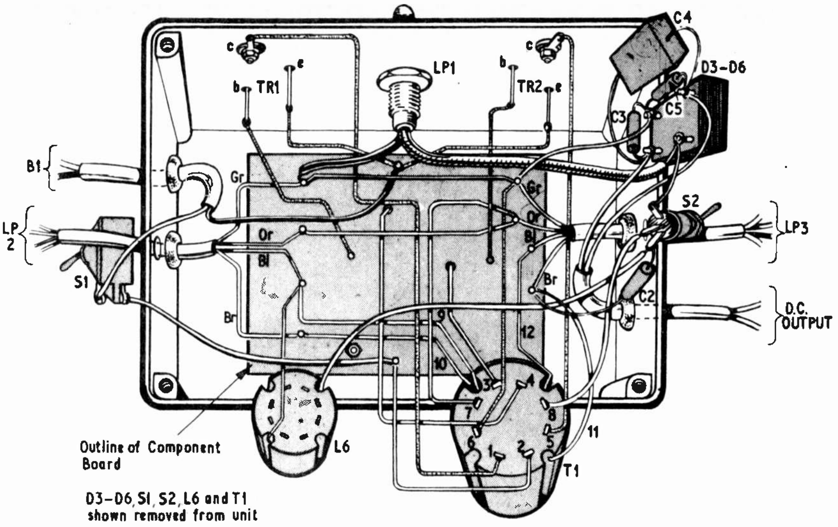



Fig. 3. Interwiring details of case mounted components and the board of Fig. 2

## COIL WINDING

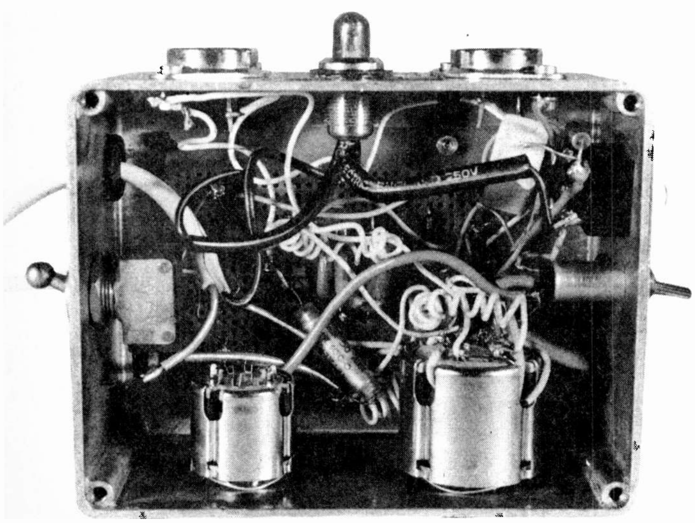
The transformer consists of a 35mm Ferroxcube pot core with the bobbin wound as follows.

First, about 10ft of 24 s.w.g. enamelled copper wire is doubled and wound on to the bobbin evenly until a double winding for L2 of 14 turns for each half is obtained. Next, the 15 turn feedback winding L1 is added using 30 s.w.g. wire followed by a layer of plastic insulating tape.

The main secondary winding L5 is now added, this being tapped after 10 turns and another 220 turns then put on and insulated with a layer of tape. Finally, two 10 turn heater windings (L3, L4) are put on.

Each winding should be identified by different coloured sleeving before fitting the bobbin into the pot core.

To operate a 13 watt fluorescent lamp the turns on L5 should be increased to 270 and one of the insulated heater windings omitted.



For the choke L6 a 25mm Ferroxcube FX2240 is used with 200 turns of 36 s.w.g. enamelled copper wire wound on the bobbin.

## CONSTRUCTION

A suitable case for the inverter is a 2in × 3¼in × 4¾in diecast box which can be used as a heatsink for the transistors if these are mounted with mica washers and plastic bushes.

Three holes are drilled in the case and fitted with grommets for the input and output leads. Ideally all output leads should be screened to reduce capacity coupling and radio interference to a minimum.

Assembly and wiring details for the inverter are given in Figs 2 and 3. Here the circuit board should be trimmed to fit inside the case and two holes drilled to take supporting screws.

## TESTS AND ADJUSTMENTS

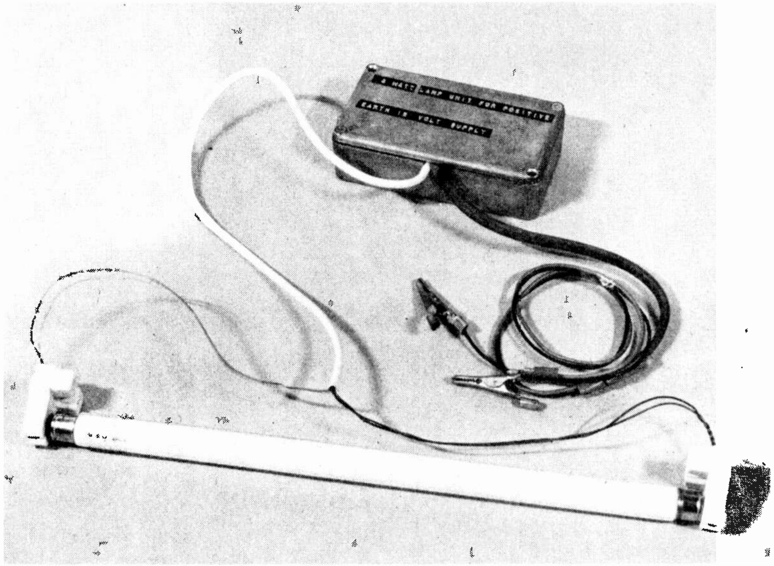
The first test of the inverter should include some means of current limiting to prevent transistor damage under fault conditions. A series 10 watt wire wound resistor of 2 to 3 ohms is suitable and should be included in the battery line. An ammeter, if available, should be used to check the current.

With no loads connected and S2 switched to "Shaver" the unit can be switched on for a short period. If the neon lights this proves that the inverter is oscillating; with no overheating apparent the limiting resistor can be removed and the lamps connected.

The relative brightness of the lamps can be adjusted by trimming C2 or by adjusting the frequency by trimming C6. Increasing this will reduce the frequency which will reduce the voltage drop across L6 and increase the voltage drop across C2 with both lamps alight the current drawn should be about 1·8A.

A test load resistor of between 5 and 10 kilohms should be connected across the bridge output when S2 is switched to "Shaver". The switch does not stop heater current being taken by the lamp, so to prevent excessive current being drawn the inverter should not be operated in the d.c. mode without a load (shaver) connected.

# 8 WATT FLUORESCENT LAMP INVERTER



## SINGLE LAMP INVERTER

A circuit for driving a single 8 watt fluorescent lamp is given in Fig. 4. As can be seen this is less complex than the push-pull inverter, its working principles being based on the well known Hartley oscillator.

This particular configuration has the advantage that the collector of TR1 can be connected to the case which forms the heat sink. A disadvantage is

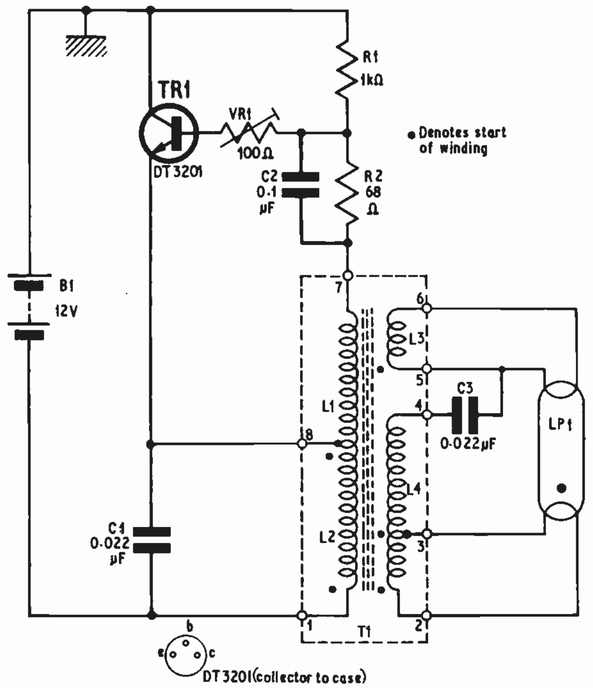



Fig. 4. Circuit diagram of single lamp inverter

## COMPONENTS . . .

8W LAMP INVERTER

**Resistors**
R1 1kΩ
R2 68Ω
All 10%, ¼W carbon

**Capacitors**
C1 0·022μF
C2 0·1μF

**Transistors**
TR1 DT3201 (Lucas) or MJE 520

**Transformer**
T1 Ferroxcube pot core type LA5

**Miscellaneous**
LP1—miniature 8W fluorescent lamp
Diecast box 4¼in × 2½in × 1¼in, miniature "tombstone" two pin lampholders, s.r.b.p. board, wire (see text)

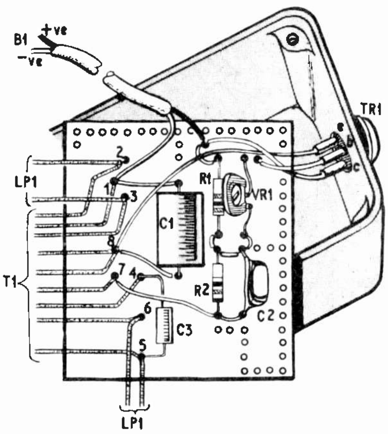
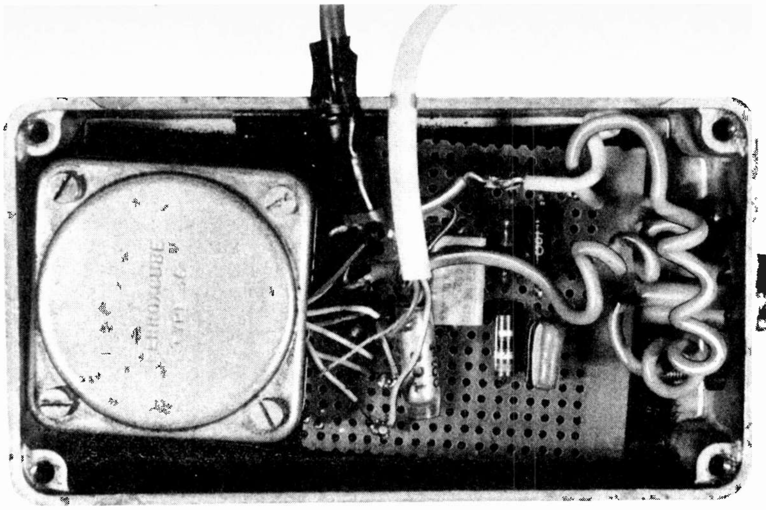



Fig. 5. Assembly and wiring details of the single lamp inverter



Interior of single lamp inverter. The components board should be insulated from the case

the risk of an excessive voltage appearing across the transistor if the unit is operated off load. Whilst there are a number of protective techniques available these were not found necessary providing the particular silicon transistor specified is used.

It is possible to strike the fluorescent lamp without the heater supply if sufficient volts are applied but this is not recommended as it shortens the life of the lamp.

No attempt was made to switch out the heaters when the lamp has struck or to switch the heaters across the battery prior to starting as the additional power consumed by the heaters is small and the extra size and complexity of the switching required was not considered worthwhile.

## CURRENT LIMITING

The secondary voltage developed by the inverter must be high enough to strike the lamp and this voltage is higher than the normal running voltage. The lamp provides a negative resistance load on the inverter and a series impedance is required to limit the lamp current and drop the running voltage to the correct value.

The series impedance normally consists of a choke for higher power lamps; a small value capacitor (C3) is adequate.

## TRANSFORMER

The transformer T1 consists of an LA5 pot core wound as follows. The primary winding L2 is wound on first using 26 turns of 26 s.w.g. enamelled wire. The feedback winding (L1) is then added using 10 turns of 32 s.w.g. wire and in the same direction as the primary. After identifying the ends with coloured sleeves, wrap round a layer of plastic insulating tape.

The secondary winding (L4) consisting of 350 turns of 36 s.w.g. wire is put on next, with a tapping at 18 turns for a lamp heater supply. The ends of this are identified and a layer of tape added. A final heater winding, in the same direction as before, of 20 turns of 32 s.w.g. wire (L3) completes the transformer.

## UNIT CONSTRUCTION

The next stage is to mount TR1 on a 4¼in × 2¼in × 1in diecast box as in Fig. 5. The Ferroxcube pot core is attached to a piece of s.r.b.p. board which approximately fits the box area. One method of doing this is to fit 6B.A. soldering tags under two adjacent screws on the pot core and to solder these tags to pins fitted on the board.

After completing the component assembly, unit operation should be checked. An a.c. meter or neon can me used to check that the unit is oscillating and producing a secondary voltage. Failure of the circuit to operate is indicated by a low input current and no secondary volts and can be due to a reversed or shorted winding or a low supply voltage.

## CONNECTING THE LAMP

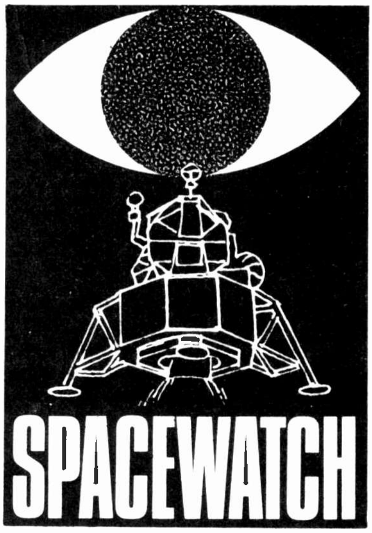
When the fluorescent lamp is connected and the normal supply voltage is applied, an initial glow at the tube ends will indicate that the heaters are working and the tube should strike and light up almost immediately.

To assist in starting during preliminary tests a fine wire can be stretched between the metal end caps and connected to one of the heater pins. This may be dispensed with in normal use if the tube is mounted close to a metal mounting bracket which is connected to the metal end caps and one heater winding.

When the lamp lights, small adjustments of bias and frequency can be made to obtain the best performance. The variable resistor VR1 should be set for optimum light output with satisfactory starting under the worst conditions (a cold lamp and a low voltage battery).

The oscillator frequency can be adjusted by varying the capacity across the primary or secondary coil until it is above the audio range. If measuring facilities are available a frequency of 18 to 25kHz is suitable remembering that the capacity of the cable connecting the lamp to the inverter will have some effect.

The final power consumption of the unit should be about 0·6A at 12V. ★




BY FRANK W. HYDE

## RADIO TELESCOPE TO REACH LIMITS OF THE UNIVERSE?

A new radio telescope of very large aperture (VLA) is to be set up by the National Science Foundation under Dr W. McElroy. This is an outstanding project which will make this aerial system the most sensitive and greatest collector of radio energy from outside the earth.

No final details are at present available but the general design will be in the form of multiple dishes in a pattern 25 miles long. Situated somewhere in the mountainous area of south western America, it will take four to six years to build at a total estimated cost of 60 million dollars.

The limit of range is claimed to be between 13 and 16 thousand million light years. Hitherto, the limit of any array has been thought to be 13 thousand million light years because this is approximately the limiting factor set by the speed of light. Dr Edward David, who is science adviser to the President, has said that the project will put America in the forefront of space exploration by radio for many years to come.

Carl Sagan, one of the pioneers of listening for signals that might emanate from other civilisations, stated recently that an instrument of such gathering power would be ideal for seeking evidence of external intelligences.

## GRAND TOURS CANCELLED

The proposed grand tours of space have been dropped from the new U.S. space budget funding as being too expensive when set against the scientific value of data recovered. This will be a disappointment to many astronomers engaged on studies of the solar system.

Another project that has been dropped is the Nerva programme. This project for a 75,000lb thrust, nuclear propelled rocket has been under development since 1955. It is to be replaced by a project to study small 15,000lb thrust atomic engines that can be used on unmanned missions in the 1980's. These missions will concern the outer planets. It seems that this means, in reality, only a postponement of the grand tours idea.

## SKYLAB

There are three scientists among the crew for *Skylab* space laboratory. This space station will go into orbit for seven months next year.

The date for launch is April 30, 1973. A day later the first three-man crew will be launched in an *Apollo* spacecraft. They will meet and lock on to the space station, the crew will then transfer aboard and work for 28 days in *Skylab* before returning to earth.

If this first mission is successful then about a month later the second crew will journey to the space station where they will stay for 56 days. After their return and another waiting period the third crew will go to *Skylab* for another 56 days.

The work undertaken in *Skylab* will be extensive and will include observations of the sun with a large telescope attached to the station; observations of earth resources and the weather; and experiments in chemical, physical, and medical effects of weightlessness.

The nine crew members together with the six back-up crew will represent more than a third of the 44 active astronauts. Those not assigned to *Skylab* missions will be undergoing training for the space shuttle programme with the exception of the crews for *Apollo 16* and *Apollo 17* due for launch in April and December 1972.

## MARINER 9

*Mariner 9* has been raised in orbit a second time to compensate for Mars effect on the spacecraft. This effect is twofold; the direct effect is the gravitational field of the planet and the perigee point has been raised from 1,388km (862 miles) to 1,650km (1,025 miles). This increases the mean orbital period by some 79 seconds to 11hr. 59min. 32sec.

Originally three 20-day cycles were allocated to complete the revised mapping of the surface with a fourth period in hand as reserve. The great dust storm which raged for so long has made it necessary to complete this mapping in two 20-day cycles with a third period to cover gaps. The raising of the orbit will facilitate this.

The other reason for changing the craft's orbit is that the distance between Mars and earth is now rapidly increasing. This requires a reduction in data transmission time. The present rate is 16,200 bits/sec. Another important item is that the Golstone antenna will have to be assigned to the *Apollo 16* mission. The new orbit places the transmissions in the middle of the Golstone viewing period ensuring maximum transfer of data.

## NEW VIEW OF MARS

The surface changes on Mars have always excited the imagination from the time of Schiaparelli in 1877. With the fading hopes of life on Venus it was natural to turn to Mars. Markings on Mars were translated as being due to vegetation of an elementary kind which extended with the release of moisture from melting polar caps.

Even this interpretation is now suspect. Again it is the pioneer Carl Sagan together with Peter Gierasch and Joseph Veverka who have been responsible for directing attention to other explanations. This team have shown that the *Viking* landings on Mars will face difficulties as a result of the dust storms and atmospheric disturbances.

There is a special difference between the generation of wind on the earth and on Mars. Essentially, the difference is that on Mars the vertical relief is comparable with the scale height. This is the vertical distance over which the pressure falls by half.

In the mountainous areas it means that the isotherms follow the contours of the relief. The result is that if a horizontal wind strikes a slope it runs into a steep thermal gradient. It is possible that convective relief winds could attain velocities of 250mph.

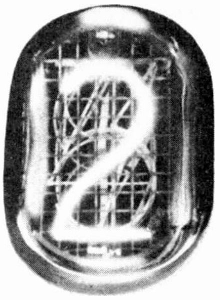
There are also global systems which are seen to be dependent on the seasonal heating and cooling of the polar regions. If local and global winds should reinforce one another then speeds nearing 400mph could arise.

The highest velocities are found over large basins and large plateaux which are bordered by steep relief. The velocities are many times greater than the minimum required to transport the dust.

Maximum activity should come when Mars is at perihelion since the effects of uneven solar heating would ensue. It would appear then that the growth of the dark areas are due to wind activity. Radar measurements have already shown that the dark areas are zones of high elevation. An extensive study of the Syrtis Major area confirms that the changes, seasonal and secular, are in conformity with the observation of windborne dust.—Exit little green men?

# ALPHA NUMERIC DISPLAYS

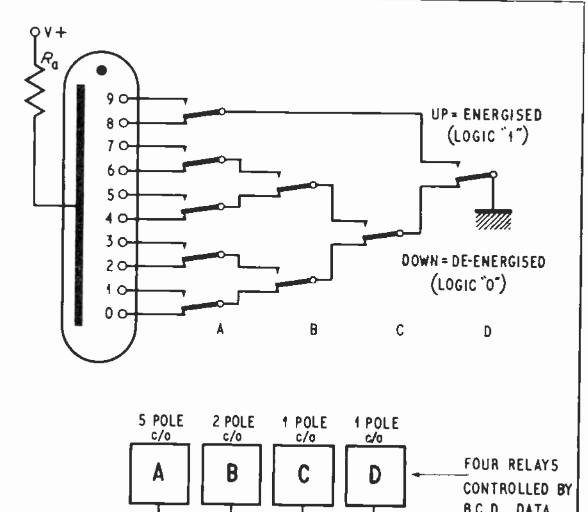
Part 2



By R.W.Coles

## Decoding & Driving circuits for cold cathode tubes

WHEN it is necessary to display the contents of a memory or counter a special circuit is needed to decode the B.C.D. into a one out of ten output in order to drive a cold cathode tube. The outputs of this circuit must be able to withstand the high voltages present when driving these tubes. In this month's article some of the methods of decoding and driving are described.




| REQUIRED CATHODE | B.C.D. DATA (4 LINES) | | | |
|---|---|---|---|---|
| | A | B | C | D |
| 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 |
| 2 | 0 | 1 | 0 | 0 |
| 3 | 1 | 1 | 0 | 0 |
| 4 | 0 | 0 | 1 | 0 |
| 5 | 1 | 0 | 1 | 0 |
| 6 | 0 | 1 | 1 | 0 |
| 7 | 1 | 1 | 1 | 0 |
| 8 | 0 | 0 | 0 | 1 |
| 9 | 1 | 0 | 0 | 1 |

Fig. 2.1 A relay decoding tree using four relays to switch the inputs of a cold cathode tube

### DECODING AND DRIVING CIRCUITS

The simplest way of energising a numicator tube is to select the required cathode by means of a multi way switch, the pole of which is earthed. This is fine if such a simple system is compatible with the display inputs, but in most cases data will be presented to the display in coded form, requiring some method of decoding before application to the tube.

The code most used is the simple four bit (bit means binary digit) code called B.C.D. (binary coded decimal). A four bit binary group has 16 possible combinations, which by convention are equivalent to the decimal numbers 0 to 15. In the B.C.D. code only the first ten combinations are utilised to represent the numbers 0 to 9, and if the other six combinations are allowed to appear, they represent error states. With this in mind we can now look at the simplest way of decoding the B.C.D. code, and using the decoded form to drive a cold cathode tube.

Fig. 2.1 shows a circuit arrangement known as a relay decoding tree, which consists of four relays each controlled (energised or de-energised) by a particular digit in the B.C.D. group. If a digit is a logic "1" then its associated relay will be energised, and if it is a logic "0" its relay will be de-energised, each B.C.D. combination giving a unique path through the relay contacts to the appropriate cathode.

Decoding trees of this kind can be very useful in some applications, but have a number of disadvantages common to all circuits which use relays, including slow operation and short life. A solid state decoder driver circuit overcomes all of the disadvantages of the relay tree, and today tiny i.c.s are available which will decode the B.C.D. and drive the numicator cathodes directly, all for less than £1.

### I.C. DECODERS

The availability of decoder/driver i.c.s at such low prices makes it most unlikely that anyone would want to go to all the trouble and expense of building this sort of circuitry with discrete diodes and transistors, and there seems little need to discuss these possibilities.

The first i.c.s produced to drive cold cathode displays were the now very common SN7441As. These i.c.s form part of the TTL range of logic types, and

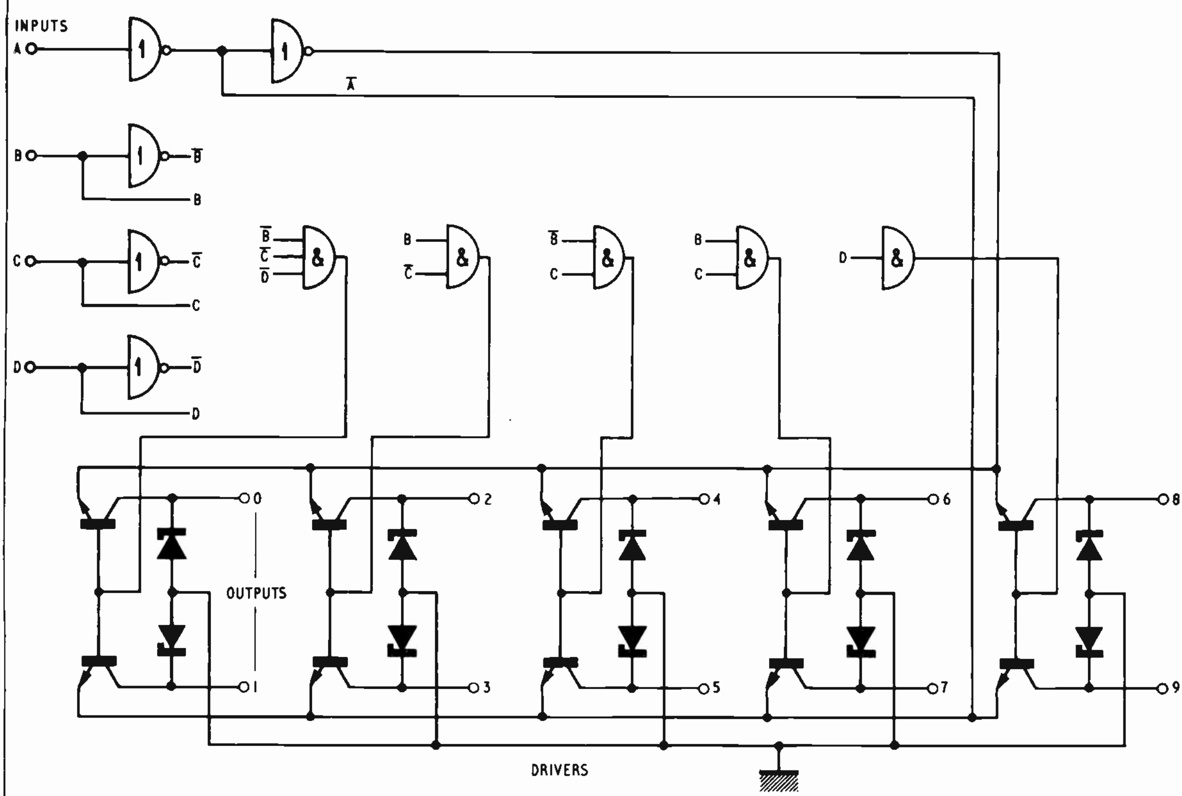



Fig. 2.2 Internal diagram of the SN7441A integrated circuit decoder/driver

because of the relatively large number of components integrated in each device, come under the sub-heading of "Medium Scale Integration" (M.S.I.).

The 7441 has four TTL logic compatible inputs, marked A, B, C, and D, and has ten outputs which will withstand at least 55 volts in the off state, and sink currents high enough to drive even large tubes.

## INTERNAL CIRCUIT

The circuit of the 7441 is shown in Fig. 2.2. The inputs to the circuit are first buffered and then inverted to make available both true and complement data to the following decoding gates. Input A is used to switch on either the emitters of the odd number driver transistors, or the emitters of the even number drive transistors, thus simplifying the gating, which drives the bases of the output transistors a pair at a time.

There are five pairs of output transistors, and these are controlled by one three input gate (to decode 0 and 1), three two input gates (2 and 3, 4 and 5, 6 and 7) and the last pair by the ungated D input. This decoding uses the minimal logic, and assumes that the error states in the B.C.D. code (the binary equivalents of 10 to 15) will never occur; if they do occur, more than one of the ten outputs will be enabled. Binary 15 for example, 1111, will drive cathodes 7 and 9 at the same time, and this state of affairs must not be allowed to occur.

## ZENER DIODES

Note the Zener diodes between the collectors of the drive transistors and ground, these are a modification to the original 7441 design, and account for the A suffix in the full SN7441A type number. Their purpose is to prevent voltages appearing at the collectors of the drive transistors which would exceed their collector breakdown limit, and thus force the transistors themselves to behave like Zeners. Voltage spikes of up to the full positive supply voltage can occur at the cathodes of tubes driven by transistors, and it is clearly better to limit these spikes with a Zener than to let the transistor breakdown, even temporarily.

The fact that these i.c.s will withstand only a minimum of 55 volts on their outputs may be puzzling some readers, this value seeming to bear little relation to the already discussed supply voltage range used by "Nixie" tubes. The point here is that, unlike a relay tree, the transistor merely switches a differential voltage (of at least 55V) which is sufficient to reduce the voltage across the tube to a level below its striking potential, and thus extinguish it. The 55V differential is quite small, and does mean that the lower supply voltages specified for the tubes must be used in order to be sure of extinction of "off" cathodes. The voltage usually employed with these i.c.s is of the order of 180V, 55V being a big enough proportion of this to ensure correct operation.

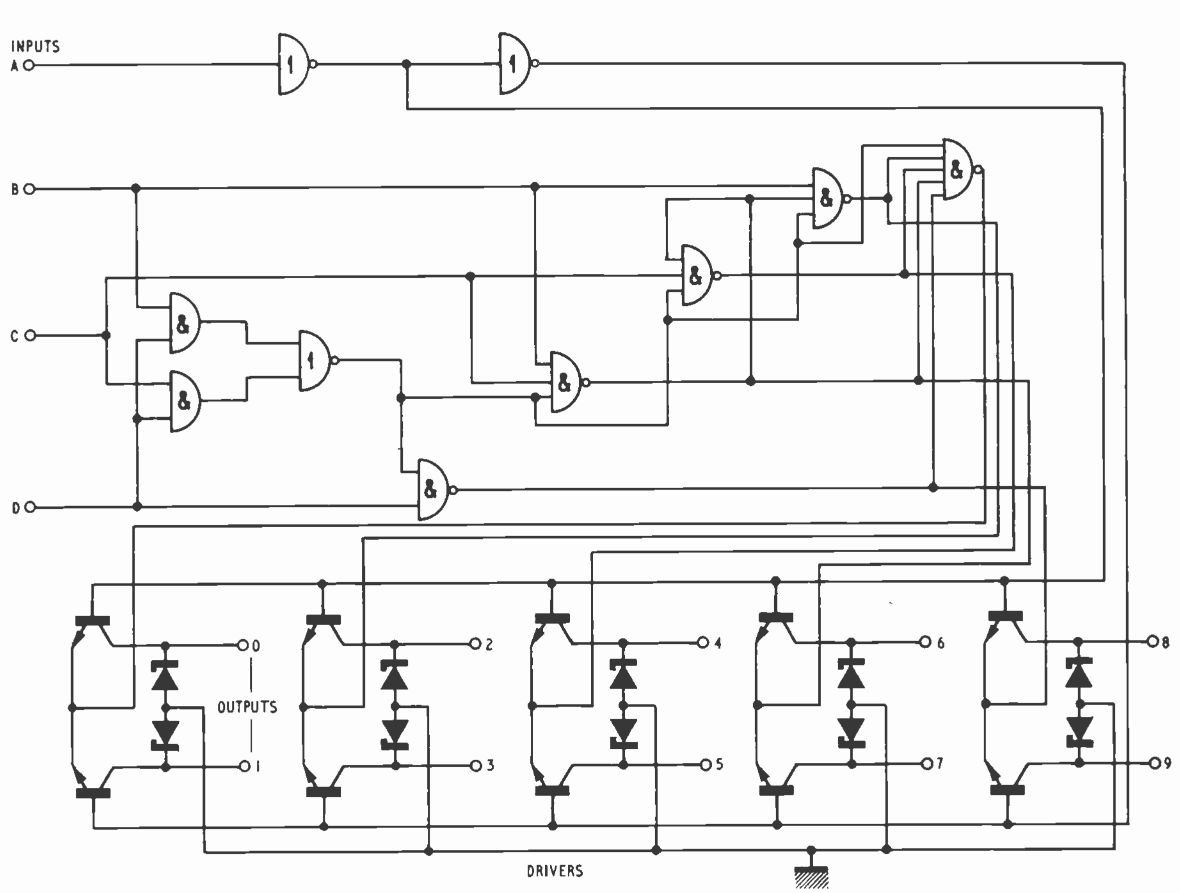



Fig. 2.3 Internal diagram of the SN74141, an improved version of the SN7441

## IMPROVED PERFORMANCE

It may have become apparent during discussion of the 7441 device that there is room for improvement in some of its characteristics; having all cathodes off for error inputs would come in very handy as will be seen and an increase in the 55V level would give more freedom in supply voltage choice. These points have not escaped the i.c. manufacturers, and a new device which incorporates the improvements mentioned above and a few more besides, has recently been introduced, the SN74141.

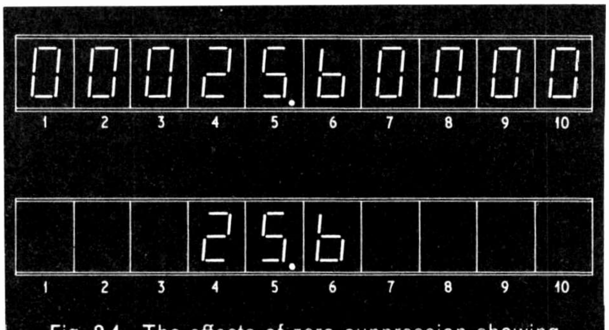



Fig. 2.4 The effects of zero suppression showing how greater readability is achieved

This new device is already available through suppliers advertising in this magazine, and at the same price as the 7441. The block diagram of the 74141 is shown in Fig. 2.3 and, as can be seen, the basic principles are the same, the only difference being that the 74141 has a full decode of the input data, so that error codes will not drive any of the cathodes, and the tube will remain off.

The differential voltage switching capability has been raised to at least 65V with this device, and other circuit improvements have been incorporated to reduce switching transients and power consumption.

## SUPPRESSION OF ZEROS

The invalid, or error code blanking, is useful when leading or trailing edge suppression of zeros is required in long displays. The effect of zero suppression is to blank the display tubes in a system which would normally show insignificant zeros, giving a resultant display which is very easy to read. For an example of the effects of combined leading and trailing edge zero suppression see Fig. 2.4.

The algorithm for producing the ripple blanking effect is quite simple.

FOR LEADING EDGE:

If digit one is a zero—blank it

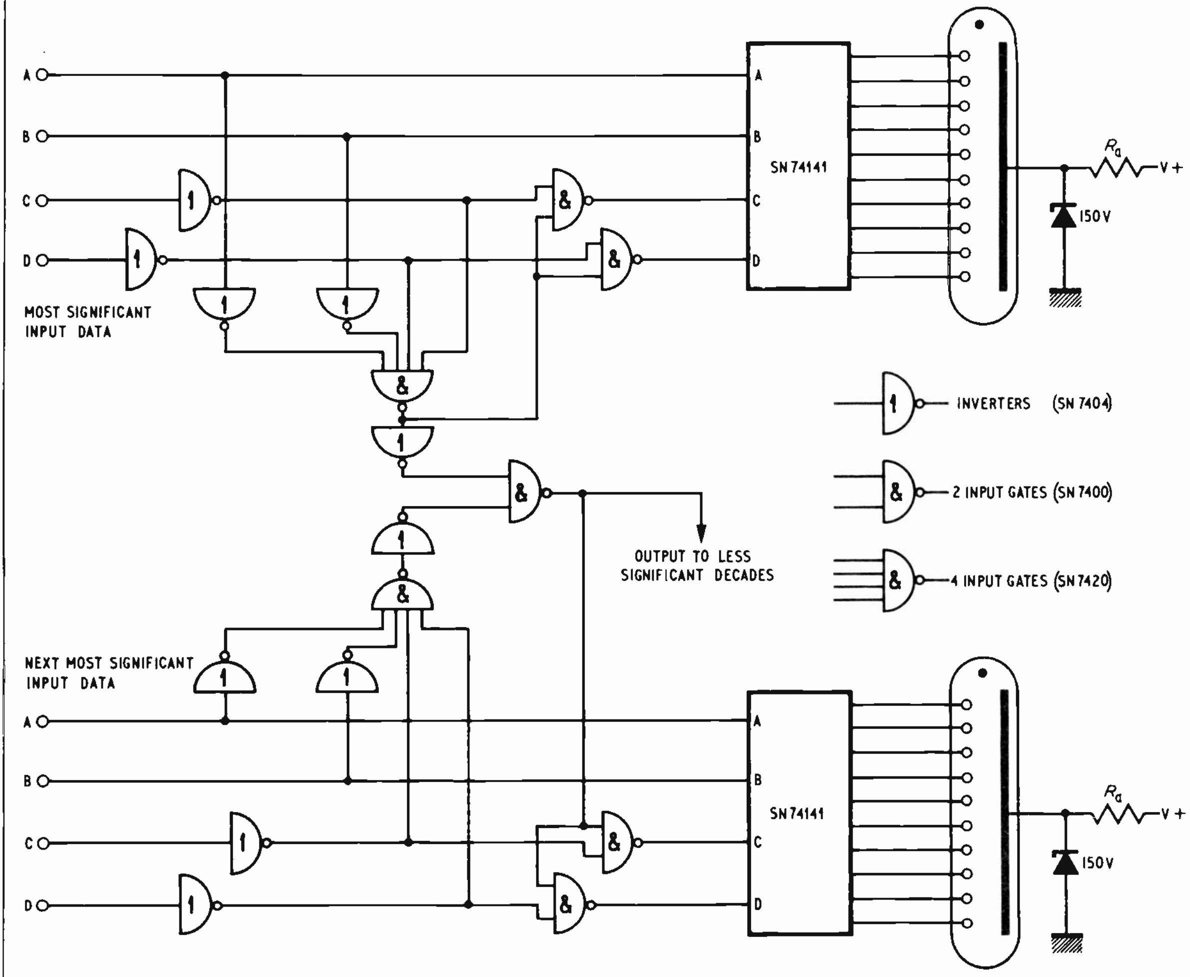



Fig. 2.5 A practical circuit for ripple blanking with the 74141 i.c.

If digit two and the digit before it are zeros—blank it

If digit three and the digits before it are zeros—blank it, and so on down the display from the left until the first integer is encountered, after which no more zero blanking is allowed.

If a decimal point is used in the display it is usual to display the zero immediately preceeding the point if no integer is present, and numbers after the point are blanked if necessary by the same algorithm as used above, but this time starting from the right-hand side.

FOR TRAILING EDGE:

If digit ten is a zero—blank it

If digit nine and the digit after it are zero—blank it

If digit eight and the digits after it are zeros—blank it also.

This process continues until an integer is encountered, or until the digit after the decimal point is reached, which is displayed regardless.

If a display holds all zeros the ripple blanking will give

- - - - 0·0 - - - -

## A PRACTICAL CIRCUIT

Blanking with the 74141 device is achieved by forcing its inputs into one of the invalid states when required, and part of a ripple blanking scheme with this device is shown in Fig. 2.5.

The operation of this circuit is simply that the 7420 4 input gate detects a zero in the most significant position and blanks it by forcing the 74141 inputs to binary 12. If the next most significant position also contains a zero its 7420 output is gated with the previous one to force binary 12 into its inputs also. This system can be expanded to handle any number of digits required, it can also be reversed of course, to give trailing edge blanking.

There is one point to note. It may be necessary to incorporate a Zener diode of 150V rating at the anode of each tube, as shown; this has the effect of clamping the anode voltage to 150V and is desirable to prevent partial striking of some of the cathodes when no current is being drawn by the tube during blanking.

**Next month: Incandescent filament display devices.**

# 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.

## UJT STEP-FREQUENCY OSCILLATOR

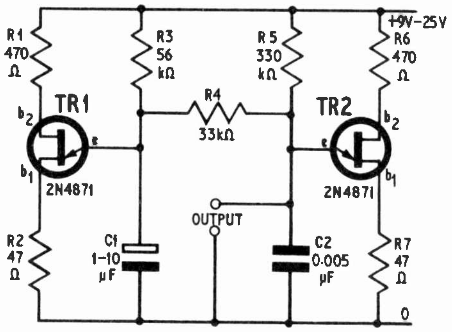



Fig. 2. Circuit diagram of unijunction oscillator

## SIMPLE LAMP STROBE

THE circuit diagram in Fig. 1 may be of interest to some of your readers. It was built especially for a school production, where it was used for special stage lighting effects.

The circuit consists of a six volt power supply, using a mains transformer and a full-wave rectifier (note: no smoothing capacitors). This powers a simple multivibrator, whose frequency is governed by potentiometer VR1. This feeds the gate of thyristor SCR1 via a small isolating transformer T2, which in this case was a discarded transistor radio push-pull type.

A 1½A 400 p.i.v. SCR, fitted to a heatsink, provided excellent control for a 150 watt reflector lamp. However, if the strobe is to be used for high speed work, then low wattage bulbs (or a string of them in parallel) should be used, as thermal inertia sets up in the filaments of high wattage bulbs and light is still emitted after the current has been turned off. This may continue until the next pulse reaches the filament, therefore not producing a true strobe effect.

I. Hunt,
Lower Hutt,
New Zealand.

THE circuit in Fig. 2 will produce a sound of increasing frequencies until the highest one is reached and then the cycle will repeat again starting from the lowest.

The circuit is basically two unijunction transistor relaxation oscillators cross-coupled by resistor R4. When the circuit is connected to the supply, capacitors C1 and C2 start to charge up via resistors R5 and R3.

Because R5, C2 is the shorter time constant, TR2 will fire first and C2 discharge. When C2 again starts to charge there is a voltage on C1 and C2 now charges via R5, R3 and R4. This will shorten the time constant for TR2, due to C1 charging. The unijunction TR2 now fires quicker and quicker until TR1 fires. The cycle will then repeat.

The cycle length is controlled by R3 and C1 and the lowest frequency by resistor R5 and capacitor C2. A wide variation of values for these components is possible and those given in Fig. 2 are only a guide.

This circuit would make an addition to the sound effects board used in the War Games Computer. Other possible uses include door bells and audio alarms.

M. K. Cook,
Newcastle-upon-Tyne 1.

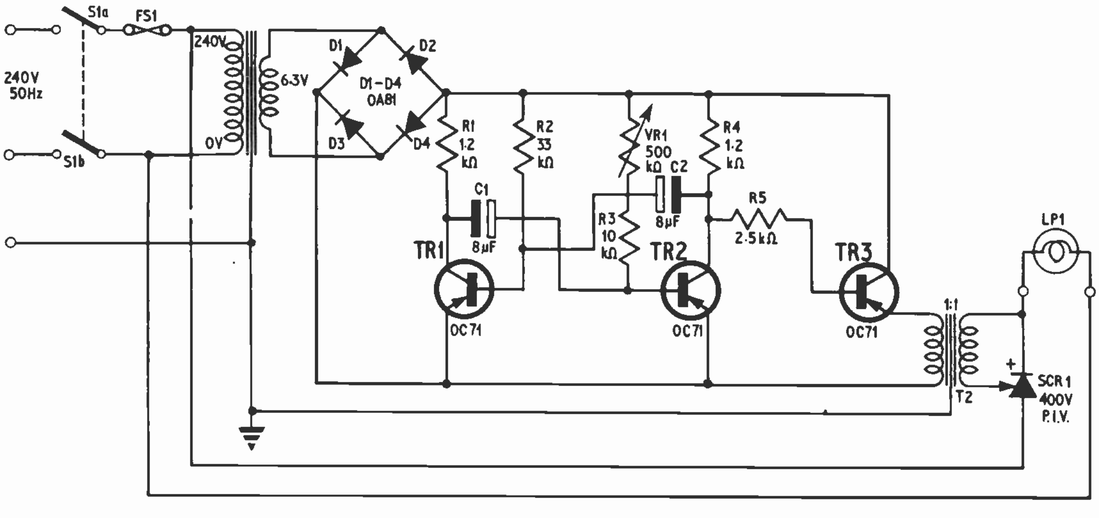



Fig. 1. Simple mains lamp strobe circuit

## TAPE SPEED CONTROL

PERHAPS the following circuit (see Fig. 3) would be of interest to your readers, and hence suitable for inclusion in the Ingenuity Unlimited section.

The circuit was designed to regulate the speed of the motor of a small capstan driven battery tape deck, a Garrard two-speed two-track transport, now out of production. The system should also prove suitable for the regulation of speed of other portable deck motors, provided that they have non-ferrous flywheels.

The pulse signal, consisting of "bursts" of sine wave from the flywheel velocity detector, is fed via C1 to the base of TR1, which is biased by potentiometer VR1 adjusted to give a collector-emitter voltage of six or seven volts. The output from TR1 passes through capacitor C2 to the base of the Schmitt trigger TR2, which is biased to near threshold by resistor R2. The output from the trigger at TR3 collector is passed to the input of the monostable TR4 and TR5 via C3. The leading edge of the monostable output waveform is sharpened by the "speed-up" capacitor C6 to give a fast switching pulse at TR5 output.

The values of C5 and R8 were chosen to give a pulse duration of about ten milliseconds, as the basic pulse repetition frequency is roughly 30Hz at a tape speed of $3\frac{3}{4}$in per second.

The monostable square wave output (of constant amplitude and duration, despite variable frequency) is fed to an integrating network consisting of R12, D1, C8 and VR2, where varying frequency causes a proportional varying d.c. voltage to appear across VR2. This potentiometer is set for the final motor speed and acts as a potential divider providing base voltage for the common collector d.c. amplifier TR6.

When the voltage at the base of TR6 exceeds the base-emitter voltage (approx. 0·6V) the transistor starts to conduct, making the anode of diode D2 less negative. When the anode-cathode voltage of D2 falls below the Zener voltage, the Darlington pair TR7 and TR8 switch off. Hence the motor power is reduced, the flywheel speed and pulse frequency fall. The centrifugal governor contacts should be connected together.

When the system is switched on, near full voltage appears across the motor, which promptly runs up to a speed where the integrating circuit voltage output causes TR6 to conduct heavily enough to decrease motor power. The motor speed then holds satisfactorily stable, although there is slight "hunting" about the mean flywheel speed set by VR2. This may be reduced by placing a 1,000$\mu$F capacitor across the motor terminals. There is also some possibility of the logic circuitry being falsely triggered by armature noise from the motor. This may be cured by decoupling the supply line and/or stabilising the power supply.

The sensor could consist of a small "button" permanent magnet ("Eclipse" type) with as much 38 s.w.g. enamelled copper wire as will fill the magnet limbs and wound over paper insulation. However, this sensor has not been tried in practice as the prototype used the magnet and coil assembly of a small magnetic earpiece. As the input voltage is not critical there is no reason why the aforementioned system should not operate.

The flywheel markers were four short pieces of 18 s.w.g. soft *iron* wire stuck to the flywheel circumference at equally spaced distances. The sensor was mounted close to the flywheel periphery (less than 2mm air gap) and provided triggering down to speeds of 30 r.p.m.

If dual speed operation is required potentiometer VR2 should be duplicated in parallel, with a changeover switch provided between the base of TR6 and the respective wipers of the additional potentiometers. The required speeds may then be separately set on the potentiometers, calibration being carried out using a measured length of tape and a stopwatch.

The power transistor TR8 must be mounted on a heatsink approximately 15 square inches of either copper or aluminium sheet.

J. D. Watson,
West Worthing.

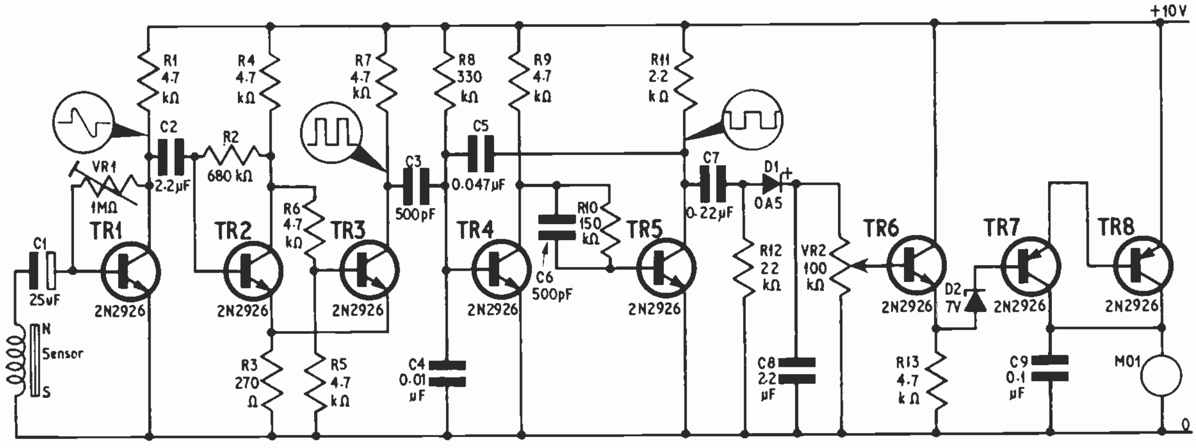



Fig. 3. Circuit diagram of the tape speed controller

## CARAVAN FLASHER UNIT

I was recently amazed when I discovered the price of heavy duty motor car flasher units, used when a trailer or caravan is being towed. These units simply accommodate the extra indicator lamps without upsetting the timing of the indicator, and to my mind, this simple task does not justify its cost.

The circuit shown in Fig. 4 is an extremely simple modification to a car's existing indicator circuit, the only extra components being two 12V relays (single-pole change-over) which may be purchased fairly cheaply.

A further modification, at a slightly extra cost, would be to make RLA a double-pole change-over relay and wire as the other contact and a switch shown dotted in Fig. 4. If S1 is depressed and the trafficator switched to the "LEFT" position, ALL the six indicator lamps will flash on and off, constituting an emergency warning system in the event of an accident or breakdown.

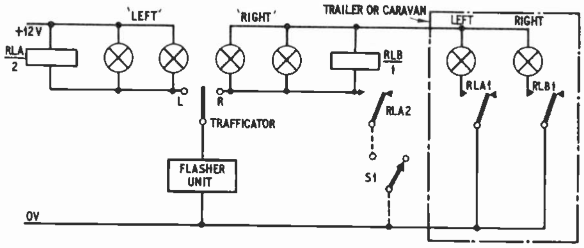


Fig. 4. Caravan or trailer flasher unit

L. Musworth,
Lancs.

## UNISELECTOR PAPER FEEDER

The idea to use a uniselector as a capstan drive for a paper recorder or seismograph was originally thought of as an alternative to the revolving disc system which had a somewhat restricted recording period. The circuit Fig. 5 provides variable paper tape speed from 2mm to 25cm per minute.

The unijunction TR1 generates positive going pulses, which are controlled by VR1. These are conveyed to TR2 by C2 which inverts the pulses and switches on TR3 for the duration of each pulse. Normally no heatsink is required for the power transistor TR3.

The uniselector used was a small 50Ω type and was marked T30338C. When all the switchgear is removed a 1·8cm shaft is revealed which can be extended by a sleeve. This is used together with a sprung jockey wheel to feed the paper from a roll.

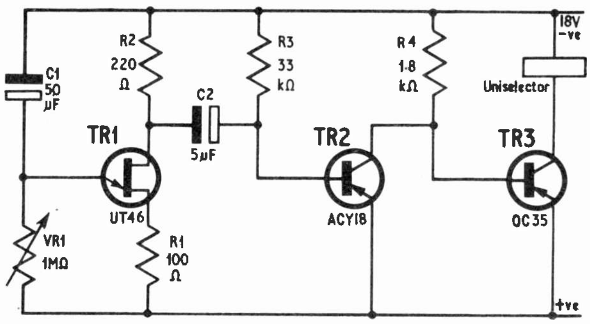


Fig. 5. Circuit diagram for paper feed controller

B. Darnton,
Sherfield English, Hampshire.

## CAR ALARM TIMER

Having purchased a car alarm quite recently I was amazed how many times I forgot it was there and released a fearful blast from the car horns.

The circuit diagram, Fig. 6, shows a simple 4 to 12 seconds timer. The switch S1 is the trigger, it can be either the "tremor" switch supplied with burglar alarm kits or, as I have used, a pressure switch underneath the driver's seat cover.

When you leave the car you set the alarm by closing the toggle switch S2. When you get back in the car and sit down LP1 lights, this tells you that you've got about 6 seconds before the horns blast, so you open S2 and all is well.

The capacitor C2 across the relay holds the horn on if a real theft is going on. The transistors TR1 and TR2 can be any germanium general purpose types, i.e. OC71 or OC81. The lamp LP1 can be a l.e.s. 12V type (or 6V for motor cycles).

I. Davey,
Hinckley, Leicester.

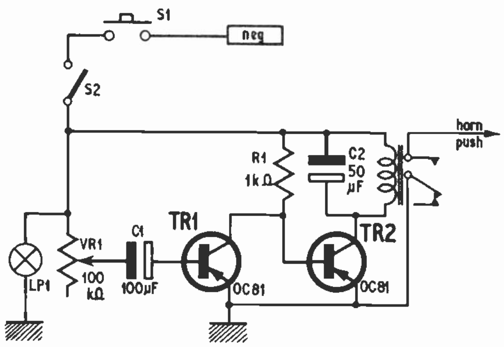


Fig. 6. Circuit diagram for a simple 4 to 12 second delay timer for a car burglar alarm

# SPECIFICATION . . .

**Circuit**
17 transistors, nine diodes and two integrated circuits with ceramic filters to give good selectivity and ease of alignment. Phase lock stereo decoder

**Tuning Range**
87–108MHz f.m. only

**Sensitivity**
$2\mu V$ for 20dB quieting and $8\mu V$ for 40dB

**Signal to noise ratio**
60dB for inputs above $50\mu V$

**Distortion**
Tuner 0·5% and stereo decoder approx. 0·3% at 1kHz, 100% modulation

**Output**
200mV at 100% modulation

**Selectivity**
6dB down at 235kHz bandwidth and 80dB down at 900kHz bandwidth

**Image rejection**
45dB

**I.F. rejection**
80dB

**A.M, rejection**
50dB

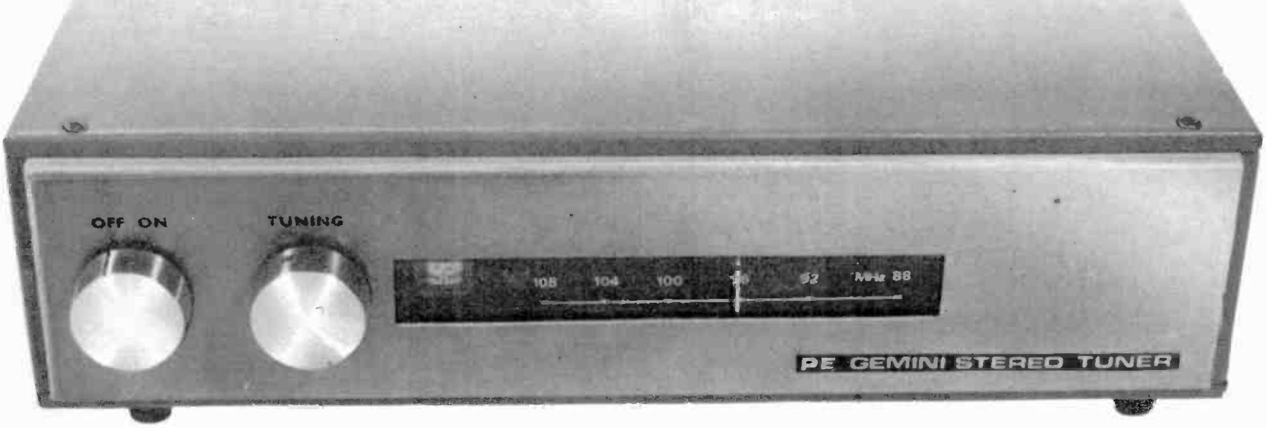
**Stereo separation**
Better than 30dB at 1kHz

**Discriminator**
Differential peak detector with single easily adjusted coil

**Stereo decoder**
Phase lock loop type with only one easily adjusted coil

**Construction**
Built in case matching the P.E. Gemini preamplifier, with its own built-in power supply to enable it to be used with any high quality amplifier

# P.E. GEMINI STEREO TUNER




**PART ONE**

**BY D.S.GIBBS & I.M.SHAW**

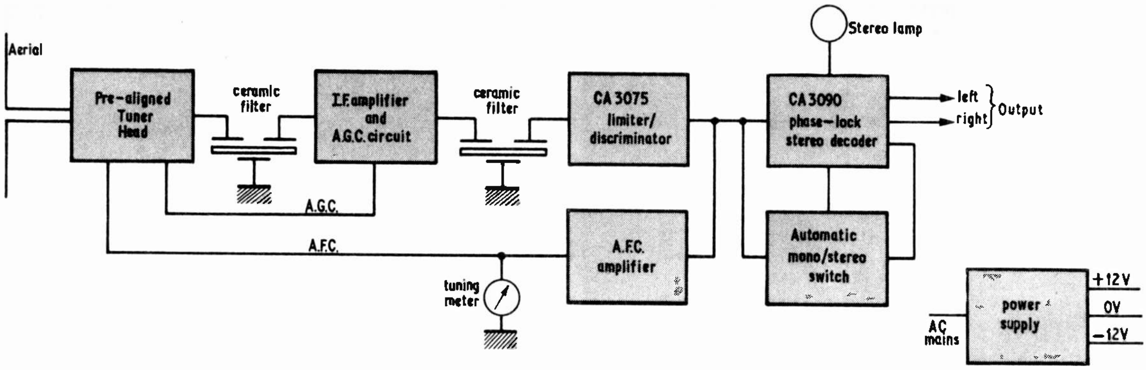



Fig. 1. Block diagram of the complete stereo tuner

THE "P.E. Gemini" Stereo Tuner is designed to give a very high standard of performance with the simplest possible alignment. In the past a high quality f.m. tuner has been a difficult project for the home constructor because of the problem of alignment, which in most cases could only be accomplished satisfactorily with the aid of a sweep generator. Pulse counter designs overcame the alignment problem, but only at the expense of poor selectivity, and spurious whistles when used with a stereo decoder.

Now all this has changed. By the use of advanced integrated circuits, ceramic filters and a pre-aligned tuner head, it is possible to build an f.m. tuner which can easily be set up by the home constructor.

The circuit can be conveniently broken down into five parts: the tuner head, the i.f. amplifier and filter, the limiter and discriminator using the CA3075 integrated circuit, the phase locked stereo decoder using the CA3090 integrated circuit, and the power supply. A block diagram is shown in Fig. 1.

## TUNER HEAD

It is difficult for the home constructor to build a satisfactory tuner head since not only must lead lengths be kept to an absolute minimum and the individual stages carefully screened from each other, but the finished tuner head must be aligned and tracked to give consistent performance over the whole f.m. band. Consequently, this design makes use of a ready made and pre-aligned tuner head. The internal circuitry is shown in Fig. 2 for purely academic interest.

The tuner head used is a three transistor design with a three-gang tuning capacitor to give good selectivity. The whole tuner head is enclosed in a metal case to give good screening.

The tuner has facilities for a.f.c. (automatic frequency control) and a.g.c. (automatic gain control). The a.f.c. action, with the help of the a.f.c. amplifier, is very powerful and the tuner shows no tendency to drift. Unfortunately the strong a.f.c. causes

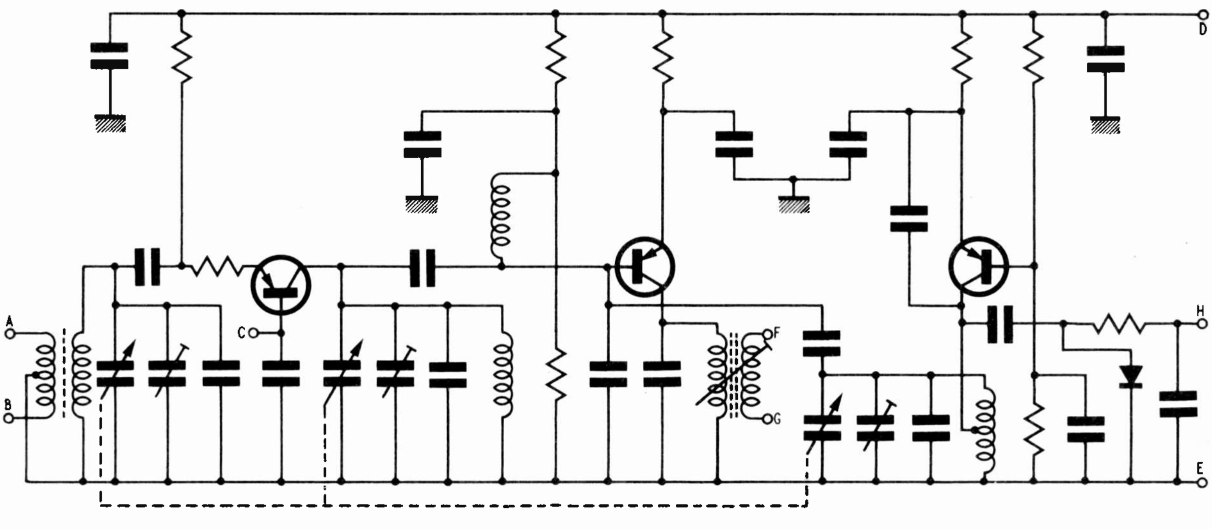



Fig. 2. Theoretical diagram of the pre-aligned f.m. tuner head

# COMPONENTS . . .

### Resistors

| | | | |
|---|---|---|---|
| R1 | 1·8kΩ | R25 | 470kΩ |
| R2 | 330Ω | R26 | 390Ω |
| R3 | 330Ω | R27 | 150Ω |
| R4 | 47Ω | R28 | 4·7kΩ |
| R5 | 330Ω | R29 | 10kΩ |
| R6 | 680Ω | R30 | 10kΩ |
| R7 | 100kΩ | R31 | 2·2kΩ |
| R8 | 22kΩ | R32 | 100Ω |
| R9 | 3·3kΩ | R33 | 3·3kΩ |
| R10 | 330Ω | R34 | 22kΩ |
| R11 | 82Ω | R35 | 6·8kΩ |
| R12 | 22Ω | R36 | 22kΩ |
| R13 | 1MΩ | R37 | 6·8kΩ |
| R14 | 100Ω | R38 | 22kΩ |
| R15 | 10kΩ | R39 | 10kΩ |
| R16 | 390Ω | R40 | 10kΩ |
| R17 | 12kΩ | R41 | 10kΩ |
| R18 | 6·2kΩ | R42 | 10kΩ |
| R19 | 10kΩ | R43 | 820Ω |
| R20 | 4·7kΩ | R44 | 2·7kΩ |
| R21 | 47kΩ | R45 | 820Ω |
| R22 | 2·2kΩ | R46 | 820Ω |
| R23 | 10kΩ | R47 | 820Ω |
| R24 | 10kΩ | R48 | 820Ω |

All ± 5%, $\frac{1}{4}$W carbon.

### Potentiometer

VR1 4·7kΩ (*or* 5kΩ) linear miniature moulded track preset

### Capacitors

C1 4μF elect. 40V
C2 150pF polystyrene 125V
C3 680pF polystyrene 125V
C4 0·1μF disc ceramic 30V
C5 1,000pF disc ceramic
C6 1,000pF disc ceramic
C7 0·022μF disc ceramic 18V
C8 33pF polystyrene 125V
C9 1,000pF disc ceramic
C10 0·01μF disc ceramic 18V
C11 10μF elect. 16V
C12 1,000pF disc ceramic
C13 0·01μF disc ceramic 18V
C14 0·01μF disc ceramic 18V
C15 10pF polystyrene 125V
C16 47pF polystyrene 125V
C17 0·01μF disc ceramic 18V
C18 1,000pF disc ceramic
C19 220pF polystyrene 125V
C20 25μF elect. 25V
C21 0·22μF polyester
C22 25μF elect. 25V
C23 3,300pF polystyrene 125V
C24 1μF polyester 100V
C25 0·47μF polyester 100V
C26 1μF polyester 100V
C27 2·5μF elect. 16V
C28 6,800pF polyester
C29 6,800pF polyester
C30 4μF elect. 40V
C31 4μF elect. 40V
C32 470pF polystyrene 125V
C33 470pF polystyrene 125V
C34 0·015μF polyester
C35 32μF elect. 40V
C36 125μF elect. 16V
C37 250μF elect. 25V
C38 250μF elect. 25V
C39 0·0047μF polyester
C40 2,000μF elect. 25V
C41 0·1μF 1,000V

### Transistors

TR1 ZTX311
TR2 ZTX311
TR3 ZTX311
TR4 ZTX311
TR5 ZTX108
TR6 ZTX500
TR7 ZTX500
TR8 ZTX108
TR9 ZTX108
TR10 ZTX108
TR11 ZTX108
TR12 ZTX550
TR13 ZTX500
TR14 ZTX108

### Integrated Circuits

IC1 CA3075 (R.C.A.)
IC2 CA3090Q (R.C.A.) quad in-line *or* CA3090E dual in-line (see text)

### Diodes

D1 ZS170
D2 ZS170
D3 ZS170
D4 ZS170
D5 ZS170
D6 ZS170
D7 KS110A
D8 KS120A

### Filters

F1–2 Vernitron FM4 ceramic filter (2 off)

### Meter

ME1 50-0-50μA centre zero f.m. tuning meter, 220–250Ω

### Transformer

T1 Mains transformer, secondary 12V–0–12V 0·5A

### Inductors

L1 17 turns of 30 s.w.g. enamel on Neosid NS/E3 former
L2 2mH adjustable coil type 87135 BX 1·3mH to 2·3mH or type QL10 1·5mH to 3mH (details next month)

### Lamps

LP1 6V 60mA l.e.s. indicator lamp (stereo pilot)
LP2 12V 120mA l.e.s. scale lamp
LP3 12V 120mA l.e.s. scale lamp

### Switches

S1 Double pole rotary mains switch
S2 Optional single pole on-off switch for a.f.c.

### Sockets and Plug

SK1 Coaxial aerial socket
SK2 DIN output socket 5-way 180°
PL1 Panel mounting miniature mains connector 3-way type P429 with socket P430

### Miscellaneous

Case Contil MOD-2 size G (West Hyde Developments Ltd., Ryefield Crescent, Northwood Hills, Northwood, Middlesex)
F.M. Tuner head (details next month)
FS1 Fuse 1A slow blow and fuseholder
Printed circuit board (fibreglass) 10in × 4·5in
Satin finished brushed aluminium front panel $12\frac{3}{4}$in × $2\frac{3}{4}$in
Jackson tuning dial and drive to be described in Part 2
Aluminium panel 18 s.w.g. 10in × 2in

# P.E. GEMINI STEREO F.M. TUNER CIRCUIT

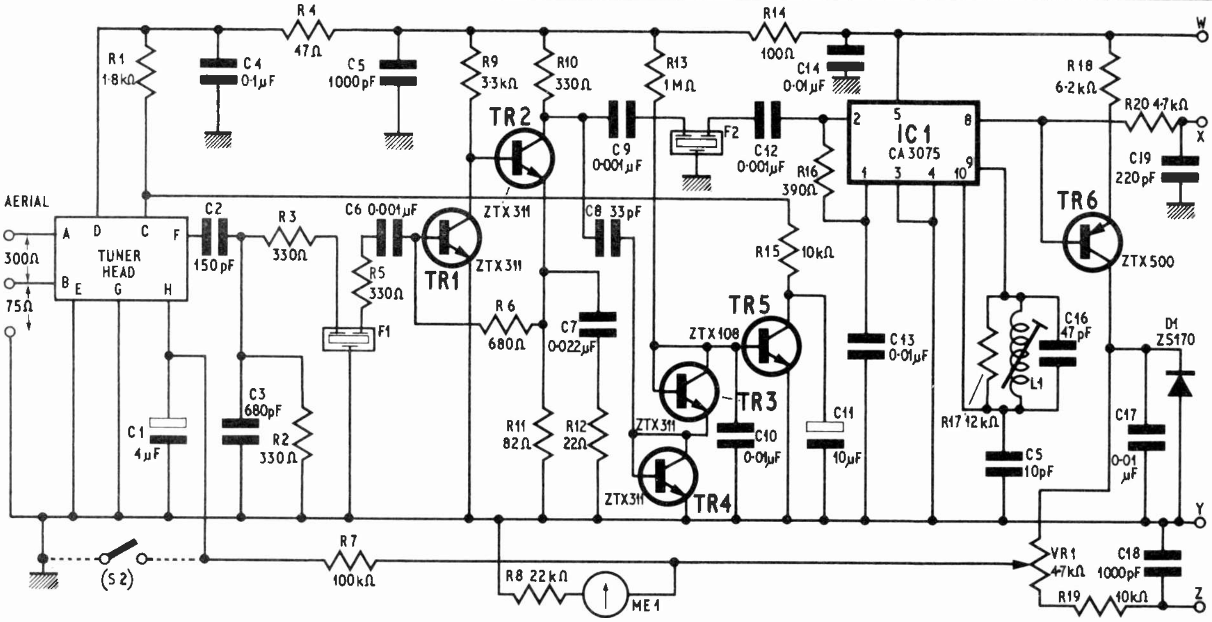


Fig. 3a. Circuit diagram of the i.f. amplifier with tuner head connections

the tuner to "jump" from one station to another as the tuning knob is turned. Commercial designs usually overcome this by providing a switch to cut out the a.f.c. whilst tuning, but in this design, such an arrangement was omitted so as not to spoil the simple and functional appearance of the front panel. However, the constructor can include an a.f.c. switch if he desires and the correct position for it is marked on the circuit diagram (Fig. 3a) as S2.

A.g.c. is a facility that is frequently omitted on f.m. tuners, on the philosophy that the signal is going to be limited anyway so why bother to control its level? If the input stages are allowed to overload, spurious sidebands can be produced and "pulling" of the logical oscillator may occur. This is clearly undesirable so an a.g.c. system has been included which effectively prevents overloading in any stage of the tuner.

## I.F. AMPLIFIER

Between the tuner head and the CA3075 limiter/discriminator there is a ceramic filter i.f. section (shown in Fig. 3). TR1 and TR2 form the actual i.f. amplifier, a simple two transistor feedback pair which provides a modest amount of gain and acts as a buffer between the two ceramic filters. These filters must be operated with resistive source and load impedances of 330 ohms, which is easily provided by making the collector load resistor of TR2 330 ohms and putting a 330 ohm resistor in series with the input (R5). The input impedance of the amplifier itself is very low and can be ignored. The total gain of the i.f. amplifier is about 20dB but there is a loss of about 3dB in each of the filters, giving an overall gain for the stage of 14dB.

## CERAMIC FILTERS

The ceramic tuned filters are Vernitron type FM-4. These filters give a remarkably high standard of selectivity, each filter being approximately equivalent to two double-tuned critically coupled transformers. No adjustment is required of couse so that there are no alignment problems. However, because of production tolerances the filters are graded into five frequency groups at 37·5kHz intervals around 10·7MHz and are identified by coloured dots. There is no advantage in using any particular frequency group, but you should ensure that both filters carry dots of the same colour.

The frequency response of two filters is typically 6dB down at 235kHz bandwidth and not less than 80dB down at 900kHz bandwidth. This is shown in Fig. 4. This is actually somewhat on the narrow side, since a bandwidth of 300kHz is usually considered advisable for multiplex reception.

The reason for this is that for good stereo separation a tuner must have a linear phase/frequency relationship for modulation frequencies up to 53kHz. In effect this means that the time delay through the whole tuner must be the same at all frequencies, so that all the harmonic components of a complex waveform will come out with exactly the same phase relationships as when they went in. This is important because the correct phase relationship between the pilot tone and the multiplex sidebands is essential for good stereo separation.

In fact the phase/frequency response of the ceramic filters is perfectly linear up to 53kHz, as Fig. 5 shows, and there should be no problems on this score.

But this is not the end of the story. An f.m. signal generates a very complex series of sidebands, which is unfortunately beyond the scope of this article to discuss in detail. At low modulation frequencies all the significant sidebands are contained within the ±75kHz deviation, and no problem arises. However, at high modulation frequencies there are significant sidebands beyond the ±75kHz limits and these are attenuated to some extent by the filters.

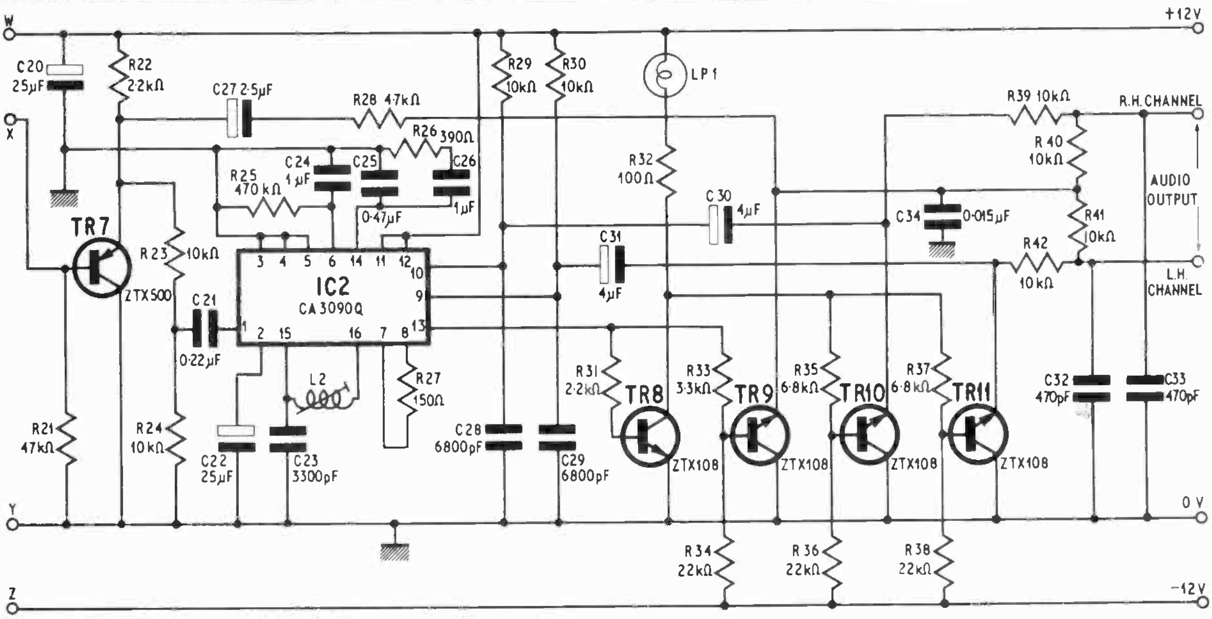



Fig. 3b. Circuit diagram of the stereo decoder

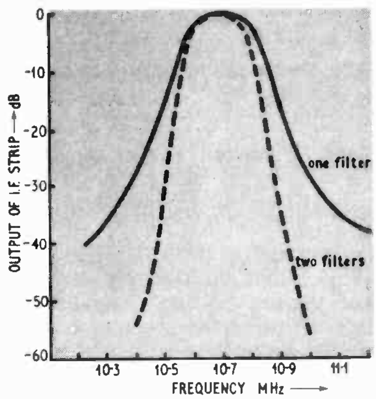



Fig. 4a. Frequency response of the i.f. amplifier and filters

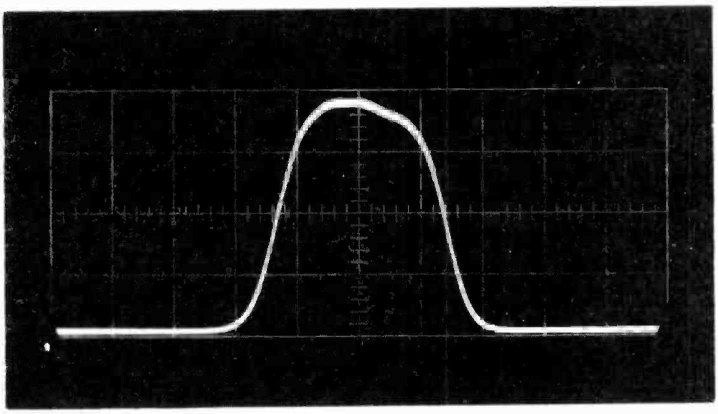


Fig. 4b. Oscillogram, displayed by a sweep generator, of the response shown in Fig. 4a. Horizontal scale is 100kHz per division

This appears as slight distortion on the output waveform.

This distortion is not of great importance since it only appears on the L–R difference signal, which is generally of low amplitude. It is in any case a small price to pay for the convenience of the ceramic filters and the majority of new commercial designs use these filters.

## A.G.C. AMPLIFIER

The output of the i.f. amplifier is peak-peak rectified by transistors TR3 and TR4, which are connected as "super diodes" and do actually cost less than conventional diodes. The rectified signal voltage is applied to the base of TR5 but, as the signal level rises, TR5 base is driven more negative, turning off TR5. This reduces the bias on the first stage of the tuner head so the gain of the tuner head falls, preventing overloading.

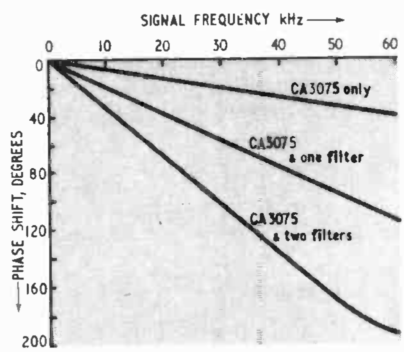



Fig. 5. Phase vs frequency characteristic of the detector and i.f. amplifier, showing very good linearity

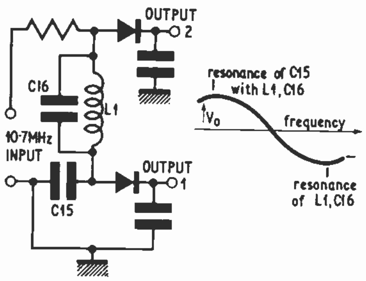



Fig. 6. Basic circuit and output waveform of the differential peak detector $V_2$ = output 1 — output 2

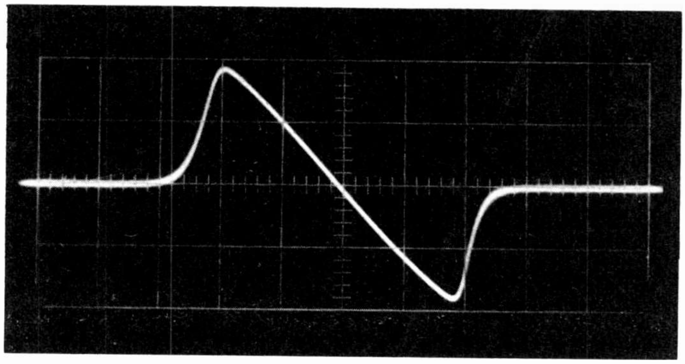


Fig. 7. Frequency response oscillogram of the CA3075 and i.f. strip together. Horizontal scale 100kHz per division; vertical scale lV per division

## LIMITER AND DISCRIMINATOR

The R.C.A. type CA3075 limiter/discriminator contains three cascaded differential amplifiers which provide 60dB gain and excellent limiting. These are followed by a discriminator using what R.C.A. call a "differential peak detection circuit". This requires only a single coil and is consequently very simple to align.

The differential peak detector is novel but very simple. When the input frequency is slightly below the resonant frequency of L1 and C16 the net impedance of the L1–C16 combination is inductive. This forms a series tuned circuit with C15 and a large signal voltage is developed across C15 at this frequency. As the frequency is increased the voltage across C15 falls as it moves away from resonance but the voltage across L1–C16 increases, reaching a peak at their own resonant frequency. If we now rectify these two signals and measure the difference between them we obtain the familiar S curve (see Fig. 6).

In the CA3075 the rectification is done by four transistors which charge up two capacitors also within the i.c. The difference between these two voltages is amplified by a differential amplifier and appears at the output.

The output of the CA3075 for ±75kHz deviation is approximately 500mV r.m.s. At this level the distortion is about 0·5 per cent. The distortion generated by the CA3075 actually remains virtually constant up to 50kHz due to the very wide bandwidth of the discriminator, but as already discussed the sideband cutting introduced by the filters increases the distortion at high frequencies.

When comparing the specification of this tuner with commercial models, remember that many manufacturers specify the distortion at 30% modulation, i.e. only ±25kHz deviation. The distortion at 75kHz deviation is usually considerably greater. This is analogous to specifying the distortion of a 10 watt amplifier at 1 watt.

## A.F.C. AMPLIFIER

The a.f.c. input of the tuner head requires a control voltage of about ±1 volt. However, the output of the CA3075 is superimposed on a d.c. level of 5·4 volts. To overcome this difficulty TR6 acts as a level shifter, giving an output centred on zero, and also inverts the output of the CA3075 to give the correct phase of feedback. If the feedback were of the wrong phase the a.f.c. voltage would send the tuning in the opposite direction to that required with the result that the tuner would refuse to lock onto a station.

The output of the a.f.c. amplifier is also used to operate the tuning meter.

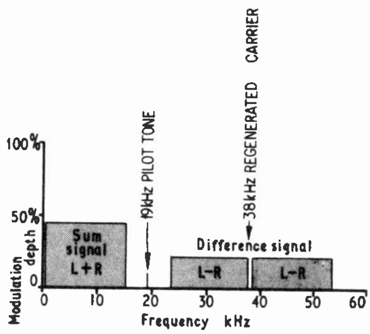



Fig. 8. Spectrum of stereo signal with equal but different signals in the left and right hand channels. The relative amplitudes of the sum and difference signals can vary according to the signals present in the left and right hand channels

## STEREO SIGNAL

The stereo signal at the output of the discriminator has three main parts. These are shown in Fig. 8. Extending from 30Hz up to 15kHz is the normal audio signal, which in the case of a stereo transmission is the sum of the left and right hand channels (L + R). With a mono tuner this is all you ever hear. Above this there is a low level 19kHz pilot tone, and above that, extending from 23 kHz to 53kHz there are a pair of sidebands which are modulated with the difference between the left and right hand channels (L−R).

The 38kHz carrier is eliminated to economise on bandwidth and improve the signal to noise ratio and so it has to be regenerated in the receiver from the 19kHz pilot tone. This enables the (L−R) difference signal to be obtained and the left and right hand channels can be obtained by adding and subtracting. i.e.

$$(L + R) + (L - R) = 2L$$
$$(L + R) - (L - R) = 2R$$

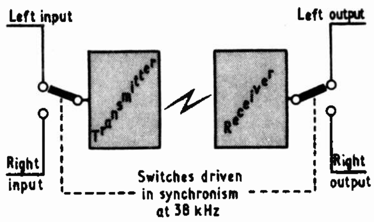



Fig. 9. Basic principles of stereo transmission system

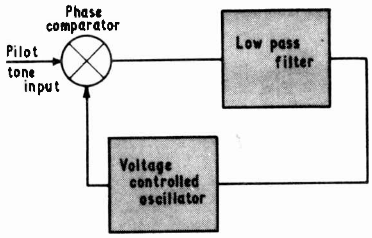



Fig. 10. Basic block diagram of the phase lock loop

A stereo decoder has a difficult job to do. It has to sort out the 19kHz pilot tone from the signals on either side of it, which may be up to nine times larger. This requires high-$Q$ tuned circuits. It then has to double this frequency to 38kHz to replace the missing carrier in exactly the same phase as the original. A phase error between the regenerated carrier and the difference sidebands drastically reduces the stereo separation and the higher the $Q$ of the tuned circuits the more sensitive to errors of tuning the decoder will be.

The amateur may find it difficult to understand why a phase error in the regenerated 38kHz carrier should upset the separation. One way of looking at it is to imagine a switch at the transmitter looking alternately, at 38kHz, at the left and right hand channels (see Fig. 9).

If we have a similar switch in the receiver, exactly in synchronism with the switch at the transmitter, we can reconstitute exactly the original left and right hand signals. But suppose that the receiver switch is not exactly in synchronism with the transmitter switch. When the receiver switches to the right hand channel the transmitter might still be looking at the left hand channel. Thus the left and right hand signals get mixed up and the separation is greatly reduced.

There are slight differences between the actual modulation process and the simple description above, but it is nevertheless valid and most stereo decoders work on exactly this principle.

Most commercial stereo decoders compromise between the conflicting requirements of good selectivity (i.e. high $Q$) and good phase stability by using three tuned circuits of moderate $Q$. However, such decoders are difficult for the home constructor to adjust, and may not be particularly stable once adjusted. Up to the present time one had little choice, but now integrated circuits have made it possible to use phase lock loop techniques to overcome this problem.

## PHASE LOCK LOOPS

All phase lock systems contain the same basic components, and the bare bones are shown in Fig. 10. There is a voltage controlled oscillator, a phase comparator which gives an output voltage related to the phase difference between this oscillator and the input signal, and a low pass filter which removes switching transients and high frequency components from the output of the phase comparator and also determines the bandwidth of the system.

When the input signal is first applied the v.c.o may not be running at exactly the right frequency. If this is the case the difference frequency appears at the output of the phase comparator, and if sufficiently low it passes through the low pass filter and frequency modulates the v.c.o. If the v.c.o. is now able to reach the signal frequency it will lock on to the signal. Once locked, any drift in the v.c.o. causes a phase error. This changes the output voltage of the comparator which pulls the v.c.o. back into the correct phase, enabling the v.c.o. to maintain the correct phase to within a few degrees, even when grossly misadjusted.

The v.c.o. can only lock on to signals close to its own frequency; signals beyond these limits have no effect. This gives the system good selectivity without the phase problems normally associated with high $Q$.

Phase lock loops are not new; they have been used in sophisticated instrumentation systems for years, but up to the present their cost and complexity has made them impracticable for consumer equipment.

## STEREO DECODER

The CA3090Q stereo decoder integrated circuit is a remarkable device, containing no less than 128 transistors. It is shown in diagrammatic form in Fig. 11 but space restrictions prevent us publishing the full circuit diagram.

To describe the operation of this circuit in detail would take an article all by itself, but the following brief explanation may be of interest to the constructor.

A double balanced phase lock detector provides a d.c. output according to the phase difference between the pilot tone and the 19kHz signal generated in the circuit. This output is filtered by C25 and C26–R26 (outside the i.c.) and applied to a reactance circuit, which controls the frequency of the tuned circuit L2/C23 connected to pins 15 and 16. The actual oscillator is of the negative resistance type, the negative resistance cancels out the (positive) loss resistance of the tuned circuit and enables it to oscillate at 76kHz. This frequency varies according to the phase lock detector output voltage. The v.c.o. output is fed to a bistable, the 38kHz output driving the L-R detector.

The reason for using a bistable to generate the 38kHz waveform rather than running the oscillator at 38kHz is to ensure that the waveform is perfectly symmetrical. This assists in obtaining good stereo separation. This bistable drives two others that provide two pairs of 19kHz outputs differing in phase by 90 degrees. The first bistable drives the phase lock detector discussed above whilst the second drives the pilot presence detector which operates the pilot tone indicator.

# STEREO DECODER

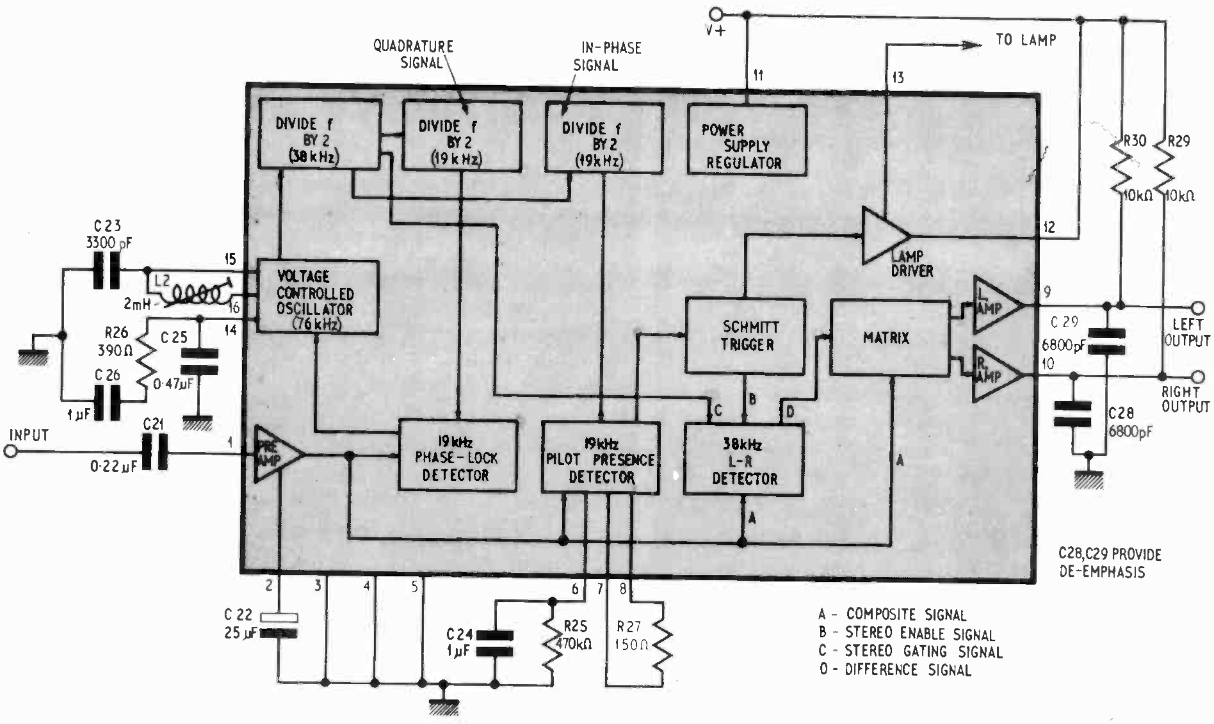



Fig. 11. Block diagram of the circuitry within the CA3090 integrated circuit

# POWER SUPPLY

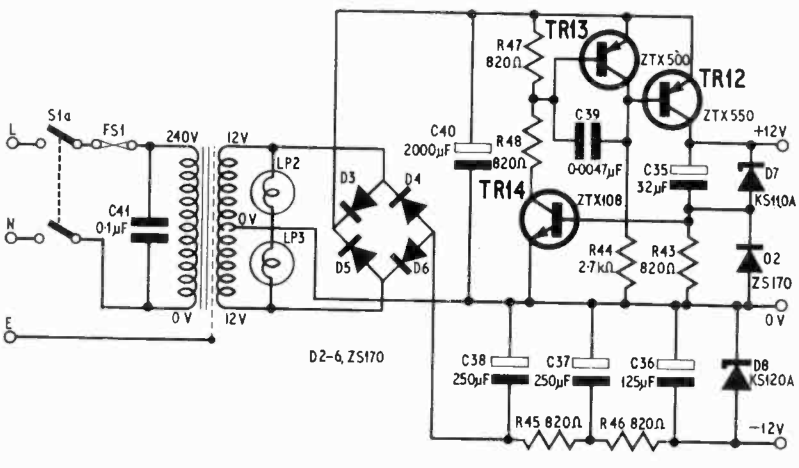



Fig. 12. Circuit diagram of the stabilised power supply

A third phase sensitive detector, driven by the 38kHz bistable, separates the two channels. The left and right hand signals are mixed with a proportion of the input signal to balance out the crosstalk, which is inevitably produced by square wave demodulation, and the result is fed through the output amplifiers within the i.c.

Most of the other transistors in the i.c. perform mono/stereo switching or provide bias potentials.

The CA3090Q has quad in-line lead-out pins, i.e. alternate pins are staggered to give greater separation. The CA3090E is identical to the CA3090Q except that the pins are dual in-line. Allowance in the printed circuit pattern must be made according to which type is used.

## AUTOMATIC STEREO SWITCHING

One unfortunate feature of phase lock loops is that the oscillator has to run continuously. This would not matter if the B.B.C. did not have the unfortunate habit of putting a 23kHz pilot tone on top of mono programmes. The result is that, due to stray coupling within the i.c., a low amplitude 4kHz tone appears at the output. The level is very low, but nevertheless is just sufficiently loud to be annoying, so we were obliged to include an automatic stereo/mono switch. This cuts out the decoder when a mono programme is being received and completely eliminates the whistle.

The mono/stereo switching is performed by TR9, TR10 and TR11. These three transistors are worked in inverted mode (i.e. the emitter is used as the collector) to give a very low saturation voltage.

When a mono programme is being received the output from pin 13 of the CA3075 is low, so that the lamp driver transistor TR8, and TR9 are turned off. The collector voltage of TR8 is high and this turns TR10 and TR11 hard on. These two transistors short out the left and right hand channel outputs of the i.c. TR9 however is turned off and allows the signal from the emitter follower TR7 to pass straight through to the outputs.

When a stereo programme is being received the output from pin 13 rises and turns on the lamp driver and TR9. This closes the "through path" but TR10 and TR11 have now been turned off and the two outputs of the stereo decoder are now coupled to the output.

## POWER SUPPLY

The tuner requires +12 volts at about 160mA and −12 volts at only 2·5mA. The −12V is provided by a simple zener diode stabiliser (Fig. 12) although extensive decoupling is necessary to prevent hum appearing on the a.f.c. line.

The +12V is provided by a three transistor series regulator. Any tendency for the output voltage to rise causes TR14 to conduct more heavily. This increases the current in TR13, which reduces the current flowing in the regulator transistor TR12 and hence the output voltage. The purpose of C35 is to ensure that when the power supply is first switched on the +12V supply rises at the same rate as the −12V supply. This prevents the a.f.c. circuit from locking on to the wrong station.

**Next month: Part 2 will give details of construction**

# NEWS BRIEFS

## LIGHT TOOTH

BY USING Fibre Optics your dentist may soon be able to see through your teeth without using X-rays.

This concept, known as transillumination, has not been widely used before because lights bright enough to shine through teeth usually have been too large for use inside the mouth, as well as being too hot for the patient's comfort.

The fibre optics tool inserted in the mouth is about the size of a small screwdriver and can easily be manœuvred inside the mouth. When illuminated a healthy tooth seems to glow white, tooth decay shows up as a darkened shadow. Fillings appear as black spots or lines and hardened, crust-like accumulations of food residues and mouth secretions are clearly distinguishable.

Developed in America this new technique will soon be ready for distribution.

One possible result of transillumination could be the mass screening of children by trained dental assistants who would refer those needing treatment to dentists.

## BBC COLOUR

UNDER a substantial re-equipping programme to bring full colour-broadcasting facilities to its regional television studios, the BBC has ordered further colour television broadcast cameras worth more than £100,000 from EMI Electronics Ltd.

Approximately £2 million has already been spent on EMI 2001 cameras by the BBC over the past three years and the addition of the new cameras will bring the Corporation's total to some 116 cameras. This represents over 80 per cent of the colour cameras used for studio productions and for outside broadcasting by the BBC.

The additional colour cameras will be used in BBC studios located in major cities throughout Britain including Bristol, Southampton, Leeds, Newcastle and Manchester. Several studios will be able to televise local programmes in colour for the first time, while at other locations, the EMI cameras will extend existing colour facilities. The BBC has already re-equipped a number of studios including Glasgow and Birmingham under its scheme which is expected to take about 18 months to complete.

# ELECTRONORAMA

## RIDING THE MILLIMETRIC WAVES

To assist in meeting the explosive growth expected in telecommunications in the next 20 years the Post Office and the Science Research Council have begun what is probably the largest microwave-propagation study yet. This project could have a major influence in opening up the 10–100GHz range of the radio spectrum (wavelengths down to 3mm) to new microwave telecommunication system use.

The propagation study is based at the Post Office Research Station at Martlesham Heath, near Ipswich. The SRC Radio and Space Research Station is carrying out supporting research at Slough.

The Post Office needs to study the problems of transmitting radio waves at these super-high frequencies because its existing radio-relay network operating at frequencies of 2, 4 and 6GHz, is now approaching congestion and the higher frequencies offer greater message carrying capacity.

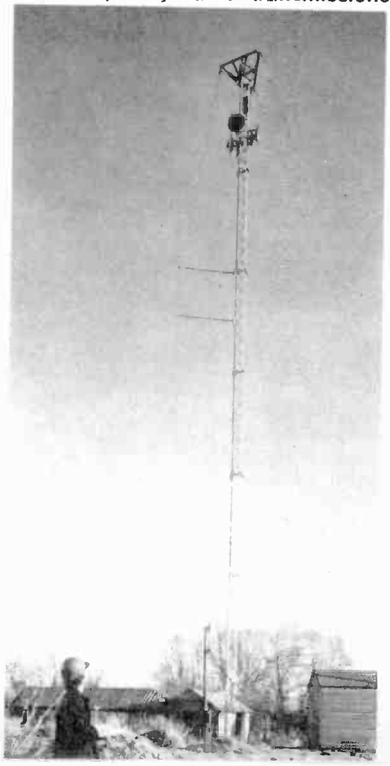
As frequencies rise above 10GHz, transmissions are increasingly affected by the weather: heavy rainfall can cause serious signal fading; and the temperature stratification that occurs on clear evenings in still air can occasionally produce multiple transmission paths that could adversely affect microwaves carrying high-speed digital signals.

A network of experimental radio transmitters has been set up in East Anglia between Martlesham and Mendlesham to find out just how radio transmissions at these millimetric wavelengths are affected by the weather and what can be done to avoid disruption of service.

**Artist's impression of the slender mast that will carry Post Office microwave equipment of the future. The masthead canopy carries all electronic equipment and the two dish antennas**

**View of raingauge and radio telemetry installation used in the Post Office microwave research project**

**Experimental microwave station in East Anglia set up to study the effect of the weather on super-high-frequency radio transmissions**



**Standard lattice steel microwave tower in the Post Office radio-relay network near Plymouth. The lowest dish antenna on the left-hand leg, with a protective radome, is installed for the new 11GHz link to Caradon Hill**

# INDUSTRY NOTEBOOK

By Nexus

## FLY-CATCHERS

When you visit a manufacturer of high voltage power supplies you expect to see equipment for scientific applications and for general industry. I was not disappointed when visiting Brandenburg Ltd., Thornton Heath, Surrey, who specialise in high voltage work. As expected, there were units in production for use with scanning electron microscopes, electron beam machining equipment, photo-multipliers, and neat little solid state e.h.t. power packs for CRT units, the big new market for these being in computer video terminals.

But what were those peculiar devices with concentric cylindrical metal grids and a light in the middle? They were traps for flying insects. An ultra-violet light source is used as the lure to attract insects between the grids. The air is ionised between the grids and the flies, moths, gnats, bite the dust in a handy disposal tray at the bottom.

Development of this novel application for high voltage was done jointly by Brandenburg and Rentokil and the equipment is supplied by Rentokil under the trade name "Rentoflash". So far, Brandenburg has built 7,000 of these units which, I gather, are particularly effective in cow houses.

## MOBILE IDEAS

To find out what's new in the mobile radio world I called on Jim Finke who has been setting up a Motorola production unit in Wiesbaden, W. Germany, to serve the European market. Motorola pioneered mobile radio in the United States, starting with a car radio as early as 1928.

The name Motorola came to company founder Paul Galvin as a flash of inspiration while shaving. It is now world famous in both communication equipment and solid state devices. Big breakthrough for Motorola was development of first the "Handie-Talkie" and, later, the "Walkie-Talkie".

"Wasn't mobile radio getting a little 'old hat' ", I asked Finke. That was enough to trigger him off. "Not a bit of it", he flashed back. "Do you realise that when a guy has a heart attack the first half hour is critical? Why not fit the ambulance with a special radio unit for transmitting the patient's electrocardiograph through to the hospital. Let the doctor diagnose the heart condition and decide the treatment while the patient is still on his way."

Well, that is only one of the Motorola ideas for expanding the market for mobile radio beyond basic two-way voice communications. Another, already in production and selling to police forces in the USA, is a tiny dashboard-mounted teleprinter which prints out messages in hard copy. Transmission from the base station is by coded audio tones over the usual f.m. mobile frequencies and eavesdropping criminals have little chance of deciphering messages unless they can find out the tone codes and get hold of the right receiving equipment. Another big advantage of this system is that police officers can leave their car unattended and find a hard print-out of all messages waiting for them when they return.

Yet another idea is a bus location system, one of which has already been installed in Chicago. With microelectronics it's amazing how many extra facilities can be squeezed into vehicles without excessive penalties on space. Digital communications between vehicles is also a growing field.

But Europe, however closely integrated economically, is completely fragmented for the mobile radio man. Each country has its own technical specifications and licence regulations. Motorola says it's a real nightmare dealing with 14 countries, each with different requirements. Which explains why those huge transcontinental lorries have no mobile radio. An installation legal in the country of origin is often illegal as soon as it crosses the border!

## THE BRITISH ENGINEER

The Survey of Professional Engineers conducted by the Council of Engineering Institutions brings good news for electronic engineers. Incomes below £1,200 have all but disappeared and the great middle body of engineers' salaries now come in the range £2,400–2,599. Unemployment, at one per cent, was well below the national average of 3·3 per cent when the survey was taken.

But there were areas of disappointment. The report, which covers 1971 and was completed last December, showed that only 19 per cent of all engineers took any courses during the period and, of these, 50 per cent were on management courses while only 33 per cent took technical updating courses. This amounts to only 7 engineers in every 100 who had technical refresher courses, hardly enough, one would think, in these days of fast moving technology.

It is debatable, too, despite improved salaries, whether the engineer is adequately paid. Lavatory attendants at British-Leyland are reported as getting £1,500 a year and I have heard of loaders at London Airport (Heathrow) getting £70 a week take-home pay. The trouble with engineers is that they are generally enthusiasts. Good for them to enjoy their work, of course, but no reason why they should undervalue their services.

## A MOVE INTO THICK FILMS

Coutant Electronics, a major manufacturer of power supplies, has decided to expand into the custom-built thick film market.

This is not quite such a revolutionary decision as might at first appear because the company has had an in-house thick film capability for some years. Now, it is being made available to all.

Coutant has had an interesting history. It was the first company in the Unitech group and every previous diversification has resulted in new companies being formed. Celdis, the well-known component distributors was an early example, the name Celdis being derived from Coutant Electronics Ltd., DIStributors. Coutant's pressure transducer interests were also hived off separately as Transducers (C.E.L.) Ltd.

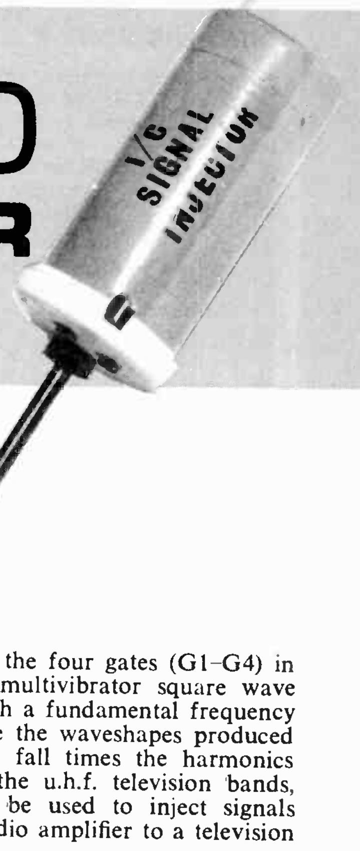
If the thick-film venture goes well, will it, too, be hived off into a separate concern?

## BLUE STREAK—ALL SYSTEMS WERE GO! !

My recent comments on the *Europa 11* launcher failure brought a sharp reminder from a member of the Hawker Siddeley Dynamics design team that the British *Blue Streak* first stage performed perfectly and the failure was due to the inertial guidance system in the third stage when *Europa 11* was at an altitude of 17 miles.

*Blue Streak*, says my correspondent, maintained its 100 per cent success rate after its previous ten successful launches.

# WIDE BAND SIGNAL INJECTOR




## BY J.D. CROFT

***Can be used for servicing***

- **Audio equipment**
- **Radio sets**
- **V.H.F. and U.H.F. television receivers**

ONE of the most useful aids for servicing audio and high frequency equipments is undoubtedly a device which will provide a modulated signal to enable tracing the signal path through the circuit.

This injector uses one of the most common TTL integrated circuits, the SN7400N, which consists of four two input NAND gates.

Although the total component count of the circuit is 40, all but five of these are within the i.c. package so that construction is very easy.

**MULTIVIBRATOR**

By suitably connecting the four gates (G1–G4) in the i.c. as in Fig. 1, a multivibrator square wave generator is produced with a fundamental frequency in the audio range. Since the waveshapes produced have very short rise and fall times the harmonics generated extend up to the u.h.f. television bands, thus the generator may be used to inject signals into anything from an audio amplifier to a television set.

## CIRCUIT DETAILS

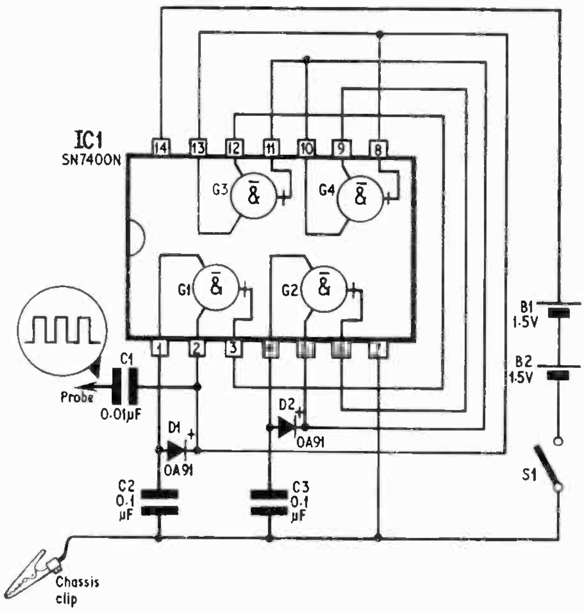



Fig. 1. Circuit diagram of signal injector

## Components . . .

**Capacitors**
C1 0·01µF 450V
C2 0·1µF
C3 0·1µF

**Diodes**
D1, D2 OA91 (2 off)

**Integrated Circuit**
IC1 SN7400N

**Switch**
S1 Lever operated miniature microswitch

**Miscellaneous**
B1, B2 HP16 (2 off), 1 crocodile clip, plastics sleeve, 4in length of screwed brass rod ⅛in diameter

## CONSTRUCTION

Despite the apparent complication of the circuit, it is no more expensive to build than a conventional multivibrator using two transistors and is certainly a lot neater.

The majority of small components are built up on a piece of 0·1in matrix Veroboard measuring $1\frac{1}{4}$in × 1in as in Fig. 2. The only point to watch is the correct location of the i.c. before soldering as it is very difficult to remove all 14 pins at once if it has to be removed.

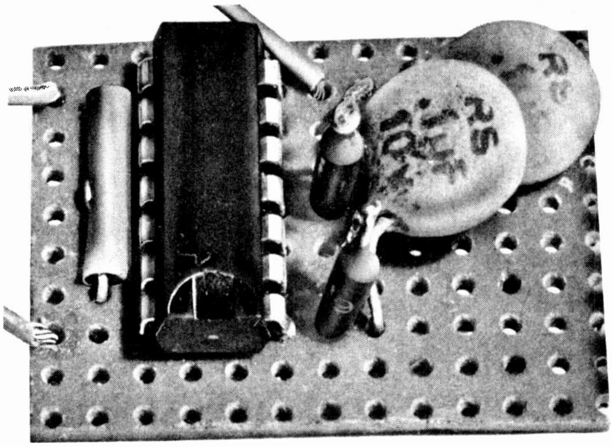
## UNIT HOUSING

The actual housing was a $2\frac{1}{4}$in × 1in dia. tin with a snap-on plastics lid. As it was impossible to obtain a battery holder small enough to fit this, it was necessary to solder the battery leads directly to the battery terminals. If the constructor wishes to use a battery holder a larger tin will be found necessary.

A small microswitch is used for S1 with the lever bent as shown to protrude slightly from the lid. Adjacent to this is the probe, a 4in length of $\frac{1}{8}$in diameter brass rod threaded at one end and covered with plastic sleeving so that only the tip is bared.

## TESTING

The finished unit can be tested by connecting a pair of phones between the probe tip and chassis clip. If all is well a tone of about 3kHz should be heard.



Small component assembly on 0·1in matrix Veroboard

To check the u.h.f. properties of the generated tone, connect the output to a television receiver aerial socket which should produce an audible output from the receiver speaker.

The earth clip is not essential for use at radio frequencies but a higher output will be obtained if it is used. ★


# WIRING DETAILS

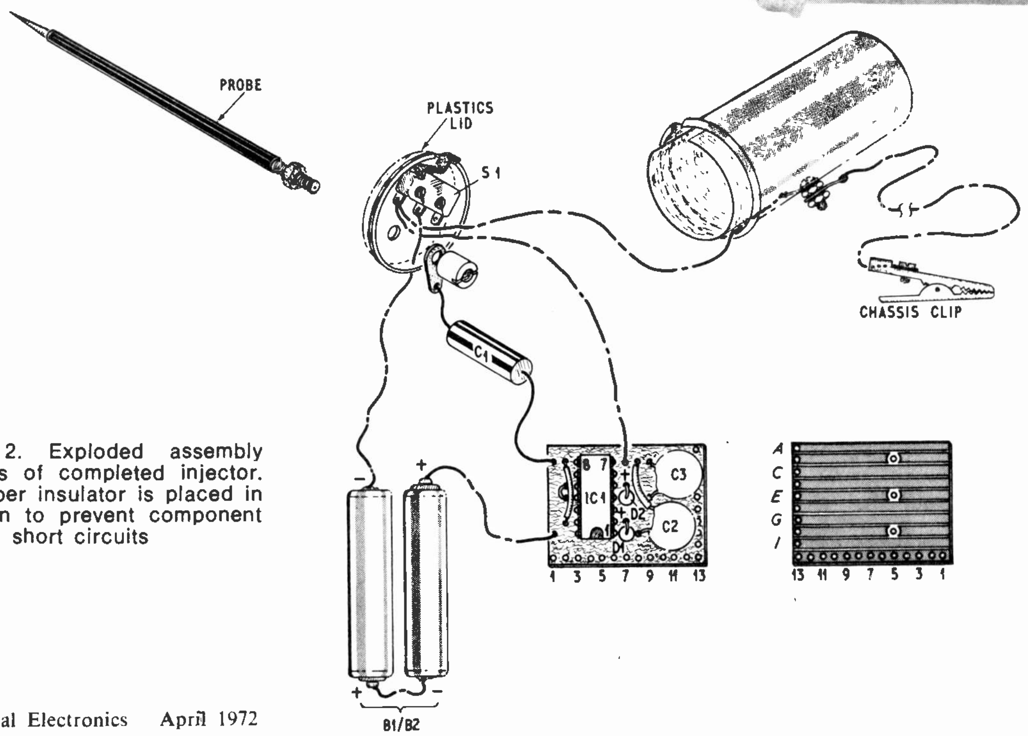



Fig. 2. Exploded assembly details of completed injector. A paper insulator is placed in the tin to prevent component board short circuits

# 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.

## PRESSURE SENSITIVE RESISTOR

A product that should prove both versatile and also tax readers' inventive instincts is ResilistoR, a special pressure sensitive resistor announced by **Logic Applications Ltd.**

The "resistors" are made from cubes, slices or discs of polyurethane foam impregnated with a special graphite conductive substance. According to the amount of pressure applied the graphite granules are brought closer to each other causing a gradual reduction in resistance across the device. As soon as the applied pressure is released, the ResilistoR reverts back to its unloaded resistance and shape.

Resistances from 50 ohms to 500 kilohms are available in varying ranges. The voltage range of the device may vary from 5V to 40V a.c./d.c. according to resistance range required. Devices capable of handling 100V d.c. at 60mA and 240V a.c. at 500mA have been produced to special order.

An experimenter's pack, containing one cube, one disc and one slice is available, price £2·50 including postage and packing.

The uses of ResilistoR is obviously very numerous and some of the applications which incorporate the devices are: intruder alarm pads; motor controllers; limit switches and volume controls.

In the electronic music field they have been used in keyboards and make excellent foot controls for Waa-Waa Pedals. Aids for the disabled is one field where experiments have been carried out with some success.

Further information, experimenting kit, and resistance ranges can be obtained from Logic Applications Ltd, 47 Victoria Street, London, S.W.1.

## LIGHT SOURCES

The forecast by many experts that light sources will be one of the biggest growth sections in the electronics industry this year seems to be underway. Already, devices using varying methods of producing a light source are appearing on the market.

The solid state Ga As light indicator from **West Hyde Developments** uses a gallium arsenide light source and can be driven directly by a T.T.L. i.c.

The indicator will operate at 15mA at 1·6V or more. The recommended operating conditions are 40mA for brightest display (approximately 750 foot Lamberts). The device will continue to emit an adequate light down to 5mA.

Full details are available from West Hyde Developments Ltd, Ryefield Crescent, Northwood Hills, Northwood, Middx.

The use of liquid crystal cells for a light source is the latest development from **RCA.**

Not available generally, at the present time, the TA8032 and the TA8034 are single digit, seven segment numeric display devices.

The TA8032 is a transmissive type in which both conductive surfaces are transparent. This device is particularly suitable in applications where back or edge-lighted readouts are desirable.

The TA8034 is a reflective type and utilises a mirrored area on the inner surface of the back plate. This type is particularly useful in those applications where available front lighting is of primary importance.

These devices operate from 8V to 50V and are primarily intended for a.c. operation at frequencies from 30 to 60Hz although operation at other frequencies (400Hz) is possible. D.C. operation is not recommended.

Technical specifications and information is available from RCA, Solid State Europe, Sunbury-on-Thames, Middlesex, TW16 7HW.

**Guest International** have just introduced the Litronix Data-Kit 62 seven segment numeric display using gallium arsenide red light emitting diodes. The display contains approximately 56 diodes in one 14-pin dual-in-line package and the luminescence is typically 500 foot Lamberts at 20mA.

Back to the more realistic light sources, filament and neon types, Guest have also released a range of miniature neon and filament lamps with either wire-ended terminations or flanged bases.

Particulars of the Data-Kit 62 and the miniature lamps are available from Guest International Ltd, Nicholas House, Brigstock Road, Thornton Heath, Surrey, CR4 7JA.

## PRINTED CIRCUIT AIDS

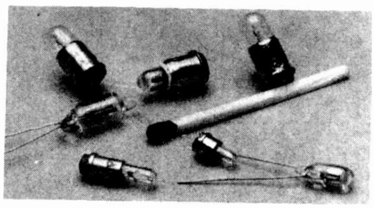
Of special interest to readers who once having proved a bench "lash-up" circuit have difficulty in translating the circuit to a printed circuit layout. **Technomark** are now marketing a kit for making printed circuits easily.

The Technomark printed circuit pack is known as the Ambitrack system and costs £5·35 with s.r.b.p. boards or £6·25 with epoxy based glass fibre boards.

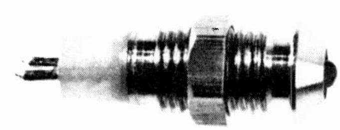
The pack contains three 8½in × 6½in copper laminated sheets, with a 0·1 matrix scored into the copper surface; a bottle of etchant and a bottle of cleaning fluid; a pair of tweezers; magnifying glass; special grid patterned tracing sheets; and a special etchant resist pen. The case of the pack acts as a suitable etchant bath.

The circuit pattern is drawn onto the copper surface with the special resist pen and then immersed in the etching fluid. Alpha-numeric graduations around the edges of the boards allow for easy checking once the etching process is completed and the board cleaned.

Kits are available from Technomark, Borough Green, Sevenoaks, Kent.

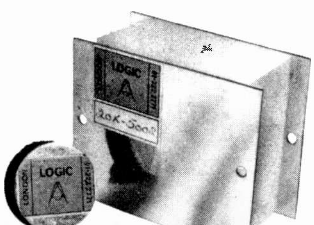


Range of miniature indicators marketed by Guest International

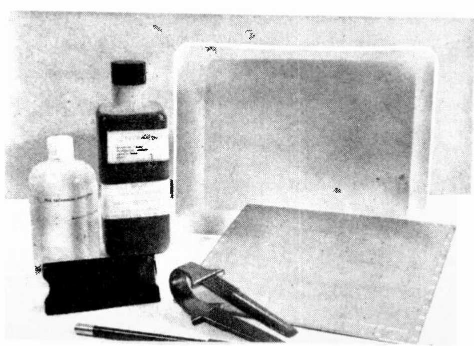


Ga As light source from West Hyde Developments

Two types of ResilistoR from Logic Applications




Technomark Ambitrack printed circuit kit



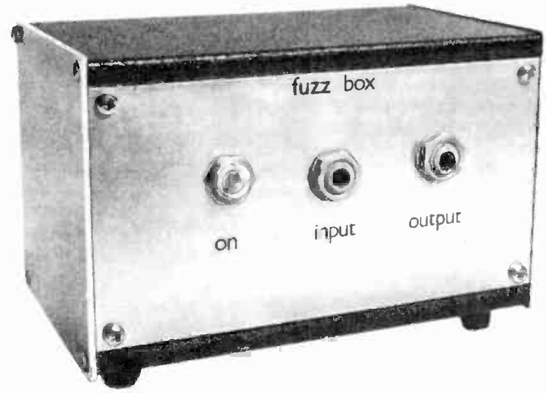
# FREE!

## With the MAY issue SEMICONDUCTOR LEAD-OUT IDENTICHART

Lists the most commonly available types of pnp, npn, field effect and unijunction transistors; thyristors and triacs; power, small signal, Zener, and tunnel diodes.
Provides rapid lead, tag, or terminal identification for these popular solid state devices.
This Wall Chart, measuring 21in × 15½in, has been specially designed for the constructor's workshop and gives vital information at a glance.
**No more doubts when wiring up these devices!**

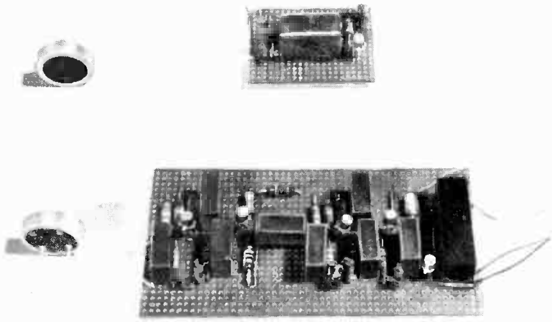
## FUZZ BOX

Add the wild sound of "fuzz" to your music. This is the third in the trio of sound effects units for pop group guitars and musical experimenters.




## Ultrasonic Transmitter-Receiver

With a range extendible up to 100 feet, this equipment combines ease of construction with high sensitivity. Its applications range from "invisible beam" burglar alarms to remote control and signalling, and it doesn't need a transmitting licence.



PRACTICAL
**ELECTRONICS**

**May issue on sale April 14**

# PATENTS REVIEW...

## PRESSURE TRANSDUCER ALARMS

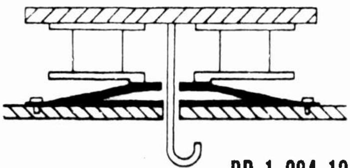


Fig. 1 BP 1 224 134

THEFT detection devices, for instance for use in museums, are legion. Usually ultrasonic or electromagnetic barriers are used although sometimes light or infra-red waves are relied on. In each case movement of a foreign object in a space saturated with the radiation is sensed in one way or another.

Cerberus AG of Switzerland have patented (BP 1 244 134) what looks like a novel approach to theft detection. The object to be protected is supported on a force transducer. The transducer produces an output signal and this signal is fed to an amplifier and alarm system. When the transducer is loaded with a constant force the signal is stable, but a change in load means a change in the output signal and the alarm is triggered.

To take a simple example, a painting could be suspended by two cables, each attached to a force sensitive sensor. When the force exerted on the sensors due to the weight of the painting is changed, if an attempt is made to steal the painting, the signal from at least one sensor changes to sound the alarm. The patent also gives suggestions for suitable constructions for the sensors and circuits for converting a change of output into an alarm.

A convenient type of sensor was piezo-electric elements arranged in a cavity mounted on a vibration absorbent base (to prevent building vibrations setting off the alarm). Ideally, two elements are mounted with their axes parallel and the cord between them so as to sense not only vertical forces (due to a downward tug) but also lateral forces, such as might be caused by moving an object by sliding it sideways.

A particularly sensitive construction is a ring-shaped piezo-electric transducer with the point of application of the force situated at the ring centre.

In one example given by the inventors, sensitivity is further increased by suspending the picture or the like from a hook which is mounted on a dished spring with non-linear deflection characteristics, i.e. which will flatten suddenly at a certain loading, see Fig. 1. In a normal state of loading the spring is flattened, but if only a slight change of loading takes place it will cause a dramatic arching of the spring and a sudden force to be exerted on (or taken off) the transducer. This prevents "tricking" of the alarm by relieving the load in a slow manner.

Although not suggested, devices of this type could presumably also be used in other fields, e.g. by fishermen to sense "bites" at night.

## COMPANDER CIRCUIT FOR DISC RECORDING

IN the audio field it is common practice to compress sounds together in amplitude before recording them. Among other considerations this lessens the risk of overloading the disc cutter and ensures that the recorded groove does not encroach into the adjacent groove space. In sophisticated systems the audio signal is expanded over the lower range of amplitudes and compressed over the higher range. Unfortunately so-called "hush" noise is often heard when a loud noise decays rapidly. First there is a rise in background noise as the compressor gain rises and then there is a fall in background noise as the expander gain falls.

The problem is complicated and EMI Limited have patented (BP 1 245 394) a correspondingly complicated answer.

As the block diagram in Fig. 2 shows, an audio input signal is amplified and fed in parallel to both an analog divider circuit and a logarithmic amplifier. The output of the log amplifier is rectified to provide an output signal which corresponds to the envelope of the audio signal fed from the log amplifier. The rectifier circuit also functions as a limiter and its output is fed in parallel to both a minimum selector circuit and a maximum selector circuit. Both these selector circuits are also supplied with a limiting bias voltage.

The minimum selector circuit produces an output signal which corresponds to whichever is the less—the envelope signal or the bias voltage. The output signal from this minimum selector circuit is fed to an elongator circuit which forms an expansion control signal.

The maximum selector circuit produces an output signal which corresponds to whichever is the greater—the envelope signal or the bias voltage. The output signal from this maximum selector circuit is applied to an elongator and hold circuit which produces a compression control signal.

These compression and expansion control signals are fed to a comparator, the output of which is connected to the hold circuit in the elongator of the compression control signal path. Both the compression and expansion control signals are then summed and the combined signal is applied (via an anti-log circuit) to the analog divider circuit to control the transfer factor applied to the audio signal which is passing through the analog divider.

By suitable choice of circuit parameters, the combined amplified input signal and the processed signal is held constant as the compression and expansion components decay together. As a result of this process the gain of the divider circuit remains substantially constant. Background noise thus remains equally constant with a consequent avoidance of "hush" effects.

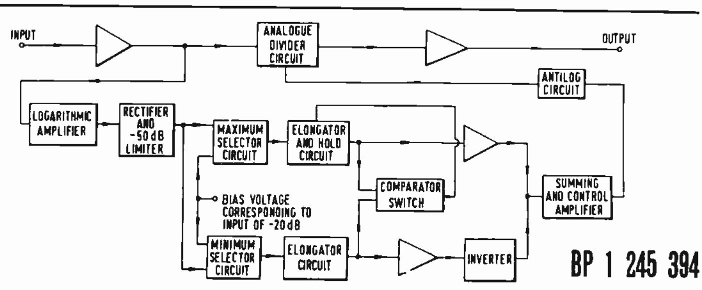



Fig. 2 BP 1 245 394

# Great new OFFER from DIOTRAN

## TRANSISTORS

## BRAND NEW FULLY GUARANTEED DEVICES

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AC107 | 15p | AF115 | 17p | BC140 | 35p | BCY31 | 22p | BF272 | 80p | EC403 | 15p | ORP60 | 40p |
| AC113 | 20p | AF116 | 17p | BC141 | 35p | BCY32 | 25p | BF273 | 30p | GET880 | 27p | ORP61 | 40p |
| AC115 | 23p | AF117 | 17p | BC142 | 45p | BCY33 | 17p | BF274 | 30p | MAT100 | 15p | ST140 | 12p |
| AC125 | 17p | AF118 | 30p | BC143 | 40p | BCY34 | 20p | BF308 | 35p | MAT101 | 17p | ST141 | 17p |
| AC126 | 17p | AF124 | 21p | BC145 | 45p | BCY70 | 17p | BF309 | 37p | MAT120 | 15p | TIS43 | 40p |
| AC127 | 17p | AF125 | 20p | BC147 | 17p | BCY71 | 30p | BF316 | 75p | MAT121 | 17p | UT46 | 27p |
| AC128 | 17p | AF126 | 20p | BC148 | 12p | BCY72 | 15p | BFW10 | 55p | MPF102 | 43p | V405A | 25p |
| AC141K | 17p | AF127 | 20p | BC149 | 17p | BCZ11 | 20p | BFX29 | 27p | MPF105 | 43p | V410A | 45p |
| AC142K | 17p | AF139 | 33p | BC150 | 17p | BD121 | 85p | BFX84 | 20p | OC19 | 30p | 2G301 | 19p |
| AC151 | 15p | AF178 | 50p | BC151 | 20p | BD123 | 85p | BFX85 | 27p | OC20 | 50p | 2G302 | 19p |
| AC154 | 15p | AF179 | 50p | BC152 | 17p | BD124 | 75p | BFX86 | 22p | OC22 | 30p | 2G303 | 19p |
| AC155 | 17p | AF180 | 50p | BC153 | 27p | BD131 | 80p | BFX87 | 25p | OC23 | 33p | 2G304 | 20p |
| AC156 | 17p | AF191 | 50p | BC154 | 30p | BD132 | 80p | BFX88 | 22p | OC24 | 45p | 2G306 | 35p |
| AC157 | 17p | AF186 | 45p | BC157 | 20p | BDY20 | £1 | BFY50 | 20p | OC25 | 25p | 2G308 | 35p |
| AC165 | 17p | AF239 | 37p | BC158 | 17p | BF115 | 22p | BFY51 | 20p | OC26 | 25p | 2G309 | 35p |
| AC166 | 17p | AFZ11 | 37p | BC159 | 20p | BF117 | 45p | BFY52 | 20p | OC28 | 40p | 2G339 | 17p |
| AC167 | 20p | AFZ12 | 45p | BC167 | 13p | BF118 | 60p | BFY53 | 17p | OC29 | 40p | 2G339A | 15p |
| AC168 | 20p | AL102 | 85p | BC168 | 13p | BF119 | 70p | BSX19 | 15p | OC35 | 33p | 2G344 | 15p |
| AC169 | 14p | AL103 | 85p | BC169 | 13p | BF152 | 35p | BSX20 | 15p | OC36 | 40p | 2G345 | 15p |
| AC176 | 23p | ASY26 | 25p | BC170 | 12p | BF153 | 35p | BSY25 | 15p | OC41 | 20p | 2G371 | 13p |
| AC177 | 20p | ASY27 | 30p | BC171 | 13p | BF154 | 35p | BSY26 | 15p | OC42 | 22p | 2G371B | 10p |
| AC187 | 30p | ASY28 | 25p | BC172 | 13p | BF157 | 45p | BSY27 | 15p | OC44 | 15p | 2G374 | 17p |
| AC188 | 30p | ASY29 | 25p | BC173 | 13p | BF158 | 25p | BSY28 | 15p | OC45 | 12p | 2G377 | 27p |
| ACY17 | 25p | ASY50 | 25p | BC174 | 13p | BF159 | 30p | BSY29 | 15p | OC70 | 15p | 2G378 | 15p |
| ACY18 | 20p | ASY51 | 25p | BC175 | 22p | BF160 | 30p | BSY38 | 15p | OC71 | 9p | 2G382 | 15p |
| ACY19 | 22p | ASY52 | 25p | BC177 | 17p | BF162 | 30p | BSY39 | 15p | OC72 | 12p | 2G401 | 30p |
| ACY20 | 20p | ASY54 | 25p | BC178 | 17p | BF163 | 35p | BSY40 | 30p | OC74 | 12p | 2G414 | 30p |
| ACY21 | 20p | ASY55 | 25p | BC179 | 17p | BF164 | 35p | BSY41 | 35p | OC75 | 15p | 2G417 | 25p |
| ACY22 | 19p | ASY56 | 25p | BC180 | 20p | BF165 | 35p | BSY95 | 12p | OC76 | 15p | 2N388 | 30p |
| ACY27 | 18p | ASY57 | 25p | BC181 | 22p | BF167 | 22p | BSY95A | 12p | OC77 | 25p | 2N388A | 50p |
| ACY28 | 19p | ASY58 | 25p | BC182 | 10p | BF173 | 22p | BU105 | £3·90 | OC81 | 15p | 2N404 | 22p |
| ACY29 | 30p | ASY58 | 25p | BC182L | 10p | BF176 | 35p | C111E | 60p | OC81D | 15p | 2N404A | 30p |
| ACY30 | 25p | ASZ21 | 40p | BC183 | 10p | BF177 | 35p | C400 | 30p | OC82 | 15p | 2N524 | 55p |
| ACY31 | 25p | BC107 | 10p | BC183L | 10p | BF178 | 45p | C407 | 25p | OC82D | 15p | 2N527 | 60p |
| ACY34 | 18p | BC108 | 10p | BC184 | 13p | BF179 | 50p | C424 | 17p | OC83 | 20p | 2N696 | 12p |
| ACY35 | 18p | BC109 | 11p | BC184L | 13p | BF180 | 30p | C425 | 40p | OC84 | 20p | 2N697 | 15p |
| ACY36 | 30p | BC113 | 25p | BC186 | 27p | BF181 | 30p | C426 | 30p | OC139 | 15p | 2N698 | 24p |
| ACY40 | 15p | BC114 | 30p | BC187 | 27p | BF182 | 30p | C428 | 20p | OC140 | 17p | 2N699 | 55p |
| ACY41 | 18p | BC115 | 30p | BC207 | 11p | BF183 | 30p | C441 | 27p | OC170 | 15p | 2N706 | 7p |
| ACY44 | 35p | BC116 | 35p | BC209 | 11p | BF184 | 25p | C442 | 35p | OC171 | 15p | 2N706A | 8p |
| AD140 | 40p | BC117 | 35p | BC209 | 11p | BF185 | 30p | C444 | 37p | OC200 | 25p | 2N708 | 12p |
| AD142 | 40p | BC118 | 25p | BC212L | 11p | BF188 | 30p | C450 | 17p | OC201 | 27p | IN709 | 45p |
| AD149 | 43p | BC119 | 45p | BC213L | 11p | BF194 | 23p | C720 | 12p | OC202 | 27p | 2N711 | 40p |
| AD161 | 35p | BC125 | 35p | BC213L | 11p | BF195 | 24p | C722 | 25p | OC203 | 25p | 2N717 | 42p |
| AD162 | 35p | BC126 | 35p | BC214L | 12p | BF196 | 30p | C740 | 25p | OC204 | 25p | 2N718 | 24p |
| AD161/ | | BC132 | 25p | BC225 | 25p | BF197 | 35p | C742 | 17p | OC205 | 35p | 2N718A | 50p |
| 162(MP) | 63p | BC134 | 30p | BC226 | 35p | BF200 | 45p | C744 | 17p | OC309 | 35p | 2N726 | 27p |
| ADT140 | 50p | BC135 | 30p | BC317 | 12p | BF222 | 80p | C760 | 17p | P346A | 17p | 2N727 | 27p |
| ADZ11 | £2 | BC136 | 30p | BC318 | 12p | BF257 | 35p | C762 | 17p | P397 | 45p | 2N743 | 17p |
| ADZ12 | £2·10 | BC137 | 35p | BC319 | 12p | BF270 | 25p | C764 | 60p | OCP71 | 43p | 2N744 | 17p |
| AF114 | 17p | BC139 | 45p | BCY30 | 20p | BF271 | 17p | EC401 | 15p | ORP12 | 43p | 2N914 | 17p |

| | | | | | |
|---|---|---|---|---|---|
| 2N918 | 30p | 2N2714 | 25p | 2N3704 | 15p |
| 2N929 | 22p | 2N2904 | 25p | 2N3705 | 12p |
| 2N930 | 25p | 2N2904A | 30p | 2N3706 | 12p |
| 2N1131 | 20p | 2N2905 | 25p | 2N3707 | 13p |
| 2N1132 | 22p | 2N2905A | 30p | 2N3708 | 8p |
| 2N1302 | 17p | 2N2906 | 25p | 2N3709 | 8p |
| 2N1303 | 17p | 2N2906A | 27p | 2N3710 | 10p |
| 2N1304 | 20p | 2N2907 | 25p | 2N3711 | 10p |
| 2N1305 | 20p | 2N2907A | 30p | 2N3819 | 40p |
| 2N1306 | 22p | 2N2923 | 13p | 2N3820 | £1 |
| 2N1307 | 22p | 2N2924 | 13p | 2N3903 | 25p |
| 2N1308 | 27p | 2N2925 | 13p | 2N3904 | 27p |
| 2N1309 | 27p | 2N2926 | | 2N3905 | 25p |
| 2N1613 | 17p | (G) | 12p | 2N3906 | 27p |
| 2N1711 | 20p | 2N2926(Y) | 11p | 2N4058 | 15p |
| 2N1889 | 35p | 2N2926 | | 2N4059 | 10p |
| 2N1890 | 45p | (O) | 10p | 2N4060 | 12p |
| 2N1893 | 37p | 2N3010 | 80p | 2N4061 | 12p |
| 2N2160 | 60p | 2N3011 | 20p | 2N4062 | 12p |
| 2N2147 | 75p | 2N3053 | 20p | 2N5172 | 12p |
| 2N2148 | 60p | 2N3054 | 50p | 2N5459 | 43p |
| 2N2192 | 30p | 2N3055 | 63p | 2S034 | 75p |
| 2N2193 | 30p | 2N3391 | 17p | 2S301 | 50p |
| 2N2194 | 27p | 2N3391A | 20p | 2S302A | 45p |
| 2N2217 | 20p | 2N3392 | 17p | 2S302 | 45p |
| 2N2218 | 25p | 2N3393 | 15p | 2S303 | 60p |
| 2N2219 | 27p | 2N3394 | 15p | 2S304 | £1·10 |
| 2N2220 | 22p | 2N3395 | 20p | 2S305 | £1 |
| 2N2221 | 22p | 2N3402 | 22p | 2S306 | £1·10 |
| 2N2222 | 27p | 2N3403 | 22p | 2S307 | £1·10 |
| 2N2368 | 17p | 2N3404 | 32p | 2S321 | 60p |
| 2N2369 | 15p | 2N3405 | 45p | 2S322 | 50p |
| 2N2369A | 15p | 2N3414 | 20p | 2S322A | 45p |
| 2N2411 | 50p | 2N3415 | 20p | 2S323 | 60p |
| 2N2412 | 50p | 2N3417 | 37p | 2S324 | £1·20 |
| 2N2646 | 55p | 2N3525 | 74p | 2S325 | £1·20 |
| 2N2711 | 22p | 2N3702 | 12p | 2S326 | £1·20 |
| 2N2712 | 22p | 2N3703 | 12p | 2S327 | £1·20 |

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| | | | | | |
|---|---|---|---|---|---|
| AA119 | 8p | BYZ11 | 32p | OA81 | 7p |
| AA120 | 8p | BYZ12 | 30p | OA85 | 7p |
| BA116 | 22p | BYZ13 | 25p | OA90 | 6p |
| BA126 | 22p | BYZ16 | 35p | OA91 | 7p |
| BY100 | 15p | BYZ17 | 35p | OA95 | 7p |
| BY101 | 12p | BYZ18 | 30p | OA200 | 6p |
| BY105 | 15p | BYZ19 | 25p | OA202 | 7p |
| BY114 | 12p | OA5 | 17p | SO10 | 4p |
| BY126 | 15p | OA10 | 22p | SO19 | 4p |
| BY127 | 17p | OA47 | 7p | IN914 | 6p |
| BY130 | 15p | OA70 | 7p | IN916 | 6p |
| BYZ10 | 35p | OA79 | 8p | IN4148 | 6p |

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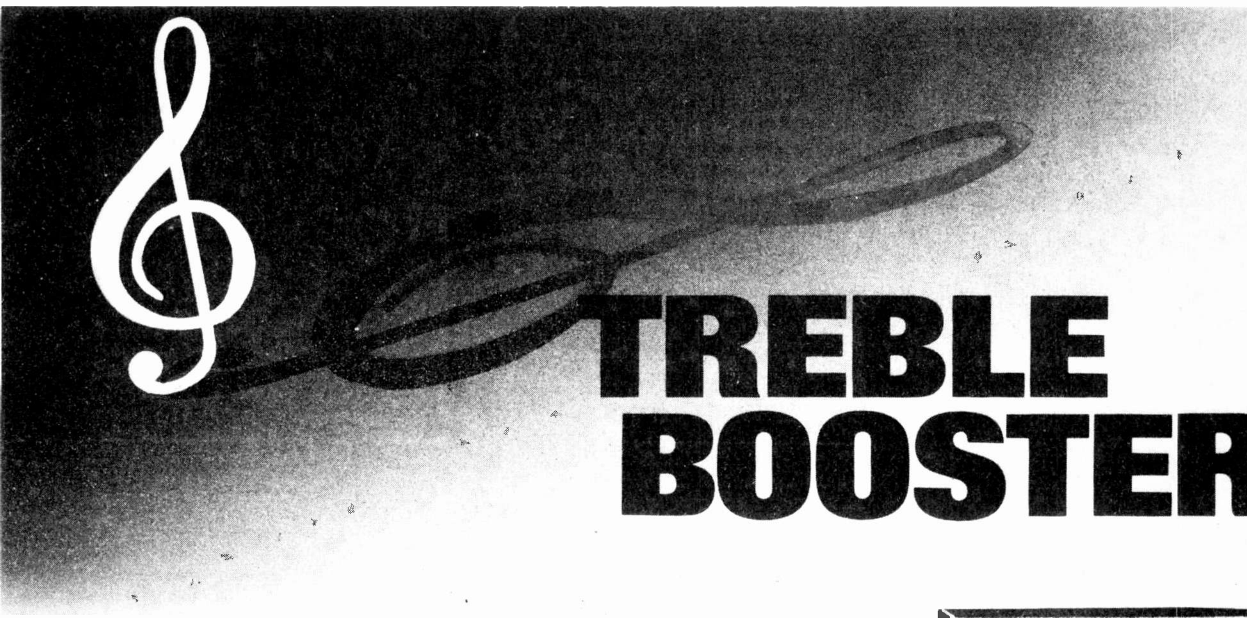
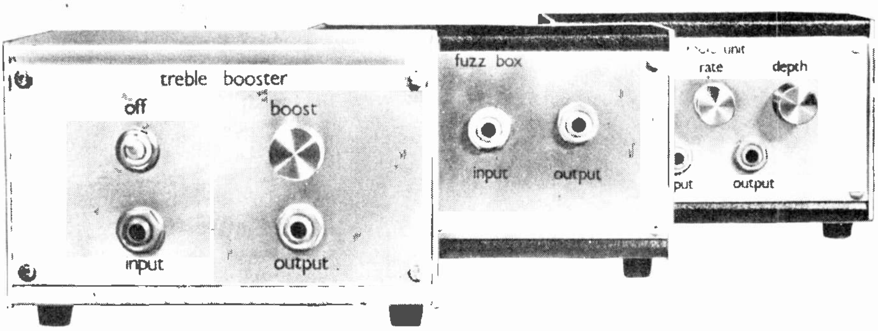


# TREBLE BOOSTER




**Second of three guitar effects units**

**By A. Russell**

A SIMPLE but effective unit for heightening the higher frequency harmonics of electric guitar sounds is a Treble Booster.

The actual sounds produced are akin to those made by the early "Rock 'n Roll" guitarists, particularly when played near to the instrument bridge.

In addition to use as an effects unit the Booster will act as a straightforward pre-amplifier if required.

## HOW IT WORKS

Basically the circuit consists of a simple pre-amplifier, using a low noise, high gain transistor.

In shunt with the input (Fig. 1) is an inductor L1. The impedance of this is less to low frequency signals and so the bass notes tend to be shunted to earth leaving the higher frequencies to be amplified and passed to the output socket JK2.

The "Boost" control VR1 is a 5 kilohm potentiometer in series with L1 and it controls the amount of bass cut applied to the incoming signal. When the wiper is rotated for maximum resistance there is almost no bass loss and all frequencies are amplified equally.

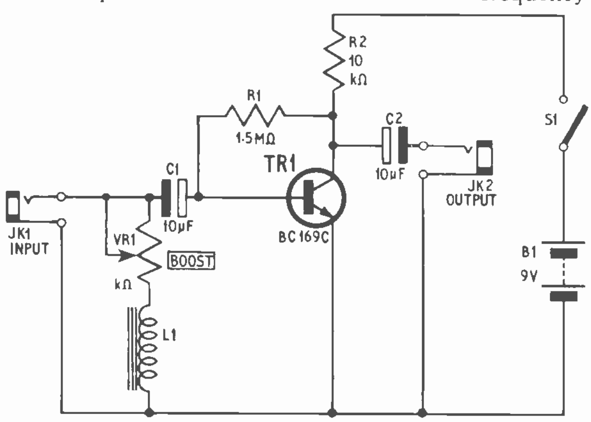



Fig. 1. Circuit diagram of Treble Booster

## CONSTRUCTION

The prototype was built on a piece of 0·15in matrix Veroboard 1½in × 2½in as in Fig. 2. No breaks are required in the copper strips.

The primary of a small transistor output transformer is used for L1. The secondary winding and centre tap is not used and the leads from these should be cut short.

Control panel and Veroboard interwiring is straightforward (Fig. 2) and should present no difficulties. To prevent hum pick-up the input and output leads should be screened.

## TESTING

With the unit completed, the wiring should be given a final check. With the battery connected you should find that the circuit will work first time since it is so simple.

A point to watch is the siting of the Booster. If it is placed near to the mains transformer of the amplifier, hum will be picked up by L1 so this should be avoided. ★

## COMPONENTS . . .

**Resistors**
R1 1·5MΩ
R2 10kΩ
¼W 10% carbon

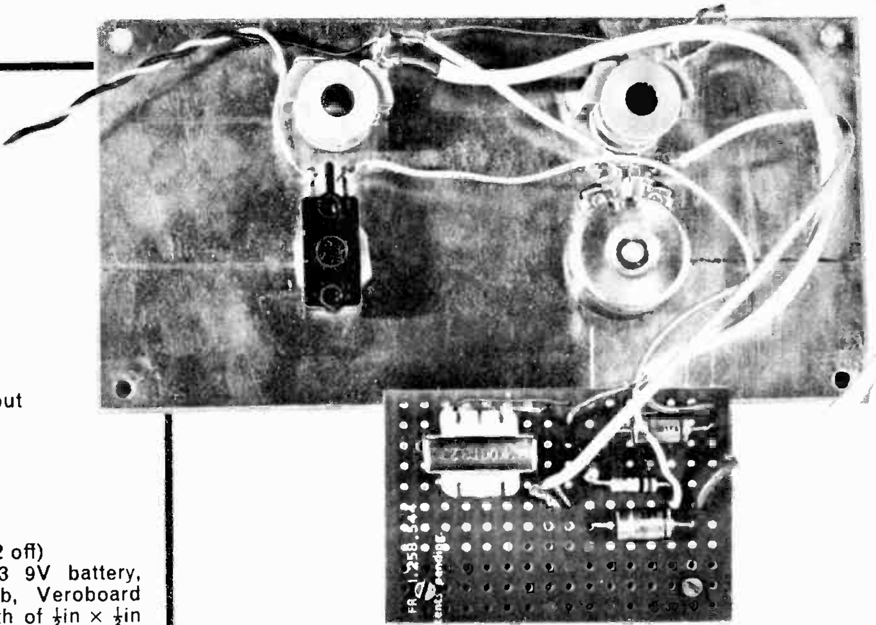
**Capacitors**
C1, C2 10µF elect. 25V (2 off)

**Potentiometer**
VR1 5kΩ lin. carbon

**Inductor**
L1 Eagle LT700 miniature output transformer

**Transistor**
TR1 BC169C

**Miscellaneous**
JK1, JK2 Standard jack sockets (2 off)
S1 On/off toggle switch, B1-PP3 9V battery, Battery connectors, Control knob, Veroboard 1½in × 2½in 0·15in matrix 2½in length of ½in × ½in plastics angle.



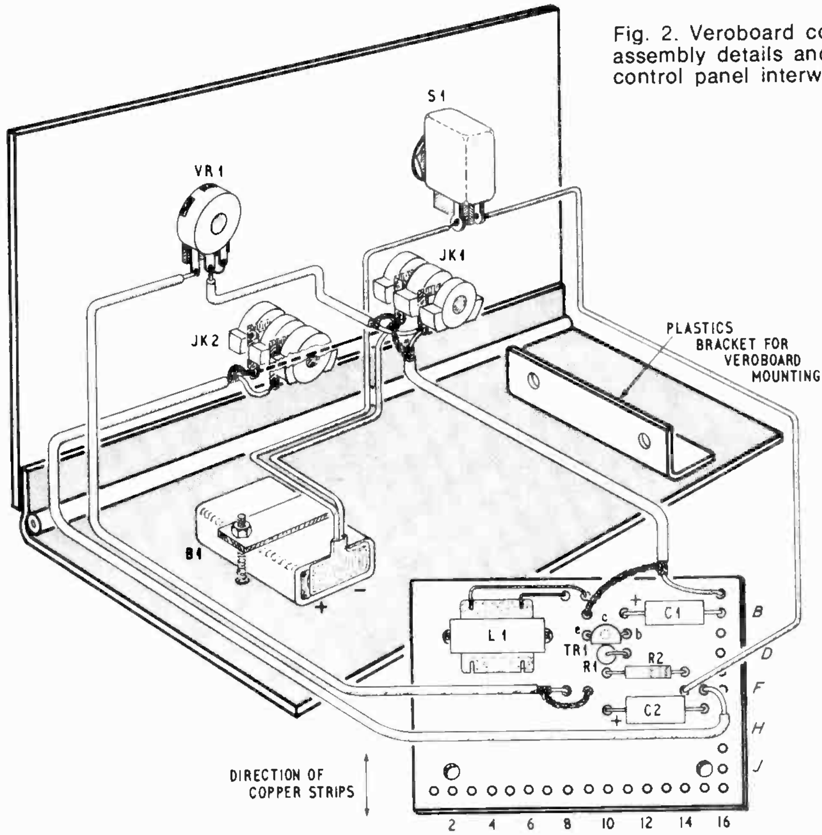



Fig. 2. Veroboard component assembly details and control panel interwiring

Silicon Controlled Switch

# SCS COUNTING CIRCUITS

By D. Burn, Ph.D.

THE purpose of this article is to introduce a relatively little known semiconductor device, the silicon controlled switch (SCS), and to show how quite simple and inexpensive counting circuits may be constructed with it.

## THE SILICON CONTROLLED SWITCH

The SCS is a four layer device, very similar to the thyristor, in which all four layers are accessible as electrodes (Fig. 1a). Unlike most thyristors, it is designed to handle only fairly small currents (up to 500mA), and may be regarded as a low power transistor combined with a "holding" circuit.

The usual symbol for the SCS is shown in Fig. 1b, which corresponds closely to the structure of Fig. 1a, and emphasises its similarity with the thyristor. On the other hand, it is much easier to understand the operation of the SCS if it is thought of as a pair of *pnp-npn* transistors connected as shown in Fig. 1c, the electrodes being named accordingly.

Suppose that a voltage is applied to the device as indicated in Fig. 1c and that the base is reverse biased by means of a resistor connected between the base and emitter. Provided that the applied voltage is less than the transistor breakdown voltage, neither transistor will conduct, since neither can obtain any base current. The device will therefore be in a stable "OFF" state.

If a positive pulse is now applied to the base, the *npn* transistor will begin to conduct and thus supply base current to the *pnp* transistor. This in turn will begin to conduct and supply more base current to the *npn* transistor, augmenting that derived from the input pulse.

The process is now self-sustaining and the current through the device rapidly increases until both the transistors are saturated. Since each transistor is providing the base current required by the other, there is no further need for the input pulse, and current will continue to flow after the input has ceased. The device is now in a stable "ON" state, with the value of the anode current being determined by the external circuitry.

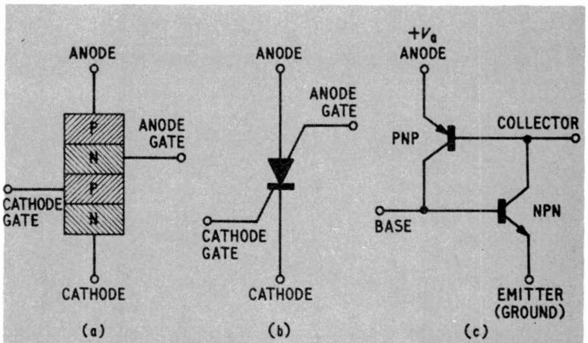



Fig. 1. The silicon controlled switch (a) internal construction; (b) circuit symbol; (c) equivalent circuit

## TURNING OFF

To turn the device off again, it may be thought that it is merely necessary to reverse the turn-on procedure and apply a negative pulse to the base. Unfortunately it is not quite as simple as that.

Due to the very high gain of the device, the magnitude of such a negative pulse would almost certainly exceed the maximum permitted reverse base-emitter junction potential and thus destroy the SCS. Instead, a technique is employed analogous to that used with thyristors: reduction of the anode current to a low value.

There is a certain minimum current, known as the holding current $i_H$, necessary to maintain the device in the "ON" state. If the anode current is reduced below $i_H$, neither transistor can obtain sufficient base current to keep it conducting and so the combination rapidly turns off. This may be achieved either by applying a negative pulse to the anode, or a positive pulse to the emitter; both methods will be illustrated in the circuit to follow. Once the device has turned off, the anode potential may be restored for, as we have already seen, it can only be turned on by a pulse at its base.

Thus, in the SCS we have an inherently bistable device which, with the minimum of additional components, will function in the same way as a bistable circuit requiring two transistors, two diodes and several resistors and capacitors. Hence it is possible to construct counting circuits which are very much simpler, and more eonomical, than their transistor counterparts.

## ANODE GATE

So far in this discussion, the collector, or anode gate, has not been mentioned. In fact, it is quite possible to design SCS counting circuits in which the collector is not used at all. However, where it is desired to provide a visual indication of the count, the collector forms a very convenient output electrode. Although at first sight it may appear somewhat paradoxical that the anode is used as a control electrode and the anode gate forms the output electrode, the *npn-pnp* concept of Fig. 1c does help to provide a logical explanation.

Reference to Fig. 1c will show that in the "ON" state, the collector will be very close to 0 volts (i.e. $V_{CEsat}$ of the *npn* transistor). In the "OFF" state, the collector will be at some positive potential determined by the external circuit.

Hence one form of read-out would be a low voltage, low current filament bulb included in the collector circuit as indicated in Fig. 2a. If, on the other hand, numerical indicator tubes are required, then another valuable feature of the SCS comes in useful, that is, it is designed to withstand high voltages. This means that the collector may be directly

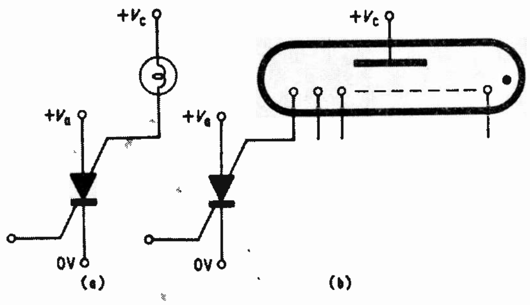



Fig. 2. (a) SCS used to drive low voltage bulb; (b) SCS driving a cold cathode tube

connected to an indicator tube cathode without the need for an intermediate, high-voltage buffer transistor (Fig. 2b).

## RING COUNTER

Having discussed the SCS in some detail, the basic circuit for a ring counter with an indicator tube read-out can be introduced (Fig. 3). While it may appear rather formidable, it is, in fact, far simpler than a corresponding transistor circuit. Its operation may be explained in the following way.

To begin, assume that the RESET line is connected to the 0 volt line, and that the first SCS, CSR0, is on. Cathode 0 of the indicator tube V1 thus has direct path to 0 volt and is therefore lit.

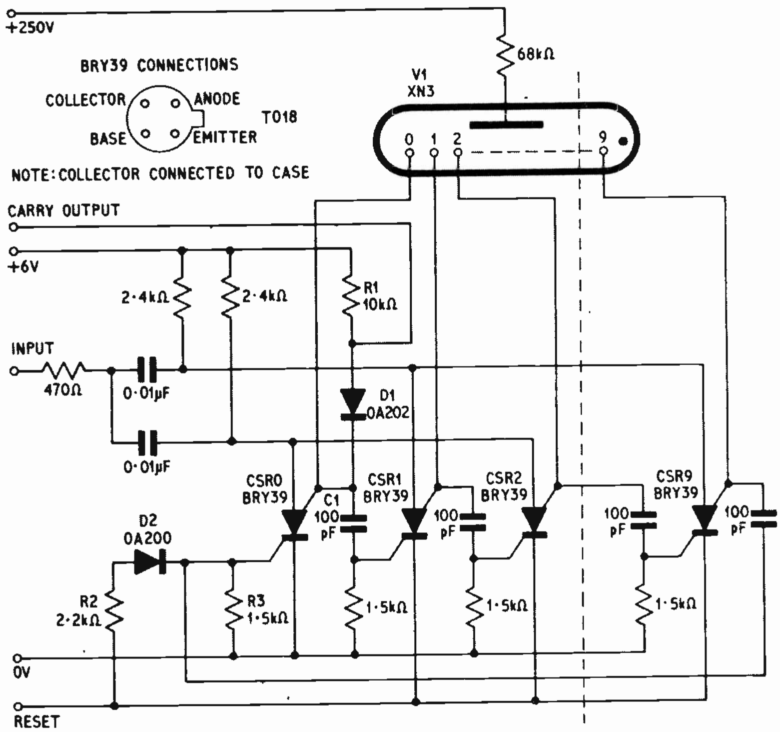



Fig. 3. An SCS ring counter

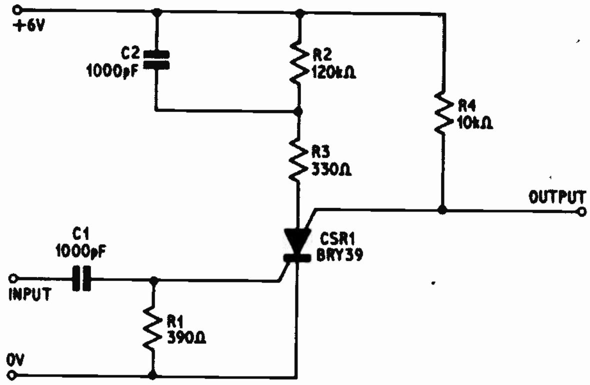



Fig. 4. An SCS pulse generator

The anode of CSR0, and of all other even numbered SCSs, will be close to 0 volt, whilst the collectors of all the other SCSs will be at potentials ranging from about +15 to +120 volts, determined mainly by the characteristics of V1.

If a negative pulse of about 6 volts amplitude is applied to the input, all SCSs will lose their anode potential so that CSR0 will turn off and cathode 0 will be extinguished. The collector of CSR0 will go positive and this positive pulse will be passed to the base of CSR1 via C1. CSR1 will therefore turn on, its collector will fall to 0 volt and cathode 1 of V1 will light. Athough the negative input pulse is applied to the anodes of all SCSs, this will not prevent CSR1 from turning on. The design of the circuit is such while the anode of CSR0 goes to about −2 volts, the anode of CSR1 only falls to about +2 volts, which is just enough to allow it to turn on.

Thus the use of two anode lines is essential to the correct operation of this type of counter, and ensures that only the correct SCS can turn on with each successive input pulse. It should perhaps be emphasised that this feature means that the circuit can only be used for an even numbered count, since an odd number of stages would require two consecutive anodes to be connected to the same line.

This then is the basic ring counter circuit, requiring only a few additional refinements to turn it into a fully operational unit.

## PULSE GENERATOR

First of all, we need to generate suitable input pulses, and although there are several pulse generator circuits that would do the job, a particularly simple one results from the use of another SCS, as shown in Fig. 4. The SCS is normally held off by the bias resistor R1. A positive pulse of any shape and duration applied to its base will turn it on so that the anode drops to close to 0 volts. C2 rapidly charges to 6 volts through R3 and the SCS, its charging current keeping the SCS turned on.

Once C2 is charged, this current falls to zero so that the only current that can flow becomes determined by R2. The value of this resistor is chosen so that this current is less than $i_H$, hence the SCS turns off, and C2 discharges through R2.

The result of all this is that a negative pulse having very short rise and fall times, and the desired amplitude and duration, appears at the collector.

## CARRY AND RESET

If one wishes to set up a chain of ring counters, the circuit must be arranged such that as each one completes its count, it automatically provides an output pulse suitable for stepping the next counter in the chain. This is achieved by means of diode D1 and resistor R1 in the collector circuit of CSR0 Fig. 3). When CSR0 is off, D1 will be reverse biased so that the output line is clamped to +6 volts.

As soon as CSR0 turns on, D1 becomes forward biased and the output falls to 0 volts, thus providing the required input to the next counter.

This very simple way of obtaining a logic output from CSR0 can, of course, be applied to every SCS in the counter, thus making it possible to add, for example, pre-determining and alarm circuits to the basic counter.

The last function to be considered is the RESET facility. It may be seen that the emitters of all SCSs, except CSR0, are connected to the reset line (Fig. 3), and it was previously assumed that this line was connected to 0 volt. Suppose that the reset line is momentarily taken to +6 volts. All SCSs other than CSR0 lose their supply voltage, and the one that was on will turn off.

At the same time, this positive pulse is coupled into the base of CSR0 via R2 and D2, and since CSR0 has not lost its supply it will be turned on. The reset line also fulfils another important function. When power is first applied to the circuit, it is probable that none of SCSs will turn on. Furthermore, since the input pulses merely turn off any SCS that was conducting, there is no way of initially turning on any particular SCS. The reset line allows the circuit to start operating correctly by turning CSR0 on.

## OTHER APPLICATIONS

So far, this discussion has been limited to counting circuits in which a read-out is required. However, many applications do not need a read-out and the SCS may be used just as efficiently to construct such circuits.

A ring counter having n stages, where n is an even number, will deliver one output pulse for every n input pulses, and is a very simple method of frequency division. A suitable circuit is illustrated in Fig. 5. It is virtually identical with that already described and operates in exactly the same way.

The indicator tube has been replaced by resistors which are returned to a voltage preferably higher than the anode supply. The reason for this is that under certain circumstances the collector of an SCS could go less positive than its anode. If this should happen, the SCS would be turned on since effectively the base of a *pnp* transistor is going negative with respect to its emitter (see Fig. 1c).

An output pulse, limited in amplitude to about 6 volts, may be obtained from the collector of any stage by means of a diode-resistor combination as shown for CSR0. Suitable input pulses may be obtained from the same type of pulse generator that was used in the counter circuit.

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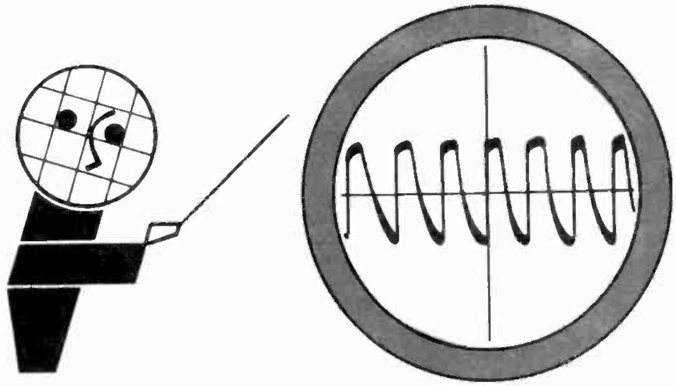

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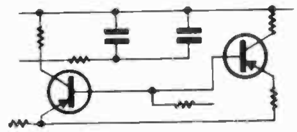

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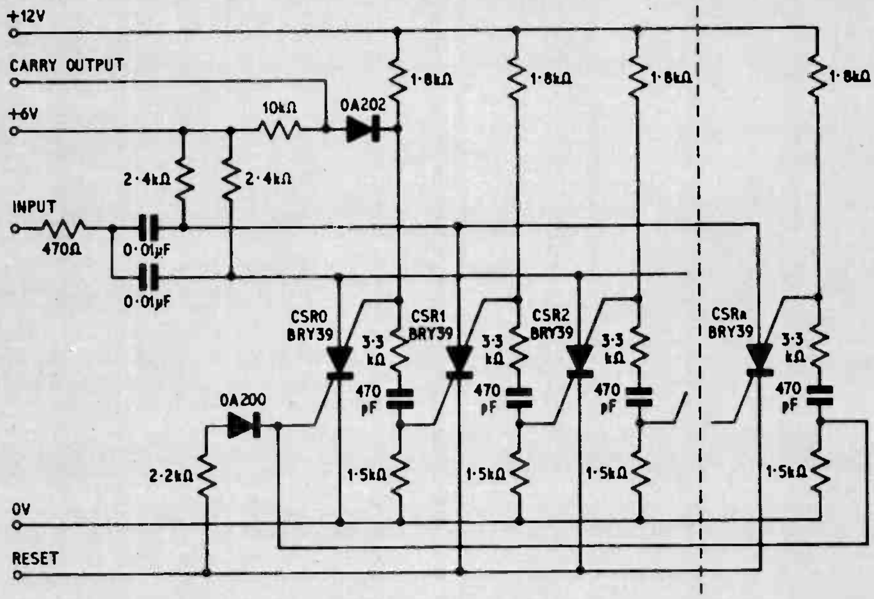



Fig. 5. An SCS frequency divider

The usual problem will arise if it is desired to produce an odd-numbered count. However, it will generally be possible to devise a gating circuit which will detect the required count and apply a reset input to the counter.

## RADIO CONTROL APPLICATIONS

Some very sophisticated circuitry has been developed for modern model radio-control gear, and the final example of a counting circuit is typical of those used in the so called digital proportional equipment.

In this system, the position adopted by a servo mechanism is proportional to the duration of an input pulse supplied to it. This duration is made variable, typically between 1 and 2 milliseconds, for travel between one extreme of servo position and the other. The transmitter is therefore required to generate a string of pulses, one for each function to be controlled, whose individual durations may be varied at will, generally by means of "joy-stick" type of controls.

The appearance of such a pulse train is shown in Fig. 6, where the four pulses might control the movement of the rudder, elevator, ailerons and engine throttle. The task of the receiver is to detect these pulses and to route each one to the correct servo.

It is not intended to describe in detail the circuits of a complete system, for which the reader is referred to the numerous publications specialising in this subject. Instead, the description is limited to one aspect of the system—how does the receiver sort out the incoming pulses and know which pulse to send to which servo? This is a vitally important task, for the result of the receiver interpreting, for example, a "left rudder" command as a "down elevator" command could well be disastrous! The part of the receiver that carries out this function is known as the decoder, and may take the form of a particularly simple SCS counter (Fig. 7).

There are several important differences between this circuit and those described earlier. In the first place, the collector (anode gate) is not used at all, the output being taken from the anode. The SCS is in fact functioning as a low current, sensitive thyristor. Secondly, the SCS is turned both on and off by means of positive and negative pulses respectively applied to its base. While this may appear to conflict with what was said earlier in this article, it is permissible here because this is a low-current, low-voltage circuit.

Finally, the circuit is not a ring counter, that is, there is no feedback from the output of the last stage to the input of the first. For reasons that will become evident later, the counter has to be told when to go back to its initial state.

## DECODER OPERATION

The operation of the circuit may be followed with the aid of the waveforms shown in Fig. 8. The

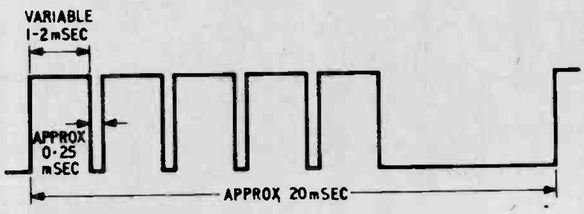



Fig. 6. Typical waveform in a digital proportional control system

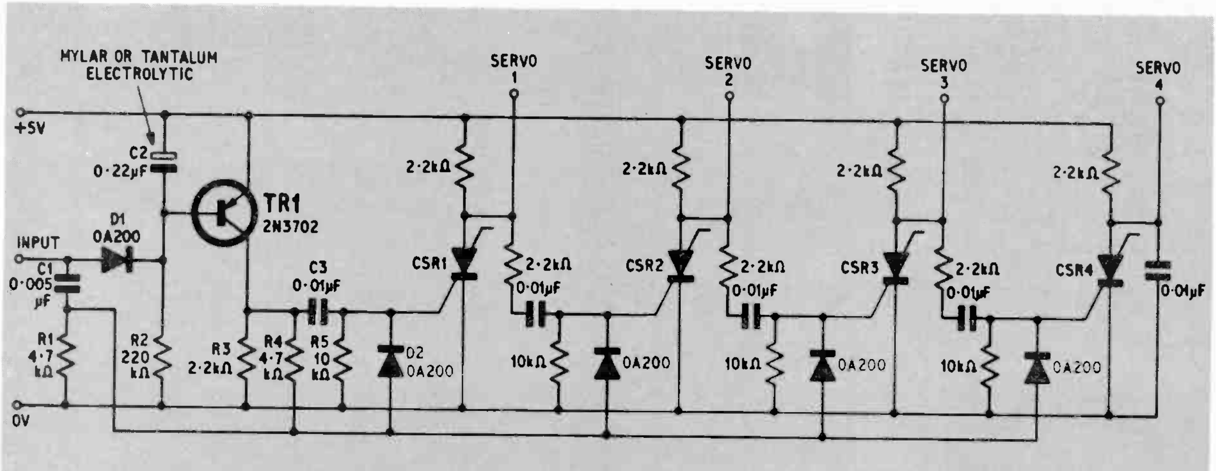



Fig. 7. An SCS digital proportional decoder

input pulses are applied to the differentiating network C1–R1 and the resulting positive spikes are passed, via diodes D2, to the bases of all the SCSs and turning them all on. (The "resting" state of the counter is that in which all the SCSs are on, so that all the outputs are at 0 volts.)

At the same time, the first positive going transition of the input will discharge C2, previously charged through R2, and thus turn TR1 off. Its collector will go negative and apply a negative-going spike, via a second differentiating network C3–R5, to the base of CSR1 and so turn it off.

There is an apparent problem here in that CSR1 has both a positive and a negative pulse applied to it at the same time. However, it will be seen from the component values that the time constant of C3–R5 is much longer than that of C1–R1 so that the negative pulse wins and CSR1 turns off. This negative pulse is prevented from reaching the bases of the other SCSs by the diodes D2.

The next input pulse will turn CSR1 on again via D2 so that its anode returns to 0 volts and terminates

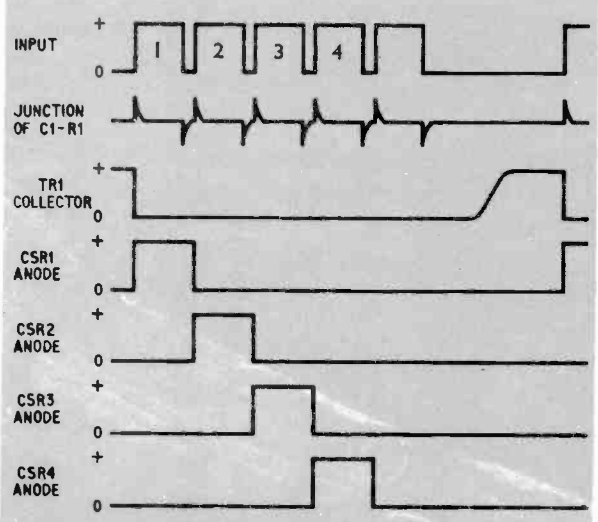



Fig. 8. Waveforms in the SCS decoder

the first output to servo 1. At the same time, this negative transition is passed to the base of CSR2, and once again the time constants are such that CSR2 is turned off and initiates the input to servo 2. This process continues until the final SCS has been turned off and then on again, and one pulse has been applied to each servo in turn.

## RESET PERIOD

Up till now, however, there has been no way of ensuring that the correct pulse has reached the proper servo, and this is where the long gap in the train of pulses comes in. There is a third and very important time constant built into the circuit, that of C2 and R2. This is a very long one, as long as the longest possible duration of two consecutive input pulses.

The result is that once TR1 has been turned off by the first pulse in a sequence, C2 does not have time to charge up sufficiently to turn it back on again until the last pulse in that sequence has been decoded. When it finally does turn on, the resulting positive transition at its collector ensures that all the SCSs are turned on, via R4 and the diodes D2, ready for the next sequence. This explains why the counter is not a closed ring, for if the transmitter and decoder should get out of step, there will be a maximum period of less than 20ms before the counter is reset to its initial state and the correct sequence is restored.

It is hoped that these examples have given some indication of the versatility of the silicon controlled switch and may perhaps prompt some further experimentation. ★

# POINTS ARISING

**LOGICAL RADIO CONTROL** *(January 1972)*

Page 51, Fig. 17a. IC1, IC2 and IC3 should read IC2, IC3 and IC4. Fig. 20. Connection pads to pins 8 and 9 on IC2 should be reversed.

**I.C. AUDIO MIXER** *(January 1972)*

Page 44. Fig. 2. An additional break should be made at 10A on the component board.


## DRILL CONTROLLER NEW 1KW MODEL

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. £1·50 plus 13p post and insurance. Made up model also available, £2·25 plus 13p post and p

## MAINS OPERATED CONTACTOR

220/240V, 50 cycle solenoid with laminated core so very silent in operation. Closes 4 circuits each rated at 10A. Extremely well made by a German Electrical Company. Overall size 2¼ × 2 × 2in. £1 each.

## NEED A SPECIAL SWITCH?

**Double Leaf Contact.** Very slight pressure closes both contacts. 6p each, 60p doz. Plastic push-rod suitable for operating, 5p each, 45p doz.

## AUTO-ELECTRIC CAR AERIAL

with dashboard control switch—fully extendable to 40in or fully retractable. Suitable for 12V positive or negative earth. Supplied complete with fitting instructions and ready wired dashboard switch. £5·75 plus 25p post and ins.

## MICRO SWITCH

5A changeover contacts, 9p each. £1 doz. 15 amp Model 10p each or £1·05 doz.

## MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at 20p each. £1·80 for ten, your assortment.

### WATERPROOF HEATING ELEMENT

26 yards length 70W. Self-regulating temperature control. 50p post free.

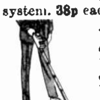
## BLANKET SWITCH

Double pole with neon let into side so luminous in dark. Ideal for dark room light or for use with waterproof element, new plastic case 30p each. 3 heat model 40p.

## CAR ELECTRIC PLUG

Fits in place of cigarette lighter. Useful method for making a quick connection into the car electrical system. 38p each or 10 for £3·42.

## TREASURE TRACER



Complete Kit (except wooden battens) to make the metal detector as the circuit in Practical Wireless August issue. £2·95 plus 20p post and insurance.

## QUICK CUPPA

Mini Immersion Heater, 350w. 200/240v. Boils full cup in about two minutes. Use any socket or lamp holder. Have at bedside for tea, baby's food, etc. £1·25, post and insurance 14p. 12v. car model also available same price. Jug heater £1·50 plus P. & P. 14p.

## SNAP ACTION SLIDE SWITCH

Rated 5A 240V. Made by Arrow. Type fitted in the handles of electric drills, vacuums, etc. 5p each, 10 for 45p.

## NUMICATOR TUBES

For digital instruments, counters, timers, clocks, etc. Hi-vac XN.3. Price 99p each. 10 for £9.

## 12 WAY SUB-MINIATURE MULTI-CORE CABLE

7·0076 copper cores, each core P.V.C. insulated and of different colour. P.V.C. covered overall and approx. 3/16in thick. Price 20p per yard.

## LIGHT CELL

Almost zero resistant in sunlight increases to 10 K Ohms in dark or dull light, epoxy resin sealed. Size approx. 1in dia. by ⅛in thick. Rated at 500 MW, wire ended. 48p with circuit. Also ORP12 light cell 45p.

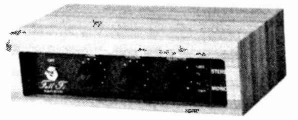
## SOLDER GUN

A must for every busy man, gives almost instant heat also illuminates job. Dual heat 100/140 watt £3·75 plus post and ins. 20p. BIG JOB 250 watt model £4·75 plus post and ins. 40p.

## 2½kW FAN HEATER

Three position switching to suit changes in the weather. Switch up for full heater (2½ kW), switch down for half heat (1¼kW), switch central blows cold for summer cooling—adjustable thermostat acts as auto control and safety cutout. Complete kit £3·95. Post and ins. 38p.

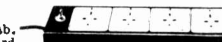
## THE FULL-FI STEREO SIX



**THE AMPLIFIER SENSATION OF THE YEAR**

You will be amazed at the fullness of reproduction and at the added qualities your records or tuner will reproduce. Built into metal chassis ready for mounting on plinth this amplifier uses an integrated solid state circuit with an output power of 6W R.M.S. split over the two channels. The amplifier is ideal for use with normal pick-ups and tuners, it has a double wound mains transformer and ganged volume and tone controls—also switching for Mono to Stereo, tuner or pick-up. UNREPEATABLE PRICE is £6·50 plus 20p post and insurance. Simulated Teak cabinet ready for mounting amplifier £1·95 (postage free when ordered with chassis).

## DISTRIBUTION PANELS



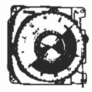
Just what you need for work bench or lab. 4 × 13A sockets in metal box to take standard 13A fused plugs and on/off switch with neon warning light. Supplied complete with 6ft of flex cable. Wired up ready to work. £2·25 with fitted 13A plug, plus 23p P. & I.

## THIS MONTH'S SNIP

### MULLARD I.F. AMPLIFIER

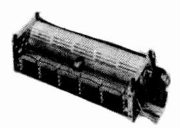
Fully screened I.F. Module for amplification and detection of FM signals at 10·7 MHz and AM signals at 470 KHz. 3 transistors, 10 tuned circuits, Mullard Ref. No. LP1165. Mounted on printed circuit board size approx. 3in × 1⅛in. Enclosed and sealed in a metal case with tin copper connecting leads. 75p each. 10 for £6·75. 100 for £62·50.

## SMITHS 24-HOUR 2 ON/2 OFF TIME SWITCH



This is the popular model as used in the Autoset and Morphy-Richards time switches. Only needs a case and an output socket. 230V 50 cycle. Contact switch up to 13A. Price £2·75.

## TANGENTIAL HEATER UNITS



This heater unit is the very latest type, most efficient, and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. We have a few only. Comprises motor, impeller, 2kW element and 1kW element allowing switching 1, 2 and 3kW and with thermal safety cut-out. Can be fitted into any metal lined case or cabinet. Only need control switch. £3·50. 2kW. Model as above except 2 kilowatts £2·50. Don't miss this. Control Switch 35p. P. & P. 40p.

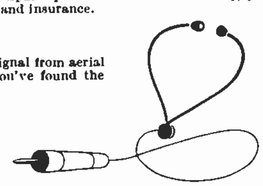
## POCKET CIRCUIT TESTER

Test continuity for any low resistance circuit, house wiring, car electrics. Tests polarity of diodes and rectifiers. Also ideal size for conversion to signal injector (circuit supplied). 30p or 2 for 50p. Post paid.

## COMPUTER TAPE

2,400ft of the Best Magnetic Tape money can buy—users claim good results with Video and sound. 1in wide £1·00 plus 33p post and insurance with cassette. ¾in wide £1·00 plus 30p post and insurance with cassette. ½in wide 85p plus 25p post and insurance with cassette. Spare spools and cassettes—1in 75p, ½in 75p each plus 20p post and insurance.

## RADIO STETHOSCOPE



**Easiest way to fault find**—traces signal from aerial to speaker—when signal stops you've found the fault. Use it on Radio, TV amplifier, anything — complete kit comprises two special transistors and all parts including probe tube and crystal earpiece. £2- twin stethoset instead of earpiece 75p extra—post and ins. 20p.

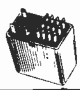
## MULLARD AUDIO AMPLIFIER MODULE

Uses 4 transistors, and has an output of 750mW into 8 ohms speakers. Input suitable for crystal mic. or pick-up. 9V battery operated. Size 2in long × 1½in wide × 1in high.
SPECIAL SNIP PRICE 60p each. 10 for £5.

## CAPACITOR DISCHARGE CAR IGNITION


This system which has proved to be amazingly efficient and reliable was first described in the *Wireless World* about a year ago. We can supply kit of parts for improved and even more efficient version. Price £5·25 plus 30p post. When ordering please state whether for positive or negative systems.

## TYPE 25 RELAYS



These are miniature relays. Size approx. 1 $\frac{1}{16}$in high × 1⅛in wide × ⅞in deep. 4 changeover silver/gold contacts. Contact rating lamp 100V d.c. Fitted with a plastic cover. Coil operates approx. 250MW d.c. Available with the following coils:

| | | |
|---|---|---|
| 28 Ω for 1V–2·5V | 45 Ω for 4V–7·5V | 52 Ω for 4·9V–6V |
| 90 Ω for 5·5V–11·5V | 130 Ω for 10V–15V | 530 Ω for 17V–36V |
| 1250 Ω for 27V–44V | 2590 Ω for 31V–65V | 5800 Ω for 27V–44V |

75p each. 10 for £6·75. Also one with 16,500 ohm coil but this has only 2 heavy duty changeover gold contacts. Price £1·45.

**Veroboard.** We are now stocking this in various sizes. Prices as follows:

| Inches | 0·1 | 0·15 |
|---|---|---|
| 2½ × 3¾ | 28p | 18p |
| 2½ × 5 | 24p | 24p |
| 3¾ × 5¼ | 24p | 24p |
| 3¾ × 5 | 27p | 27p |
| 17 × 2½ | 75p | 57½p |
| 17 × 5 (plain) | — | 75p |
| 17 × 3¾ (plain) | — | 52½p |
| 17 × 2½ (plain) | — | 37½p |
| 17 × 3¾ (plain) | 100p | 75p |
| 2½ × 5 (plain) | — | 17½p |
| 2½ × 3¾ (plain) | — | 15p |
| Pin intersection tool | 47½p | 47½p |
| Spot face cutter | 37½p | 37½p |
| Pkt. 50 pins | 20p | 20p |

## FLUORESCENT CONTROL KITS

Each kit comprises seven items—Choke, 2 tube ends, starter, holder and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes for fish tanks and indoor plants. Chokes are super-silent, mostly resin-filled. Kit A—15·20W £1. Kit B—30–40W £1. Kit C—80W £1·20. Kit E—65W £1·20. Kit F for 8ft 125W tube £1·75. Kit MF1 is for 6in, 9in and 12in miniature tubes £1. Kit MF2 for 21in 13W. miniature tube £1. Postage on Kits A and B 23p for one or two kits then 23p for each two kits ordered. Kits C, D and E 23p on first kit then 18p for each kit ordered. Kit F 33p then 23p for each kit ordered. Kit MF1 18p on first kit then 15p on each two kits ordered.

## 0-8 AMMETER

2in square full vision for flush mounting. Moving iron instrument. Ideal for charger. Price 43p each. 10 for £3·90.

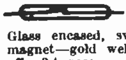
**Box Sign for Window Display**, at home, office or shop, 2ft wide × 14in high × 5in deep. This is an illuminated box sign made from sheet metal hammer finish enamel with a clear plastic window. You simply have your message printed or written on poster board or thick card. (Or use stick down letters available at most stationers.) You will then have a box sign normally costing anything between £10–15. Illumination is by a 2ft. fluorescent tube with control gear enclosed. Message card can be changed quite easily from hinged top back. Price £3 each, plus 65p post, etc.

**Motivated Illuminated Box Sign.** As previous item but with geared motor moving the message making it change eight times a minute. Very attention arresting. To use this for your own messages you would have to have each sign written on card then cut this up in strips which could be glued to the one supplied with the box sign. Price £4·50, plus 65p post and service.

**Geared Motor** with take off socket. The gear train is driven by normal type induction motor and gives a final speed of 6 r.p.m. The motor is mounted behind a chrome plate through which the take off drive protrudes and was originally intended to drive a spit for cooking, is also ideal for driving models or for driving a colour changing disc for the local dance hall, discotheque, etc. Really well made assembly. Price £1·75 plus 25p post, etc.

**Dry Film Lubricant.** In aerosol can for easy application and for putting lubricant into places where the normal oil cannot reach. Home and everyday uses. We have purchased a large quantity of these from the Liquidator and are able to offer them to you at about half of the original list price. 30p per (8oz) can or 12 cans for £3 post paid. The lubricant is I.C.I. fluon L169.

## REED SWITCHES



Glass encased, switches operated by external magnet—gold welded contacts. We can now offer 3 types:

**Miniature.** 1in long × approximately ⅛in diameter. Will make and break up to ½A up to 300V. Price 13p each, £1·20 dozen.

**Standard.** 2in long × $\frac{3}{16}$in diameter. This will break currents of up to 1A, voltage up to 250V. Price 10p each, 90p per dozen.

**Flat.** Flat type, 2in long, just over $\frac{3}{16}$in thick, flattened out, so that it can be fitted into a smaller space or a larger quantity may be packed into a square solenoid. Rating 1A 200V. Price 30p each, £3 per dozen.

Small ceramic magnets to operate these reed switches 9p each, 90p dozen.

Dry **Reed Relays.** Solenoids on moulded bobbins within magnetic shields printed circuit or panel mounting.

| *Ref.* | *Coil Resistance* | *Reed Switches* | *Price* |
|---|---|---|---|
| 71005 | 2 K | 1 normally open | 25p |
| 81916 | 5 K | 1 normally open, 1 normally closed | 75p |
| 05003 | 4 K | 1 normally open | 25p |
| 62040 | 1500 & 500 ohms | 1 normally open | 35p |

**Multiple Reed Relay Ref. 53001.** Contains 13 normally open reeds within a solenoid. Operates on 600mW. Coil resistance 9K ohms. Price £1·95 each.

**Multiple Reed Relay. Ref. 031.** 2 normally open 1 normally closed coil resistance 30 ohms. Price 75p.

Where postage is not stated then orders over £5 are post free. Below £5 add 20p. Semi-conductors add 5p post. Over £1 post free. S.A.E. with enquiries please.

# J. BULL (ELECTRICAL) LTD.

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

# Readout—
## A SELECTION FROM OUR POSTBAG

**Correspondents wishing to have a reply must enclose a stamped addressed envelope. We regret we are unable to guarantee a reply on matters not relating to articles published in the magazine. Technical queries cannot be dealt with on the telephone.**

## Who pays?

Sir—I have just read your February Editorial and may I, with respect, be permitted to ask a question?

Who is going to pay for all these fantastically expensive schemes you are proposing? As a taxpayer, I, for one, strongly object. After all, it only needs a little less speed (i.e. to the prevailing conditions) and a little more courtesy and consideration for other road users by a very small fraction of motorists, and your problem of "Motorway Supervision" in large measures disappears.

The considerations of safety for the air do not compare with those for the road. I cannot imagine BOAC allowing a "proven-dangerous - complete - with - endorsements" driver even to enter the flight deck, let alone fly.

No, Sir, do not suggest pampering them at our expense, but sock'em hard by removing their licences at their OWN expense. I regret that this sentiment does not promote the electronic trade, as we know that is your inclination of course, but would you say me nay?

J. G. Newbury,
Ashby Parva,
Rugby.

## Paradoxical stage

Sir—I am a retired teacher, having spent 41 years teaching "low level" mathematics and physics in secondary schools, and I naturally compare the new maths with the traditional. I did have some contact with the new maths and Nuffield Science before I retired, and I followed the new maths programme on BBC schools television and have close contacts by observing my grandchildrens' textbooks and their methods.

This comparison causes me much worry. I believe a blend of the old and new is the best solution, but so far as I can see, the balance is being tipped too much in favour of the new maths, and the reason put forward is that we must teach our students about computers and computer programming.

This was the reason why one of my grandsons went through junior school without learning the multiplication tables! The Headmaster said that computers do all that! Needless to say, the boy was seriously handicapped at the Comprehensive School.

But it does not end there. A careful study of his textbooks shows that the old traditional methods take about five per cent of the space.

From my own observations I know that those old fashioned initials H.C.F. and L.C.M. have key rolls in computer mathematics, and I know from experience that they teach far more about numbers than any other sysem, but they have absolutely no mention in the modern text book, and even comparing the value of fractions by bringing them to a common denominator has only one paragraph in a whole chapter given to that subject.

And how does this affect traditional physics? Part of the purpose of going to school is to learn to think in a logical way.

The Wheatstone Bridge is a first-class example of logical thinking yet I can find no help in the maths text book for working out

$$Rx = \frac{R3}{R4} \times \frac{R2}{R1}$$

It looks as though we are coming to the paradoxical stage when the physics department will have to teach "old fashioned" mathematics in order that the students will understand the "computer" mathematics departments who are doing all this to help in the teaching of electronics?

G. A. Cozens,
Southampton.

## "Switched on"

Sir,—It may interest you to know that I am 76 years old and I became hooked on your magazine about three years ago. Your magazine has revived my old interest in these subjects of fifty or more years ago —"the cat's whisker days."

All my working life I have never been able to find the time to follow up these interests but I have now found my feet, so to speak. I like the methods used by your technical contributors in explaining the functions of the new apparatus and components. These descriptions have given me a new lease of life. They are, for the most part, brief and precise and full of technical interest.

I have been an electrical and mechanical engineer all my working life, in the heavy steel and iron industries, and felt very "switched off" when I had to retire. I can recommend your magazine to any retired gentleman who has some knowledge of these subjects and now requires a real interest in life.

H. O. Guest,
Worral,
Sheffield.

## BACK NUMBERS WANTED

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

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

**November 1969**
Mr. J. Fenn, 33 Tinwell Lodge Cottages, Tinwell, Stamford, Lincolnshire.

**May, June 1970**
D. J. Parfitt, c/o The Duke of Richmond Hotel, Cambridge Park, St Peter Port, Guernsey, Channel Islands.

**July 1970 to March 1971**
Mr. S. January, 18 Hassan Assem, Zamalek, Cairo, A.R.E.

**September, October, November 1971**
Mr. I. M. Johnstone, 8 Hillpark Crescent, Blackhall, Edinburgh, EH4 7BG.

**November 1971**
Mr. J. L. Concannon, C.P.O. Mess, H.M.S. *Osprey*, Portland, Dorset.

**February 1971**
Mr P. J. Arden, 1, Hallam Grange Rise, Fulwood, Sheffield S10 4BE

**May 1969 to March 1970**
D1922536 Cpl. R. Larkman, "B" Flight (SAM), RAF North Luffenham, Oakham, Rutland.

**January 1969**
Mr A. J. Campbell, "Donegal", 9, Medina Gardens, East Oakley, Basingstoke, Hants.

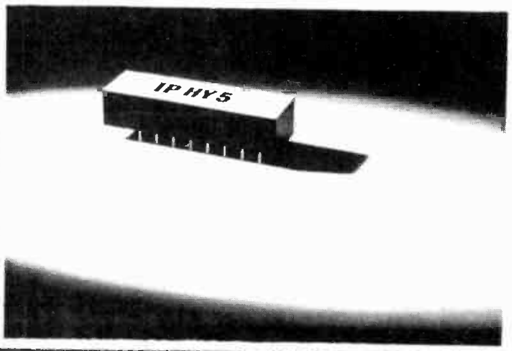
**October 1970**
Mr A. P. Allid, 15740, Sherman Way, Van Nuys, California, USA.

**January 1967**
Mr R. D. Frank, Post Office Box 88, Mt. Lawley 6050, Western Australia.

**August to December 1968**
Mr B. M. Oddy, 27, Gimble Way, Pembury, Kent.

**July to September 1969**
Mr M. McPhie, Lowfields, 6, Enterpen, Hutton-Rudby, Yarm-on-Tees, Yorks.

# I.L.P. (Electronics) Ltd




## HY40 IS POWER AMP PERFECTION

Lets face it — an immediate success, the HY40 is here to stay.

HY40 means Hybrid Power, power neatly locked away inside an Intregrated Circuit. Power the modern way, simply mount only five additional components on a printed circuit board (all of which are supplied with the HY40). Power not only for Hi-Fi, power for Groups, for public address, for industry, power for all.


### HY40 is HI-FI POWER
### ILP are POWER PROUD

In addition to the P.C. board and manual supplied with the HY40 we now include the five remaining components, at minimal cost, needed to complete the assembly of a High Performance Power Amplifier.

By merely combining two HY40s with a Stereo Preamplifier (2 x HY5) and simple Power Supply (PSU45), premium quality stereo may be obtained for a very modest outlay.

The free manual supplied with the HY40 gives clear, easy build instructions for Power Supply; volume, bass, treble and balance controls, together with inputs for Ceramic and Magnetic Pick-ups, Tape, Tuner and Auxiliary functions.

Internally the HY40 is based on conventional and proven circuit techniques developed over recent years.

**OUTPUT POWER** British Rating 40 WATTS PEAK, 20 watts RMS continuous.

**LOAD IMPEDANCE** 4–16 ohms

**INPUT IMPEDANCE** 22Kohms at 1Khz.

**INPUT SENSITIVITY** 300 mV for maximum output.

**VOLTAGE GAIN** 30db at 1KHz.

**FREQUENCY RESPONSE** 5Hz-60KHz ± 1db.

**TOTAL DISTORTION** less than 1% (typical 0.1%) at all output powers.

**SUPPLY VOLTAGE** ± 22.5 volts D.C.

**SUPPLY CURRENT** 0.8 amps maximum.

**PRICE**: including comprehensive manual, P.C. Board and FIVE EXTRA COMPONENTS:
**MONO £4·40 STEREO £8·80**
**all post free.**

## A WORLDS FIRST TO JOIN THE WORLDS BEST

The HY5 is a unique and revolutionary concept in High-Fidelity pre-amplifiers. Thanks to the latest techniques, all feedback and equalization networks are, for the first time, combined into an integrated pre-amplifier circuit.

Simply by adding volume, treble, bass potentiometers and only three stabilizing capacitors, which are supplied, your HY5 is complete and ready for use.

The HY5 provides equalization for almost every conceivable input. This years developments in equalization technique enables precise correction for both output voltage and frequency response for any crystal or ceramic cartridge. Yet another feature of the HY5 is its inbuilt stabilization circuit, allowing it to be run off any unregulated power amplifier supply.

The HY5 contains a balance circuit which, when linked by a balance control to a second HY5, forms a complete stereo preamplifier.

Specifically and critically designed to meet exacting Hi-Fi standards, the HY5 combines extremely low noise with a high overload capability. When used in conjunction with the HY40 and PSU45 forms a completely integrated system.

**INPUTS**
Magnetic Pick-up (within ±1db RIAA curve) 2mV.
Tape Replay (external components to suit head). 4mV.
Microphone (flat) 10mV.
Ceramic Pick-up (equalized and compensatable) 20 – 2000mV variable.
Tuner (flat) 250mV.
Auxiliary 1 250mV.
Auxiliary 2 2–20mV.

**OUTPUTS**
Main Pre-amp output 500mV.
Direct tape output 120mV.

**ACTIVE TONE CONTROLS**
Treble ±12db.
Bass ±12db.

**INTERNAL STABILIZATION**
Enables the HY5 to share an unregulated supply with the Power Amplifier.

**SUPPLY VOLTAGE**
15–25 volt.

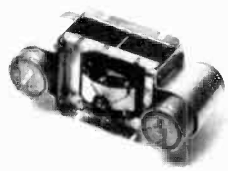
**SUPPLY CURRENT**
5mA approx.

**OVERLOAD CAPABILITY**
better than 28db on most sensitive input infinite on tuner and auxl.

**OUTPUT NOISE VOLTAGE**
0.5mV.

**PRICE**
Mono £3·60 Stereo £7·20

## POWER SUPPLY PSU45



The PSU45 is specifically designed to supply, simultaneously, your HY40 (in mono or stereo format) and one or two HY5s.

Spec.

PSU45 ± 22.5 volts, 2 amps simultaneously.

**PRICE**: **£4·50** including Postage and Packing

CROSSLAND HOUSE · NACKINGTON · CANTERBURY · KENT
TELEPHONE: CANTERBURY 63218

Also see next two pages

# SEMI-CONDUCTORS/VALVES

## ALL DEVICES BRAND NEW AND FULLY GUARANTEED

### Transistors

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2N3415 | 22p | 2N5458 | 35p | BC114 | 15p | BFW90 | 22p | NKT219 | 30p |
| | | 2N3416 | 27p | 2N5459 | 40p | BC115 | 15p | BFW91 | 20p | NKT223 | 27p |
| 2G301 | 20p | 2N3417 | 37p | 2S102 | 25p | BC116 | 15p | BFX12 | 22p | NKT224 | 22p |
| 2G302 | 20p | 2N3439 | 130p | 2S103 | 25p | BC118 | 15p | BFX13 | 22p | NKT225 | 22p |
| 2G303 | 20p | 2N3440 | 97p | 2S104 | 25p | BC119 | 30p | BFX29 | 25p | NKT229 | 30p |
| 2G306 | 30p | 2N3564 | 17p | 2S301 | 50p | BC121 | 20p | BFX30 | 25p | NKT237 | 35p |
| 2G308 | 30p | 2N3565 | 15p | 2S302 | 50p | BC122 | 20p | BFX37 | 30p | NKT238 | 25p |
| 2G309 | 30p | 2N3566 | 22p | 2S303 | 60p | BC125 | 15p | BFX44 | 37p | NKT240 | 27p |
| 2G371 | 15p | 2N3568 | 25p | 2S304 | 75p | BC126 | 25p | BFX68 | 67p | NKT241 | 27p |
| 2G374 | 20p | 2N3569 | 25p | 2S501 | 32p | BC134 | 12p | BFX84 | 25p | NKT242 | 20p |
| 2G381 | 22p | 2N3570 | 125p | 2S502 | 35p | BC135 | 12p | BFX85 | 30p | NKT243 | 62p |
| 2N388A | 49p | 2N3572 | 97p | 2S503 | 27p | BC136 | 15p | BFX86 | 25p | NKT244 | 17p |
| 2N404 | 20p | 2N3605 | 27p | 3N83 | 40p | BC137 | 15p | BFX87 | 25p | NKT245 | 20p |
| 2N696 | 15p | 2N3606 | 27p | 3N128 | 70p | BC138 | 20p | BFX88 | 20p | NKT261 | 20p |
| 2N697 | 15p | 2N3607 | 22p | 3N140 | 77p | BC140 | 35p | BFX89 | 62p | NKT262 | 30p |
| 2N698 | 25p | 2N3638 | 18p | 3N141 | 72p | BC141 | 35p | BFX93A | 70p | NKT264 | 20p |
| 2N699 | 30p | 2N3638A | 20p | 3N142 | 55p | BC147 | 10p | BFY11 | 42p | NKT271 | 20p |
| 2N706 | 10p | 2N3641 | 18p | 3N143 | 67p | BC148 | 10p | BFY18 | 25p | NKT262 | 20p |
| 2N706A | 12p | 2N3642 | 18p | 3N152 | 87p | BC149 | 12p | BFY19 | 25p | NKT274 | 20p |
| 2N708 | 12p | 2N3643 | 20p | 40050 | 55p | BC152 | 17p | BFY21 | 42p | NKT275 | 20p |
| 2N709 | 45p | 2N3644 | 25p | 40250 | 50p | BC153 | 20p | BFY24 | 45p | NKT278 | 25p |
| 2N718 | 25p | 2N3645 | 25p | 40251 | 82p | BC154 | 20p | BFY29 | 40p | NKT281 | 27p |
| 2N718A | 30p | 2N3691 | 15p | 40309 | 32p | BC157 | 15p | BFY30 | 40p | NKT401 | 87p |
| 2N726 | 25p | 2N3692 | 18p | 40310 | 45p | BC158 | 11p | BFY41 | 50p | NKT402 | 90p |
| 2N727 | 25p | 2N3693 | 15p | 40311 | 35p | BC159 | 12p | BFY43 | 62p | MKT403 | 75p |
| 2N914 | 17p | 2N3694 | 18p | 40312 | 47p | BC160 | 35p | BFY50 | 20p | NKT404 | 55p |
| 2N916 | 17p | 2N3702 | 10p | 40314 | 37p | BC167 | 11p | BFY51 | 20p | NKT405 | 75p |
| 2N918 | 30p | 2N3703 | 10p | 40315 | 37p | BC168B | 12p | BFY52 | 20p | NKT406 | 62p |
| 2N929 | 22p | 2N3704 | 12p | 40316 | 47p | BC168C | 15p | BFY53 | 15p | NKT451 | 62p |
| 2N930 | 20p | 2N3705 | 10p | 40317 | 37p | BC169B | 14p | BFY56A | 57p | NKT452 | 62p |
| 2N937 | 52p | 2N3706 | 10p | 40319 | 55p | BC169C | 15p | BFY76 | 42p | NKT453 | 47p |
| 2N1090 | 22p | 2N3707 | 12p | 40320 | 47p | BC170 | 12p | BFY77 | 57p | NKT713 | 20p |
| 2N1091 | 22p | 2N3708 | 10p | 40323 | 32p | BC171 | 15p | BFY90 | 65p | NKT717 | 42p |
| 2N1131 | 25p | 2N3709 | 10p | 40324 | 47p | BC172 | 15p | BSX19 | 17p | NKT734 | 27p |
| 2N1132 | 25p | 2N3710 | 10p | 40326 | 37p | BC175 | 22p | BSX20 | 15p | NKT736 | 35p |
| 2N1302 | 17p | 2N3711 | 10p | 40329 | 30p | BC177 | 20p | BSX21 | 20p | NKT773 | 25p |
| 2N1303 | 17p | 2N3713 | 187p | 40344 | 27p | BC178 | 20p | BSX26 | 45p | NKT781 | 30p |
| 2N1304 | 22p | 2N3714 | 200p | 40347 | 57p | BC179 | 20p | BSX27 | 47p | OC16 | 50p |
| 2N1305 | 22p | 2N3715 | 220p | 40348 | 52p | BC182 | 12p | BSX28 | 32p | OC19 | 37p |
| 2N1306 | 25p | 2N3716 | 285p | 40360 | 40p | BC182L | 10p | BSX60 | 82p | OC20 | 85p |
| 2N1307 | 25p | 2N3773 | 240p | 40361 | 40p | BC183 | 9p | BSX61 | 62p | OC22 | 50p |
| 2N1308 | 25p | 2N3791 | 275p | 40362 | 50p | BC183L | 9p | BSX76 | 15p | OC23 | 60p |
| 2N1309 | 25p | 2N3819 | 34p | 40370 | 32p | BC184 | 11p | BSX77 | 20p | OC24 | 60p |
| 2N1507 | 17p | 2N3820 | 55p | 40406 | 57p | BC184L | 11p | BSX78 | 25p | OC25 | 40p |
| 2N1613 | 20p | 2N3823 | 50p | 40407 | 40p | BC186 | 25p | BSY24 | 15p | OC26 | 25p |
| 2N1631 | 35p | 2N3854 | 27p | 40408 | 52p | BC187 | 27p | BSY25 | 15p | OC28 | 60p |
| 2N1632 | 30p | 2N3854A | 27p | 40409 | 55p | BC212L | 12p | BSY26 | 17p | OC29 | 60p |
| 2N1637 | 30p | 2N3855 | 27p | 40410 | 62p | BC213L | 12p | BSY27 | 15p | OC35 | 50p |
| 2N1638 | 27p | 2N3855A | 30p | 40412 | 50p | BC214L | 15p | BSY28 | 17p | OC36 | 60p |
| 2N1639 | 27p | 2N3856 | 30p | 40467A | 57p | BCY10 | 27p | BSY29 | 17p | OC41 | 22p |
| 2N1701 | 162p | 2N3856A | 35p | 40468A | 35p | BCY30 | 30p | BSY32 | 25p | OC42 | 40p |
| 2N1711 | 24p | 2N3858 | 25p | 40528 | 72p | BCY31 | 40p | BSY36 | 25p | OC44 | 15p |
| 2N1889 | 32p | 2N3858A | 30p | 40600 | 57p | BCY32 | 60p | BSY37 | 25p | OC45 | 12p |
| 2N1893 | 37p | 2N3859 | 27p | 40603 | 50p | BCY33 | 30p | BSY38 | 20p | OC46 | 15p |
| 2N2147 | 72p | 2N3859A | 32p | AC107 | 30p | BCY34 | 35p | BSY39 | 22p | OC70 | 15p |
| 2N2160 | 57p | 2N3860 | 30p | AC126 | 20p | BCY38 | 30p | BSY43 | 50p | OC71 | 12p |
| 2N2193 | 40p | 2N3866 | 150p | AC127 | 24p | BCY39 | 60p | BSY51 | 32p | OC72 | 12p |
| 2N2193A | 42p | 2N3877 | 40p | AC128 | 20p | BCY40 | 50p | BSY52 | 32p | OC73 | 30p |
| 2N2194 | 27p | 2N3877A | 40p | AC151 | 18p | BCY41 | 15p | BSY53 | 37p | OC74 | 30p |
| 2N2194A | 30p | 2N3900 | 37p | AC152 | 22p | BCY42 | 15p | BSY54 | 40p | OC75 | 25p |
| 2N2217 | 25p | 2N3900A | 40p | AC154 | 22p | BCY43 | 15p | BSY56 | 90p | OC76 | 25p |
| 2N2218 | 20p | 2N3901 | 97p | AC176 | 20p | BCY54 | 32p | BSY79 | 45p | OC77 | 40p |
| 2N2219 | 20p | 2N3903 | 20p | AC187 | 25p | BCY58 | 22p | BSY90 | 57p | OC78 | 20p |
| 2N2220 | 25p | 2N3904 | 25p | AC188 | 25p | BCY59 | 22p | BSY95A | 12p | OC81 | 20p |
| 2N2221 | 25p | 2N3905 | 30p | ACY17 | 27p | BCY60 | 97p | C424 | 15p | OC81D | 20p |
| 2N2222 | 20p | 2N3906 | 25p | ACY18 | 24p | BCY70 | 15p | C450 | 15p | OC82 | 25p |
| 2N2222A | 25p | 2N4058 | 12p | ACY19 | 24p | BCY71 | 20p | GET102 | 35p | OC82D | 15p |
| 2N2297 | 30p | 2N4059 | 10p | ACY20 | 20p | BCY72 | 15p | GET113 | 25p | OC83 | 25p |
| 2N2368 | 15p | 2N4060 | 12p | ACY21 | 20p | BCY78 | 30p | GET114 | 20p | OC84 | 25p |
| 2N2369 | 15p | 2N4061 | 12p | ACY22 | 20p | BCY79 | 30p | GET118 | 20p | OC139 | 25p |
| 2N2369A | 15p | 2N4062 | 12p | ACY28 | 17p | BCZ10 | 27p | GET120 | 25p | OC140 | 40p |
| 2N2410 | 42p | 2N4244 | 47p | ACY39 | 47p | BCZ11 | 40p | GET873 | 12p | OC170 | 25p |
| 2N2483 | 27p | 2N4248 | 15p | ACY40 | 14p | BD112 | 50p | GET880 | 40p | OC171 | 30p |
| 2N2484 | 32p | 2N4249 | 15p | ACY41 | 15p | BD116 | 112p | GET887 | 15p | OC200 | 40p |
| 2N2539 | 22p | 2N4250 | 18p | ACY44 | 25p | BD121 | 65p | GET889 | 22p | OC201 | 75p |
| 2N2540 | 22p | 2N4254 | 42p | AD140 | 47p | BD123 | 80p | GET890 | 22p | OC202 | 80p |
| 2N2613 | 35p | 2N4255 | 42p | AD149 | 47p | BD124 | 75p | GET896 | 22p | OC203 | 40p |
| 2N2614 | 30p | 2M4284 | 17p | AD150 | 62p | BD131 | 75p | GET897 | 22p | OC204 | 40p |
| 2N2646 | 47p | 2N4285 | 17p | AD161 | 35p | BD132 | 80p | GET898 | 22p | OC205 | 75p |
| 2N2711 | 25p | 2N4286 | 17p | AD162 | 35p | BDY10 | 125p | MAT100 | 25p | OC206 | 95p |
| 2N2712 | 25p | 2N4287 | 17p | AF109 | 45p | BDY20 | 105p | MAT101 | 25p | OC207 | 75p |
| 2N2713 | 27p | 2N4288 | 15p | AF114 | 25p | BDY61 | 125p | MAT120 | 25p | OCP71 | 42p |
| 2N2714 | 30p | 2N4289 | 12p | AF115 | 25p | BDY62 | 100p | MAT121 | 25p | ORP12 | 50p |
| 2N2904 | 20p | 2N4290 | 12p | AF116 | 25p | BF115 | 25p | MJ400 | 107p | ORP60 | 40p |
| 2N2904A | 25p | 2N4291 | 15p | AF117 | 20p | BF117 | 47p | MJ420 | 80p | ORP61 | 42p |
| 2N2905 | 25p | 2N4292 | 15p | AF118 | 44p | BF152 | 28p | MJ421 | 80p | P346A | 22p |
| 2N2905A | 20p | 2N4294 | 17p | AF121 | 30p | BF154 | 20p | MJ430 | 102p | ST140 | 15p |
| 2N2906 | 20p | 2N4303 | 47p | AF124 | 22p | BF158 | 15p | MJ440 | 95p | ST141 | 20p |
| 2N2906A | 25p | 2N4964 | 15p | AF125 | 19p | BF159 | 35p | MJ480 | 97p | TIS34 | 62p |
| 2N2907 | 23p | 2N4965 | 18p | AF126 | 16p | BF163 | 35p | MJ481 | 125p | TIS43 | 40p |
| 2N2923 | 15p | 2N5027 | 52p | AF127 | 16p | BF167 | 25p | MJ490 | 100p | TIS44 | 12p |
| 2N2924 | 15p | 2N5028 | 57p | AF139 | 28p | BF170 | 33p | MJ491 | 137p | TIS45 | 12p |
| 2N2925 | 15p | 2N5029 | 47p | AF178 | 42p | BF173 | 30p | MJE340 | 50p | TIS46 | 12p |
| 2N2926G | 12p | 2N5030 | 42p | AF179 | 45p | BF177 | 30p | MJE370 | 80p | TIS47 | 12p |
| 2N2926O | 12p | 2N5172 | 12p | AF180 | 50p | BF178 | 25p | MJE371 | 80p | TIS48 | 12p |
| 2N2926Y | 12p | 2N5174 | 52p | AF181 | 40p | BF179 | 30p | MJE520 | 75p | TIS49 | 12p |
| 2N3011 | 20p | 2N5175 | 52p | AF186 | 39p | BF180 | 35p | MJE521 | 70p | TIS50 | 12p |
| 2N3014 | 25p | 2N5176 | 45p | AF239 | 30p | BF181 | 35p | MPF102 | 42p | TIS51 | 10p |
| 2N3053 | 20p | 2N5232A | 30p | AF279 | 47p | BF182 | 30p | MPF103 | 35p | TIS52 | 11p |
| 2N3054 | 49p | 2N5245 | 45p | AF280 | 47p | BF184 | 20p | MPF104 | 37p | TIS53 | 22p |
| 2N3055 | 72p | 2N5246 | 42p | AFZ11 | 32p | BF185 | 20p | MPF105 | 37p | XB112 | 32p |
| 2N3133 | 25p | 2N5249 | 67p | ASY26 | 25p | BF194 | 15p | MPS3638 | 32p | XC141 | 35p |
| 2N3134 | 30p | 2N5265 | 325p | ASY27 | 30p | BF195 | 15p | NKT124 | 42p | ZTX107 | 15p |
| 2N3135 | 25p | 2N5305 | 37p | ASY28 | 24p | BF196 | 15p | NKT125 | 27p | ZTX108 | 12p |
| 2N3136 | 25p | 2N5306 | 40p | ASY29 | 27p | BF197 | 15p | NKT126 | 27p | ZTX109 | 15p |
| 2N3390 | 25p | 2N5307 | 37p | ASY50 | 25p | BF198 | 15p | NKT128 | 27p | ZTX300 | 12p |
| 2N3391 | 20p | 2N5308 | 37p | ASY51 | 32p | BF200 | 35p | NKT135 | 27p | ZTX301 | 15p |
| 2N3391A | 30p | 2N5309 | 62p | ASY54 | 25p | BF224 | 14p | NKT137 | 32p | ZTX302 | 20p |
| 2N3392 | 17p | 2N5310 | 42p | ASY67 | 45p | BF225 | 19p | NKT210 | 30p | ZTX303 | 20p |
| 2N3393 | 15p | 2N5354 | 27p | ASY86 | 32p | BF237 | 22p | NKT211 | 30p | ZTX304 | 25p |
| 2N3394 | 15p | 2N5355 | 27p | ASZ21 | 51p | BF238 | 22p | NKT212 | 30p | ZTX500 | 15p |
| 2N3402 | 22p | 2N5356 | 32p | AUY10 | 150p | BF244 | 32p | NKT213 | 30p | ZTX501 | 15p |
| 2N3403 | 22p | 2N5365 | 47p | BC107 | 10p | BFW61 | 47p | NKT214 | 20p | ZTX502 | 20p |
| 2N3404 | 32p | 2N5366 | 32p | BC108 | 10p | BFW87 | 25p | NKT215 | 22p | ZTX503 | 17p |
| 2N3405 | 45p | 2N5367 | 57p | BC109 | 10p | BFW88 | 23p | NKT216 | 35p | ZTX504 | 40p |
| 2N3414 | 22p | 2N5457 | 30p | BC113 | 10p | BFW89 | 20p | NKT217 | 40p | ZTX531 | 25p |

### Integrated Circuits

| | | | | | |
|---|---|---|---|---|---|
| | | FJH101 | 25p | SN7430 | 20p |
| | | FJH111 | 70p | SN7440 | 20p |
| | | FJH121 | 25p | SN7441AN | |
| CA3000 | 180p | FJH131 | 25p | | 75p |
| CA3005 | 117p | FJH141 | 25p | SN7442 | 75p |
| CA3007 | 262p | FJH151 | 25p | SN7446 | 100p |
| CA3011 | 75p | FJH161 | 70p | SN7447 | 135p |
| CA3012 | 88p | FJH171 | 25p | SN7448 | 125p |
| CA3013 | 105p | FJH181 | 25p | SN7450 | 20p |
| CA3014 | 124p | FJH221 | 25p | SN7451 | 20p |
| CA3018 | 84p | FJH231 | 25p | SN7453 | 20p |
| CA3018A | | FJH241 | 25p | SN7454 | 20p |
| | 110p | FJH251 | 25p | SN7460 | 20p |
| CA3019 | 84p | FJJ101 | 50p | SN7472 | 30p |
| CA3020 | 126p | FJJ111 | 50p | SN7473 | 40p |
| CA3020A | | FJJ121 | 60p | SN7474 | 40p |
| | 160p | FJJ131 | 60p | SN7475 | 45p |
| CA3021 | 156p | FJJ141 | 125p | SN7476 | 45p |
| CA3022 | 130p | FJJ181 | 75p | SN7483 | 87p |
| CA3023 | 126p | FJJ191 | 65p | SN7486 | 33p |
| CA3026 | 100p | FJJ211 | 125p | SN7490 | 87p |
| CA3028A | 74p | FJJ251 | 125p | SN7492 | 87p |
| CA3028B | | FJL101 | 125p | SN7493 | 87p |
| | 105p | FJY101 | 25p | SN7495 | 87p |
| CA3029 | 87p | IC10 | 250p | SN7496 | 87p |
| CA3029A | | IC12 | 250p | SN74107 | 52p |
| | 165p | L900 | 40p | SN74153 | |
| CA3030 | 137p | L914 | 40p | | 140p |
| CA3035 | 122p | L923 | 40p | SN74154 | |
| CA3036 | 72p | MC724P | 60p | | 220p |
| CA3039 | 82p | MC780P | 247p | SN74160 | |
| CA3041 | 109p | MC788P | 146p | | 180p |
| CA3042 | 109p | MC790P | 124p | SN74161 | |
| CA3043 | 137p | MC792P | 66p | | 260p |
| CA3044 | 120p | MC799P | 66p | SN74164 | |
| CA3045 | 122p | MC1303L | | | 220p |
| CA3046 | 81p | | 200p | SN74165 | |
| CA3047 | 137p | MC1304P | | | 225p |
| CA3048 | 204p | | 225p | SN74192 | |
| CA3049 | 160p | MC1305P | | | 175p |
| CA3050 | 185p | | 386p | SN74193 | |
| CA3051 | 134p | MC838P | | | 175p |
| CA3052 | 165p | | 549p | TAA241 | |
| CA3053 | 46p | MC1435P | | | 162p |
| CA3054 | 109p | | 345p | TAA242 | |
| CA3055 | 240p | MC1552G | | | 425p |
| CA3059 | 165p | | 461p | TAA243 | 150p |
| CA3064 | 120p | MC1709CG | | TAA263 | 75p |
| FCH101 | 85p | | 94p | TAA293 | 97p |
| FCH111 | 105p | MFC4000P | | TAA300 | 175p |
| FCH121 | 105p | | 75p | TAA310 | 125p |
| FCH131 | 50p | PA222 | 260p | TAA320 | 72p |
| FCH141 | 105p | PA230 | 140p | TAA350 | 175p |
| FCH151 | 105p | PA234 | 92p | TAA435 | 147p |
| FCH161 | 50p | PA237 | 210p | TAA521 | 132p |
| FCH171 | 105p | PA246 | 160p | TAA522 | 360p |
| FCH181 | 105p | PA424 | 235p | TAA530 | 495p |
| FCH191 | 105p | PA264 | 190p | TAA811 | 445p |
| FCH201 | 130p | PA265 | 200p | TAB101 | 97p |
| FCH211 | 130p | SN7400 | 20p | TAD100 | 150p |
| FCH221 | 130p | SN7401 | 20p | TAD110 | 150p |
| FCH231 | 150p | SN7402 | 20p | SL403D | 150p |
| FCJ101 | 160p | SN7403 | 20p | SL702C | 147p |
| FCJ111 | 150p | SN7404 | 20p | UA702A | 280p |
| FCJ121 | 275p | SN7405 | 20p | UA702C | 77p |
| FCJ131 | 275p | SN7406 | 80p | UA703C | 137p |
| FCJ141 | 525p | SN7408 | 20p | UA709C | 125p |
| FCJ201 | 100p | SN7409 | 20p | UA710C | 125p |
| FCJ211 | 275p | SN7410 | 20p | UA716 | 187p |
| FCK101 | 430p | SN7411 | 23p | UA723C | 162p |
| FCL101 | 230p | SN7413 | 30p | UA730C | 160p |
| FCY101 | 102p | SN7420 | 20p | UA741C | 87p |

### BRIDGE RECTIFIERS PLASTIC ENCAPSULATED

| | | | |
|---|---|---|---|
| 600 PIV 1A | 50p | 50 PIV 4A | 60p |
| 50 PIV 2A | 55p | 100 PIV 4A | 70p |
| 100 PIV 2A | 60p | 200 PIV 4A | 70p |
| 200 PIV 2A | 65p | 400 PIV 4A | 75p |
| 400 PIV 2A | 75p | 50 PIV 6A | 62p |
| | | 100 PIV 6A | 75p |
| | | 200 PIV 6A | 75p |
| | | 400 PIV 6A | 100p |

### SILICON RECTIFIERS MINIATURE WIRE ENDED PLASTIC

| | IN SERIES 1 AMP | PL SERIES 1·5 AMP | CL SERIES 3 AMP |
|---|---|---|---|
| 4001 50PIV | 7p | 8p | 19p |
| 4002 100PIV | 7p | 9p | 20p |
| 4003 200PIV | 8p | 10p | 22p |
| 4004 400PIV | 8p | 10p | 25p |
| 4005 600PIV | 10p | 12p | 26p |
| 4006 800PIV | 12p | 15p | 27p |
| 4007 1000PIV | 15p | 16p | 30p |

50 + less 15% 100 + less 20%

### SILICON RECTIFIERS STUD MOUNTING

| | 6A | 10A | 17·5A | 35A |
|---|---|---|---|---|
| 100PIV | — | 45p | 50p | £1 22 |
| 200PIV | 25p | 50p | 55p | £1·42 |
| 400PIV | 30p | 55p | 62p | £1·77 |
| 600PIV | 32p | 60p | 72p | £2·12 |
| 800PIV | 35p | 75p | 87p | £2·47 |
| 1000PIV | 40p | 85p | £1·05 | £2·77 |

50 + less 15% 100 + less 20%

### ZENER DIODES

| 400MW | 1·5 WATT | 10 WATT |
|---|---|---|
| 3·3-33 V | 2·4—100 | 3·9—100V |
| 10p each | 25p each | 40p each |

25 + less 15% 100 + less 20%

**TRANSISTOR DISCOUNTS:-** 12 + 10%; 25 + 15%; 100 + 20% any one type. Postage on all Semi Conductors 7p extra.

**S A E FOR FULL LISTS**

### VALVES

| | | | | | |
|---|---|---|---|---|---|
| OA2 | 38p | 25Z4 | 30p | EL95 | 35p |
| OB2 | 45p | 25Z5 | 42p | EM80 | 45p |
| OZ4 | 30p | 25Z6 | 65p | EM81 | 60p |
| 1L4 | 20p | 30C15 | 80p | EM84 | 35p |
| 1R5 | 40p | 30C17 | 90p | EM85 | £1·00 |
| 1S5 | 30p | 30C18 | 80p | EM87 | 70p |
| 1T4 | 25p | 30F5 | 85p | EY51 | 40p |
| 1U4 | 30p | 30FL1 | 75p | EY86 | 40p |
| 1U5 | 60p | 30FL12 | 120p | EY87 | 42p |
| 2D21 | 35p | 30FL14 | 95p | EZ40 | 55p |
| 3Q4 | 50p | 30L15 | 85p | EZ41 | 50p |
| 3S4 | 35p | 30L17 | 80p | EZ80 | 27p |
| 3V4 | 48p | 30P12 | 80p | EZ81 | 29p |
| 5R4 | 75p | 30P19 | 85p | GZ32 | 48p |
| 5U4 | 35p | 30PL1 | 75p | GZ34 | 60p |
| 5V4 | 45p | 30PL13 | 93p | KT66 | £2·05 |
| 5Y3 | 40p | 30PL14 | 90p | KT88 | £2·00 |
| 5Z4G | 40p | 35L6 | 50p | MU14 | 75p |
| 6/30L2 | 80p | 35W4 | 35p | PABC80 | 40p |
| 6AC7 | 40p | 35Z4 | 35p | PC86 | 60p |
| 6AG7 | 40p | 35Z5 | 50p | PC88 | 60p |
| 6AK5 | 35p | 50B5 | 50p | PC97 | 45p |
| 6AK6 | 60p | 50C5 | 50p | PC900 | 48p |
| 6AL5 | 20p | 80 | 55p | PCC84 | 40p |
| 6AM6 | 30p | 85A2 | 50p | PCC85 | 40p |
| 6AQ5 | 38p | 807 | 50p | PCC88 | 55p |
| 6AS6 | 40p | 1625 | 50p | PCC89 | 50p |
| 6AT6 | 35p | 5763 | 70p | PCC189 | 55p |
| 6AU6 | 25p | 6146 | 160 | PCF80 | 30p |
| 6AV6 | 30p | AZ31 | 55p | PCF82 | 34p |
| 6BA6 | 25p | CY31 | 35p | PCF84 | 60p |
| 6BE6 | 30p | DAF91 | 30p | PCF86 | 60p |
| 6BH6 | 75p | DAF96 | 45p | PCF800 | 80p |
| 6BJ6 | 50p | DF91 | 22p | PCF801 | 50p |
| 6BQ7A | 40p | DF96 | 45p | PCF802 | 50p |
| 6BR7 | 90p | DK91 | 40p | PCF805 | 80p |
| 6BR8 | 70p | DK92 | 55p | PCF806 | 70p |
| 6BW6 | 85p | DK96 | 50p | PCF808 | 75p |
| 6BW7 | 80p | DL92 | 35p | PCL82 | 35p |
| 6BZ6 | 40p | DL94 | 48p | PCL83 | 65p |
| 6C4 | 33p | DL96 | 45p | PCL84 | 45p |
| 6CD6 | 125p | DM70 | 40p | PCL85 | 40p |
| 6CL6 | 50p | DY86 | 32p | PCL86 | 45p |
| 6CW4 | 65p | DY87 | 33p | PFL200 | 65p |
| 6F1 | 62p | E88CC | 100p | PL36 | 55p |
| 6F6G | 35p | E180F | 100p | PL81 | 50p |
| 6F13 | 45p | EABC80 | 35p | PL82 | 45p |
| 6F14 | 70p | EAF42 | 35p | PL83 | 45p |
| 6F15 | 65p | EB91 | 20p | PL84 | 40p |
| 6F18 | 50p | EBC41 | 55p | PL500 | 75p |
| 6F23 | 85p | EBC81 | 30p | PL504 | 80p |
| 6H6 | 17p | EBF80 | 40p | PY32 | 55p |
| 6J4 | 50p | EBF83 | 40p | PY33 | 63p |
| 6J5 | 25p | EBF89 | 32p | PY80 | 40p |
| 6J5GT | 30p | EBL21 | 60p | PY81 | 80p |
| 6J6 | 20p | EC86 | 60p | PY82 | 35p |
| 6J7 | 45p | EC88 | 60p | PY83 | 38p |
| 6K8G | 40p | ECC40 | 65p | PY88 | 40p |
| 6L6GT | 45p | ECC84 | 30p | PY800 | 40p |
| 6LD20 | 50p | ECC85 | 40p | PY804 | 50p |
| 6Q7 | 40p | ECC88 | 40p | U25 | 80p |
| 6SA7 | 40p | ECF80 | 85p | U26 | 80p |
| 6SG7 | 40p | ECF82 | 35p | U50 | 40p |
| 6SJ7 | 40p | ECF86 | 65p | U52 | 35p |
| 6SK7 | 40p | ECH21 | 57p | U191 | 75p |
| 6SL7 | 35p | ECH35 | 100p | U281 | 40p |
| 6SN7 | 35p | ECH42 | 75p | U282 | 40p |
| 6SQ7 | 40p | ECH81 | 30p | U301 | 40p |
| 6U4 | 65p | ECH83 | 45p | U801 | £1·80 |
| 6V6G | 25p | ECL80 | 45p | UABC80 | 40p |
| 6V6GT | 32p | ECL82 | 35p | UAF42 | 55p |
| 6X4 | 35p | ECL83 | 70p | UBC41 | 50p |
| 6X5G | 30p | ECL86 | 40p | UBC81 | 40p |
| 6X5GT | 40p | EF37A | 120p | UBF80 | 40p |
| 10C2 | 50p | EF39 | 50p | UBF89 | 35p |
| 10F1 | 75p | EF40 | 50p | UCC84 | 49p |
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| 10P14 | £1·10 | EF42 | 70p | UCF80 | 55p |
| 12AT6 | 30p | EF80 | 25p | UCH21 | 60p |
| 12AT7 | 30p | EF85 | 35p | UCH42 | 70p |
| 12AU7 | 30p | EF86 | 30p | UCH81 | 40p |
| 12AX7 | 30p | EF89 | 28p | UCL82 | 35p |
| 12AV6 | 40p | EF91 | 30p | UCL83 | 60p |
| 12BA6 | 40p | EF92 | 35p | UF41 | 60p |
| 12BE6 | 40p | EF183 | 35p | UF80 | 35p |
| 12BH7 | 45p | EF184 | 35p | UF85 | 40p |
| 19AQ5 | 35p | EH90 | 40p | UF89 | 40p |
| 20D1 | 50p | EL34 | 50p | UL41 | 65p |
| 20F2 | 65p | EL33 | £1 25 | UL84 | 40p |
| 20L1 | £1·10 | EL41 | 60p | UY41 | 48p |
| 20P1 | 50p | EL42 | 65p | UY85 | 40p |
| 20P3 | 60p | EL81 | 55p | VR105/30 | 38p |
| 20P4 | £1·10 | EL84 | 25p | VR150/30 | 35p |
| 20P5 | £1·20 | EL85 | 43p | *Add 12p in £* | |
| 25L6 | 50p | EL91 | 35p | *for postage* | |

### DIODES & RECTIFIERS

| | | | | | |
|---|---|---|---|---|---|
| 1N34A | 10p | BA154 | 12p | GJ7M | 37p |
| 1N914 | 7p | BAX13 | 12p | OA5 | 25p |
| 1N916 | 10p | BAX16 | 7p | OA6 | 12p |
| AA119 | 7p | BAY31 | 7p | OA10 | 25p |
| AA129 | 10p | BAY38 | 15p | OA9 | 10p |
| AAZ13 | 10p | BY100 | 15p | OA47 | 10p |
| AAZ15 | 10p | BY103 | 22p | OA70 | 10p |
| BA100 | 15p | BY122 | 37p | OA73 | 10p |
| BA102 | 30p | BY124 | 15p | OA79 | 10p |
| BA110 | 25p | BY126 | 12p | OA81 | 8p |
| BA111 | 27p | BY127 | 15p | OA85 | 7p |
| BA112 | 70p | BY164 | 57p | OA90 | 8p |
| BA115 | 7p | BY210 | 35p | OA91 | 7p |
| BA141 | 32p | BYZ11 | 30p | OA95 | 7p |
| BA142 | 32p | BYZ12 | 30p | OA200 | 7p |
| BA144 | 12p | BYZ13 | 25p | OA202 | 10p |
| BA145 | 20p | BYZ16 | 40p | OA210 | 17p |

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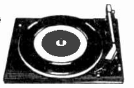

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Features unique mechanical 2-way units and fitted adjustable level controls. 8 ohm impedance. 20-20,000cps. Complete with spring lead & stereo jack plug. £7·97½. P. & P. 12½p.

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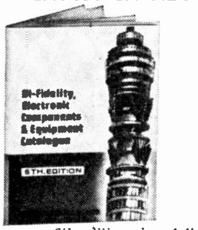


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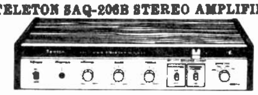

Latest exciting release. Beautifully styled with walnut case. 6 + 6 watts r.m.s. Switched inputs for Mag, Xtal, aux, tape. Incorporates volume, bass, treble, sliding balance, scratch filter and loudness controls. Rec. List £32·50. Our price £19·95. Carr. 37p.

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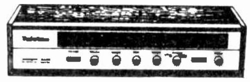
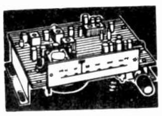


Probably the most popular budget Tuner/Amp. and now offered at a ridiculous low price. 5 watts r.m.s. per channel. Tape/Cer phono inputs. AFC/Built-in MPX. List £51. OUR PRICE £28·75. Carr. 50p.

**SUGGESTED SYSTEM**
F.2000, Garrard 2025T/C Changer fitted stereo cartridge, with plinth and cover and pair of G.W.S. 3 way Speakers. Total Rec. Price £97·73½. OUR PRICE £54·65. Carr. £1.

### ★ TRANSISTORISED FM TUNER ★

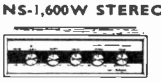


6 TRANSISTOR HIGH QUALITY TUNER, SIZE ONLY 6×4×2½in. 3 I.F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Coverage 88-108 MHz. Ready built ready for use. Fantastic value for money. £6·37½. P. & P. 12½p.
Stereo multiplex adaptors £4·97½.

### HA-10 STEREO HEADPHONE AMPLIFIER

All silicon 10 transistor amplifier operates from magnetic, ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9V battery. Inputs 5MU/100MU. Output 50mW. £5·97. P. & P. 15p.

### NS-1,600W STEREO AMPLIFIER



Exceptional budget price amplifier. All silicon transistor. Handsome walnut case. Switched input selector, separate balance, volume, treble, bass controls. Output 2 × 6W R.M.S. Inputs Mag, Tape, Xtal, Tuner, Tape Out. £14·75. Carr. 37p.

### EA.41 REVERBERATION AMPLIFIER

Self-contained, transistorised, battery operated. Simply plug in microphone, guitar, etc., and output into your amplifier. Volume control, depth of reverberation control. Beautiful walnut cabinet. 7¼in × 3in × 4¼in. £5·97. P. & P. 15p.

### BH.001 HEADSET AND BOOM MICROPHONE

Moving coil. Ideal for language teaching, communications. Headphone imp. 16 ohms. Microphone imp. 200 ohms. £4·62. P. & P. 15p.

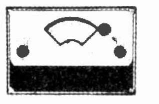
### Model S-100TR MULTIMETER/TRANSISTOR TESTER 100,000 o.p.v. MIRROR SCALE/OVERLOAD PROTECTION

0/·12/·6/3/12/30/120/600 VDC. 0/6/30/120/600 VAC. 0/12/600uA/12/300MA/12 AMP DC. 0/10K/1 MEG/100 MEG. −20 to +50 db. 0·01 − ·2 MFD. Transistor tester measures Alpha, Beta and Ico. Complete with batteries, instructions and leads. £13·50. P. & P. 25p.

### MCA. 220 AUTOMATIC VOLTAGE STABILISER

Input 88-125 VAC. Output 120 VAC or 176-250V input output 240 VAC. 200 VA rating. £11·97. Carr. 50p.

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

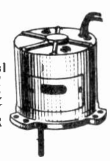


Sine 18–200,000Hz: Square 18–50,000Hz. Output max +10dB (10kΩ). Operation internal batteries.
Attractive two-tone case 7¼in × 5in · 2in. Price £17·50. Carr. 17½p.

### TE-16A Transistorised Signal Generator.

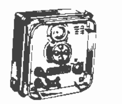
5 ranges 400 kHz-30 mHz. An inexpensive instrument for the handyman. Operates on 9v battery. Wide, easy to read scale. 800 kHz modulation. 5¼ × 5¼ · 3¼. Complete with instructions and leads. £7·97½. P. & P. 20p.

### 230/240V SMITHS SYNCHRONOUS MOTORS



Built in gearbox. All brand new and boxed. 60RPM CW: 30RPM CW; 2R/HR ACW: 2R/HR CW; 8R/DAY CW; 10RPM CW; 20R/HR ACW;
50p each Post 12p

### CRYSTAL CALIBRATORS No. 10



Small portable crystal controlled wavemeter. Size 7" 7½" × 4". Frequency range 500 Kc/s. 10 Mc/s (up to 30 Mc/s on harmonics). Calibrated dial. Power requirements 300 V.D.C. 15mA and 12 V.D.C. 0.3A. Excellent condition. £3·47½. Carr. 37½p.

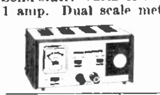
### HELICAL POTENTIOMETERS

ITT MCPM15 10 turn 2¼W. Available 500ohm, 1K, 5K ohm. £1·25 ea. P/P 15p.

### SDH-8V HI-FI PHONES

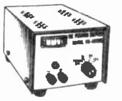
Input 8–16Ω. Frequency 20–18,000Hz stereo or mono switch, separate volume controls each earpiece, padded headband. £3.97. P. & P. 20p.

### RP214 REGULATED POWER SUPPLY



Solid state. Variable output 0-24V DC up to 1 amp. Dual scale meter to monitor voltage and current Input 220/240V AC. Size 185 × 85 × 105mm. £8·97. P. & P. 25p.

### PS.1000B REGULATED POWER SUPPLY

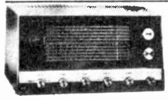


Solid state. Output 6, 9 or 12 volt DC up to 3 amps. Meter to monitor current. Input 220/240V AC. Size 4in × 3¼in × 6¼in. £11·97. P. & P. 25p.

### UR-1A SOLID STATE COMMUNICATION RECEIVER

4 Bands covering 55KHz-30MHz. FET, S Meter, Variable BFO for SSB. Built in Speaker, Bandspread, Sensitivity Control. 220/240V a.c. or 12V d.c. 12¼in × 4¼in × 7in. Brand new with instructions. £25. Carr. 37½p.

### LAFAYETTE HA-600 RECEIVER



General coverage 150-400KHz, 550KHz-30MHz. FET front end, 2 mech. filters, product detector, variable B.F.O., noise limiter, S Meter, Bandspread. RF Gain. 15in × 9¼in × 8¼in. 18lb. 220/240V a.c. or 12V d.c. Brand new with instructions £45. Carr. 50p.

### UNR-30 RECEIVER

4 Bands covering 550kHz – 30MHz. B.F.O. Built in Speaker 220/240V a.c. Brand new with instructions. £15·75. Carr. 37½p.

### B.C. 221 FREQUENCY METERS

latest release 125kHz to 20MHz. Excellent condition. Fully tested and checked and complete with calibrator charts. £27·50 each. Carr. 50p.

### SOLID STATE VARIABLE A.C. VOLTAGE REGULATORS

Compact and panel mounting. Ideal for control of lamps, drills, electrical appliances, etc. Input 230/240V a.c. Output continuously variable from 20V to 230V.
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500W. £4·97½. P. & P. 32½p.
1,000W. £7·25. P. & P. 37½p.
1,500W. £8·97½. P. & P. 42½p.
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High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range ex-stock Single hole fixing, ¼in. dia. shafts. Bulk quantities available.
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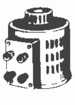
**100 WATT.** 1/5/10/25/50/100/250/500/1,000 or 2,500 ohms, £1·37½. P. & P. 7½p.

### "YAMABISHI" VARIABLE VOLTAGE TRANSFORMERS

Excellent quality . Low price . Immediate delivery



**S-260 General Purpose Bench Mounting**
1A ............ £7·00
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| BCY42 | 15p |
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| BCY59 | 22½p |
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| BF180 | 35p |
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| BF194 | 17½p |
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| BFW61 | 47½p |
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| BFX68 | 67½p |
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| BFX85 | 32½p |
| BFX86 | 25p |
| BFX87 | 27½p |
| BFX88 | 25p |
| BFX89 | 62½p |
| BFX93A | 70p |
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| BFY11 | 42½p |
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| BFY18 | 32½p |
| BFY19 | 32½p |
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| BFY21 | 42½p |
| BFY24 | 45p |
| BFY25 | 25p |
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| BFY29 | 50p |
| BFY30 | 50p |
| BFY41 | 50p |
| BFY43 | 62½p |
| BFY50 | 23p |
| BFY51 | 20p |
| BFY52 | 23p |
| BFY53 | 17½p |
| BFY56A | 57½p |
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| BFY77 | 57½p |
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| BSY28 | 17½p |
| BSY29 | 17½p |
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| BSY38 | 22½p |
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| NKT212 | 30p |
| NKT213 | 30p |
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**MAINS TRANSFORMERS "VARNISHED"**

1 amp Charger. Sec. 0–3·5–9–18V (P. & P. 22½p.) .. .. .. **96p**
2 amp Charger. Sec. 0–3·5–9–18V (P. & P. 22½p.) .. .. .. **£1·44**
1 amp (Douglas) MT103 Sec. tappings from 6V to 50V . .. **£2·12**
2 amp (Douglas) MT104 Sec. tappings from 6V to 50V .. .. **£2·97**
*Post and packing* 25p.
6 amp (Douglas) MT107 Sec. tappings from 6V to 50V .. .. **£7·52**
*Post and packing* 37½p.
Various other Transformers ranging from ½A to 5A in stock.

**TRIACS**

| | | | |
|---|---|---|---|
| SC41A | £1 | SC35D | £1·10½ |
| SC41B | £1·10 | SC36D | £1 |
| SC41D | £1·20 | SC40D | £1·50 |
| SC50D | £2·05 | SC45D | £1·62½ |
| 40430 | 97½p | SC46D | £1·42½ |
| 40486 | 95p | 40429 | 90p |
| 40512 | £1·45 | 40432 | £1·37½ |

**BRIDGE RECTIFIERS**

| A. | PIV | | A. | PIV | |
|---|---|---|---|---|---|
| 1 | 100 | 37p | 4 | 50 | 40p |
| 1·4 | 140 | 57p | 4 | 100 | 70p |
| 2 | 50 | 32p | 4 | 400 | 80p |
| 2 | 200 | 41p | 6 | 50 | 62p |
| 2 | 400 | 46p | 6 | 200 | 80p |
| | | | 6 | 400 | £1·10 |

**Economy Range Triacs**

TC4/10 (Pressfit) 4 amp 100 PIV .. **65p**
TC4/20 (Pressfit) 4 amp 200 PIV .. **75p**
TC4/40 (Pressfit) 4 amp 400 PIV .. **87½p**
ST2 DIAC .. .. .. .. **21p**

**DIACS**

MPT20 .. **40p**
MPT28 .. **37½p**
MPT32 .. **37½p**
MPT36 .. **37½p**

## P.E. SCORPIO IGNITION SYSTEM COMPLETE KIT £10·00 P. & P. 50p

## MULLARD SUB-MIN ELECTROLYTIC

**C426 range axial lead** **6p each**
Values (µF/V); 0·64/64; 1/40; 1·6/25; 2·5/16; 2·5/64; 4/10; 4/40; 5/64; 6·4/6·4; 6·4/25; 8/40; 10/16; 10/64; 12·5/25; 16/40; 20/16; 20/64; 25/6·4; 25/25; 32/10; 32/40; 32/64; 40/16; 50/6·4; 50/25; 50/40; 64/10; 80/2·5; 80/16; 80/25; 100/6·4; 125/10; 125/16; 200/6·4; 200/10; 320/6·4.

## THYRISTORS

| PIV | 50 | 100 | 200 | 300 | 400 |
|---|---|---|---|---|---|
| 1A | 25p | 27½p | 37½p | 40p | 47½p |
| 4A | 40p | 45p | 55p | – | 60p |
| 7A | — | 87½p | 92½p | — | £1·12½ |

TIC47 0·6A 200 PIV **58p**
Also 12A 100 PIV, **75p**; 2N3525 at **85p**.; 2N4444 **£1·91**

## VEROBOARD

| | 0·15 Matrix | 0·1 Matrix |
|---|---|---|
| 2½in × 3¾in | 17p | 23p |
| 2½in × 5in | 25p | 25p |
| 3¾in × 3¾in | 25p | 25p |
| 3¾in × 5in | 30p | 29p |
| 5in × 17in (plain) | 83p | — |

Vero Pins (bag of 36), **20p**.
Vero cutter, **45p**; Pin insertion Tools (0·1 and 0·15 matrix) at **55p**.

## HEAT SINKS

4·8 × 4 × 1in Finned or Two TO-3 Trans., **48p**. 4·8 × 2 × 1in Finned, for One TO-3 Trans., **33p**. For SO-1, **2½p**. For TO-5, **5p** Finned. For TO-18, **5p** Finned. For TO-18, **5p** Finned.

## RESISTORS

**Carbon Film**
⅛ watt 5%, **1p**.
¼ watt 5%, **1p**.
½ watt 5%, **1½p**.
⅛ w M/O 2%, **4p**.
1 watt 10%, **2½p**.
2 watt 10%, **6p**.

⅛W & ¼W are E24 series.
½W, 1W, & 2W are E12 series.

## MULLARD C280 M/FOIL CAPACITORS

0·01, 0·022, 0·033, 0·047, **3p**; 0·068, 0·1, **4p** each.
0·15, 0·22, 0·33, **5p** each.

| | |
|---|---|
| 0·47 | 9p |
| 0·68 | 11p |
| 1µF | 14p |
| 1·5µF | 21p |
| 2·2µF | 25p |

## WIRE-WOUND RESISTORS

2·5 watt 5% (up to 270 ohms only), **7p**.
5 watt 5% (up to 8·2kΩ only), **9p**.
10 watt 5% (up to 25kΩ only), **10p**.

## POTENTIOMETERS

**Carbon:**
Log. or Lin., less switch, **16p**.
Log. or Lin., with switch, **25p**.
Wire-wound Pots (3W), **38p**.
Twin Ganged Stereo Pots, Log. and Lin., **40p**.

## PRESETS (CARBON)

| | |
|---|---|
| 0·1 Watt | 6p |
| 0·2 Watt | 6p |
| 0·3 Watt | 7½p |

## THERMISTORS

R53 (STC) **£1·20**
K151 (Ik) **12p** VA1077 **20p**
VA3705 **95p**
Mullard Thermistors also in stock. Please inquire.

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Send 15p for Comprehensive Price Lists

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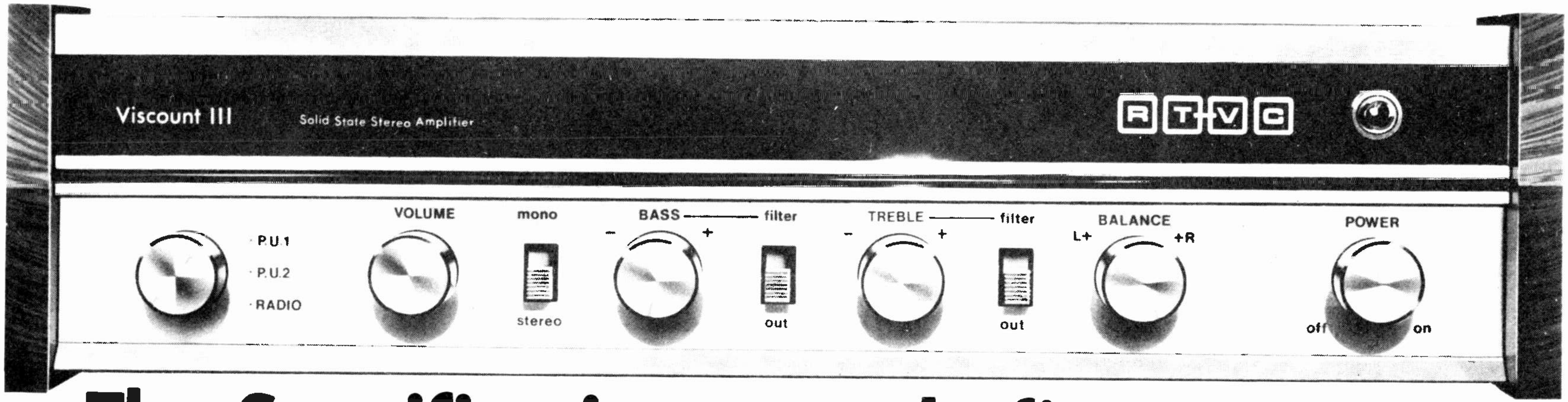
**MON-FRI 9-5.30**
**SAT 9-5**




# The Specification sounds fine the System sounds great

## Viscount 111 Audio Suite complete £49

**14 + 14 watts r.m.s. 40 Hz to 40kHz 3dB. Total distortion at 10 watts at 1 kHz - 0·1%**

This is real value for money! We have designed 3 systems and the heart of them all is the Viscount III amplifier. A unit of great eye appeal with teak finished cabinet. It is available in 2 versions—R100 for ceramic cartridges and R101 for magnetic and ceramic. FET's (Field effect transistors) are incorporated on the input stages, just like top priced units. FET's give you more of the signal you want and almost none of the hiss you don't. Both units have output sockets for headphones and tape recorder. Filters and tone controls give a wide range of bass and treble adjustment.

For all systems we have chosen the famous Garrard SP25 Mk. III deck which comes complete with simulated teak plinth and dust cover.

The exclusive Duo loudspeaker systems are incomparable for quality within their price range. Large speakers in extremely substantial cabinets. There's a choice of the Duo II's for the smaller room or the big Duo III's for real bass response.

**PRICES** SYSTEM 1

| | |
|---|---|
| Viscount III R101 amplifier | £22·00+90p p&p |
| 2 x Duo Type II speakers | £14·00+£2 p&p |
| Garrard SP25 Mk. III with MAG. cartridge plinth and cover | £23·00+£1·50 p&p |
| Total | £59·00 |

**Available complete for only £52 + £3·50 p&p**

SYSTEM 2

| | |
|---|---|
| Viscount R101 amplifier | £22·00+90p p&p |
| 2 x Duo Type III speakers | £32·00+£3 p&p |
| Garrard SP25 Mk. III with MAG. cartridge, plinth and cover | £23·00+£1·50 p&p |
| Total | £77·00 |

**Available complete for £69+£4 p&p**

SYSTEM 3

| | |
|---|---|
| Viscount III Amplifier R100 | £17·00+90p p&p |
| 2 x Duo Type II speakers, pair | £14·00+£2 p&p |
| Garrard SP25 Mk. III with CER, diamond cartridge, plinth and cover | £21·00+£1·50 p&p |
| Total | £52·00 |

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

**SPEAKERS**

**Duo Type II**

Size approx. 17in 10¾in 6¾in. Drive unit 13in 8in with parasitic tweeter. Max. power 10 watts, 3 ohms. Simulated Teak cabinet. **£14 pair** + £2 p&p.

**Duo Type III**

Size approx. 23½in 11½in 9½in. Drive unit 13½in 8¼in with H.F. speaker. Max. power 20 watts at 3 ohms. Freq. range 20Hz to 20kHz. Teak veneer cabinet. **£32 pair** + £3 p&p.

**SPECIFICATION** R101

14 watts per channel into 3 to 4 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) R101—P.U.1 and radio -65dB. P.U.2 -58dB. **R100** same as R101 but P.U.2 (for crystal cartridges) 450mV into 3 Meg. *Cross talk* better than -35dB on all inputs. *Overload characteristics* better than 26dB on all inputs. Size approx. 13¾in × 9in × 3¾in.

*Goods not despatched outside U.K.*

RTVC

S.A.E. for fully illustrated leaflet.

**Radio and TV Components (Acton) Ltd.**
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**323 Edgware Road, London, W2.** Mail orders to Acton. Terms C.W.O. *All enquiries S.A.E.*

## VARIABLE VOLTAGE TRANSFORMERS

**INPUT 230/240V a.c. 50/60 OUTPUT VARIABLE 0.260V**
**All Types from ½ to 50 amp from stock.**

**SHROUDED TYPE**

| | |
|---|---|
| 1 amp, £7·00 | 20 amp, £49·00 |
| 2·5 amp, £8·05 | 25 amp, £58·00 |
| 5 amp, £11·75 | 37·5 amp, £82·00 |
| 10 amp, £22·50 | 50 amp, £98·00 |
| 15 amp, £25·00 | |

**2·5 amp OPEN TYPE**
(Panel Mounting) ½ amp, **£4·75.** 1 amp, **£7·00.** 2½ amp, **£8·05.** All carriage paid.

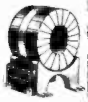
## L.T. TRANSFORMERS

All primaries 220–240V

| Type No. | Sec. Taps | Price | Carr. |
|---|---|---|---|
| 1 | 30, 32, 34, 36V at 5A | £4·68 | 45p |
| 2 | 30, 40, 50V at 5A | £6·88 | 45p |
| 3 | 10, 17, 18V at 10A | £4·95 | 45p |
| 4 | 6, 12V at 20A | £6·43 | 45p |
| 5 | 17, 18, 20V at 20A | £7·28 | 55p |
| 6 | 6, 12, 20V at 20A | £6·88 | 55p |
| 7 | 24V at 10A | £5·23 | 45p |
| 8 | 4, 6, 24, 32V at 12A | £7·15 | 45p |
| 9 | 6 and 12V at 10A | £3·75 | 45p |

## RING TRANSFORMERS

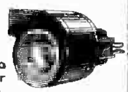
*Functional Versatile Educational*



These multi-purpose Auto Transformers, with large centre aperture, can be used as a Double wound current Transformer, Auto Transformer, H.T. or L.T. Transformer, by simply hand winding the required number of turns through the centre opening. E.g. Using the RT.100 VA Model the output could be wound to give 8V @ 12½A., 4V. @ 25A. or 2V. @ 50A., etc.

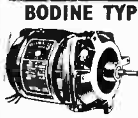
Price:
RT.100VA 3·18 turns per V. **£2·25** + 28p P. & P.
RT.300VA 2·27 turns per V. **£4·20** + 38p P. & P.
RT.1KVA 1·82 turns per V. **£6·50** + 58p P. & P.
RT.2KVA 1·5 turns per V. **£10·50** + 80p P. & P.
RT.3KVA 1·5 turns per V. **£14·00** + 80p P. & P.

## 220/240 VOLT A.C. CENTRIFUGAL FAN/BLOWER



Smooth, balanced running unit. Two pole shaded pole Mycalex motor gives approximately 90 cubic ft./min. but draws only 240mA on run. Weight 2½lb. Case dia. 3·1in, width (case only) 3·125in, width overall (inc. motor) 5·25in, aperture 3·125in × 1·85in. Price only **£2·95.** P. & P. 25p.

## BODINE TYPE N.C.I. GEARED MOTOR



**(Type 1) 71 r.p.m** Torque 10lb. inch. **Reversible.** 1/70th h.p., 50 cycle, 0·38 amp. **(Type 2) 28 r.p.m.** Torque 20lb. inch. **Reversible.** 1/80th h.p., 50 cycle, 0·28 amp. "As new" condition. Input voltage of motor 115V a.c. Supplied complete with transformer for **230/240V a.c. input.** Price, either type **£3·15** plus 35p. P. & P. or less transformer **£2·13** plus 27p P. & P.

## 12 VOLT D.C. MOTOR

Powerful 1 amp. REVERSIBLE motor. Speed 3,750 r.p.m. complete with external gear train (removable) giving approx. final speed of either 125 r.p.m. or 240 r.p.m. Size: 4½in × 2½in dia. Either type price **95p** inc. post.

## 230V/240V COMPACT SYNCHRONOUS GEARED MOTORS

Manufactured by either Sangamo, Haydon or Smith. Built-in gearbox.

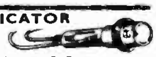
| | | |
|---|---|---|
| 1 r.p.m. cw. | 1 r.p.h. a/cw. | 10 r.p.h. a/cw. |
| 60 r.p.m. cw. | 2 r.p.h. cw. | 15 r.p.h. a/cw. |
| | 3 r.p.h. a/cw. | 20 r.p.h. cw. |
| | 6 r.p.h. cw. | 30 r.p.h. cw. |

cw. = clockwise rotation; a/cw. = Anticlockwise. Fraction of makers' price. All at **75p** incl. P. & P.

## 6-12V D.C. MINI-MOTOR

Small, powerful, precision made, smooth running, reversible motor. 7,000 r.p.m. Weight only 2oz. **£1** incl. P. & P.

**200-250V A.C. NEON INDICATOR**

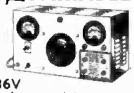


Available in red or amber at **20p** each. Or in green at **32p** each. Minimum order 3 units. P. & P. 5p.

## VENNER Electric Time Switch

200/250V Ex. GPO. Tested. Manually set 2 on, 2 off every 24h. Override switch: 10A **£2·75**, 15A **£3·25**, 20A **£3·75**. P. & P. 20p. Also available with solar dial ON dusk, OFF dawn. Price as above.

## 36V 30 AMP. A.C. OR D.C. VARIABLE L.T. SUPPLY UNIT



**INPUT**
220/240V a.c.
**OUTPUT**
CONTINUOUSLY VARIABLE 0–36V
Fully isolated. Fitted in robust metal case with Voltmeter, Ammeter Panel Indicator and handles. Input and output fully fused. Ideally suited for Lab. or Industrial use. **£68** plus £2 P. & P.

## 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 36 Flash per sec. All electronic components including Veroboard S.C.R. Unijunction Xenon Tube and instructions **£6·30**, plus 25p P. & P.

**NEW INDUSTRIAL KIT**
Ideally suitable for schools, laboratories, etc. Roller tin printed circuit. New trigger coil, plastic thyristor. Speed adjustable 1-80 f.p.s. Price **£10·50.** P. & P. 50p.

**HY-LYGHT STROBE MK III**
This strobe has been designed and produced for use in large rooms, halls and the photographic field and utilises a silica plug-in tube for longer life expectancy, printed circuit for easy assembly, also a special trigger coil and output capacitor. Speed adjustable 0-30 f.p.s. Light output approx. 4 joules. **£12·00.** P. & P. 50p. **SPECIALLY DESIGNED. FULLY VENTILATED METAL CASE.** For industrial or Hy-Lyght. Including reflector. **£4·00** P. & P. 45p. Post paid with kit.

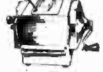
## *THE 'SUPER' HY-LYGHT KIT*

Approx. four times the light output of our well proven Hy-Lyght strobe. Incorporating:
- Heavy duty power supply.
- Variable speed from 1-23 flash per sec.
- Reactor control circuit producing an intense white light.

Never before a Strobe Kit with so HIGH an output at so LOW a price. ONLY **£20** plus 75p P. & P. **ATTRACTIVE, ROBUST, FULLY VENTILATED METAL CASE** specially designed for the Super Hy-Lyght Kit including reflector **£7·00** P. & P. 45p.

**7-inch POLISHED REFLECTOR**
Ideally suited for above Strobe kits. Price **53p**, P. & P. 13p or post paid with kits.

## 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, **£34·00** carriage paid.

**MOTOROLA MAC 11/6 PLASTIC TRIAC 400 PIV. 10 AMP**
Now available **EX STOCK.** Supplied with full data and applications sheet. Price **£1·05.** P. & P. 7p. Suitable DIAC (RCA 40583) **30p** each.

**240V A.C. SOLENOID FLUID VALVE**

Will handle liquids or gases up to 7 p.s.i. Forged brass body, stainless steel core and spring. ½in b.s.p. inlet/outlet. Precision made, British mfg. PRICE: **£1·75.** P. & P. 20p. Special quotation for quantity. *(New in makers' carton)*

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(Mfg. by Magnetic Devices Ltd.). 240v A.C. 5 r.p.m. 'Crouzet' motor. Drives 15 cams, each operating a 10 amp c/o micro switch. Cams are individually variable, allowing innumerable combinations. Ideally suited for machinery control, automation, etc. Also in the field of entertainment, for chaser lights, animated displays, etc. NEW PRICE **£5·75.** P. & P. 25p.

## D.C. AMMETERS *NEW!*

1A, 5A, 15A, 20A, **£1·75**, incl. P. & P. 0–300V a.c., **£1·90**, incl. P. & P.

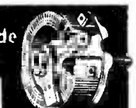
## 230V A.C. SOLENOID

**Extremely powerful** with approx. 14lb pull, 1in travel. Fitted with mounting feet. Size: 4in long, 2¾in wide, 3in high. **£2·00** incl. P. & P.

**230-250 VOLT A.C. SOLENOID**
Manufactured by Westool Ltd. (similar in appearance to above illustration). Approx. 1½lb pull. Feet size 1¾in × 1¼in. Price **85p** incl. P. & P.

**18-24 VOLT D.C. SOLENOID**
Size: O.A.L. 3¼in × 1¼in × 1in. Max. push ½ at 1lb. approx. **PRICE: 75p** incl. P. & P.

## Superior Quality Precision Made NEW POWER RHEOSTATS



**100 WATT. 1 ohm, 10A; 5 ohm 4·7A; 10 ohm, 3A; 25 ohm, 2A 50 ohm, 1·4A; 100 ohm, 1A 250 ohm, 0·7A; 500 ohm, 0·45A; 1 kΩ, 280 mA; 1·5 kΩ, 230mA; 2·5 kΩ, 2A; 5 kΩ, 140mA.** Diameter 3½in Shaft length ⅜in, dia. ¼in. All at **£1·50** each. P. & P. 5p.
**50 WATT.** 1/5/10/25/50/100/250/500/1/1·5/2·5/5kΩ. **All at £1·12 each.** P. & P. 11p.
**25 WATT.** 10/25/50/100/250/500/1/1·5/2·5/3·5/5kΩ. **All at 78p each.** P. & P. 15p.
**Black Silver Skirted knob** calibrated in Nos. 1-9. 1½in. dia brass bush. Ideal for above Rheostats, **18p** ea.

## RELAYS SIEMENS, PLESSEY, Etc.

**MINIATURE RELAYS**

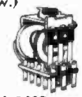
Col. (1) Coil ohms
Col. (2) Working d.c. volts
Col. (3) Contracts
Col. (4) Price
HD = Heavy duty
*Incl. Base
Post paid.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| 45 | 6–9 | 2 HD M | 50p |
| 185 | 12–18 | 4 c/o | 73p |
| 280 | 9–12 | 2 c/o | 73p* |
| 700 | 16–24 | 4M 2B | 63p* |
| 700 | 16–24 | 4 c/o | 78p* |
| 700 | 12–24 | 2 c/o | 63p* |
| 700 | 15–35 | 2 c/o HD | 73p* |
| 700 | 16–24 | 6M | 65p* |
| 1,250 | 24–36 | 4 c/o | 63p* |
| 2,500 | 36–45 | 6M | 63p* |
| 2,400 | 30–48 | 4 c/o | 50p |
| 9,000 | 40–70 | 2 c/o | 50p* |
| 15k | 85–110 | 6M | 50p* |

## 12 VOLT D.C. RELAY

Three sets c/o contacts rated at 5 amps. **78p** including P. & P. (Similar to illustration below.)

**'DIAMOND H' 230 VOLT A.C. RELAYS (Unused)**

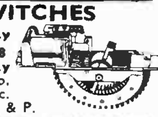


Three sets c/o contacts rated at 5 amps. PRICE: **50p.** P. & P. 10p. (100 lots **£40** including P. & P.)

**'KEY SWITCH' 230 VOLT A.C. RELAYS**
One set c/o contacts rated at 7·5 amps. Boxed. PRICE: **40p.** P. & P. 5p. (100 lots **£32** including P. & P.)

**MINIATURE RELAYS**
9-12V d.c. operation. Two c/o 500 M.A. contacts. Size only 1in × ⅞in × ½in. Price **58p** post paid. 30-36V d.c. operation. Two c/o 500 M.A. contacts. 3,200 ohm coil. Size only 1in × ⅞in × ⅞in. **43p** post paid.

## UNISELECTOR SWITCHES

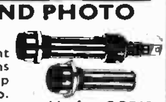


***NEW* 4 Bank 25 Way** 24V d.c. operation. **£5·88** P. & P. 12p. **6 Bank 25 Way** 24V d.c. **£6·50**, P. & P. **12p.** **8 Bank 25 Way,** 24V d.c. operation. **£7·62** plus **22p.** P. & P.

## G.E.C. 12 WAY 15 AMP CONNECTORS

NEW in makers carton. BAKELITE **£1·25** per doz. FLEXIBLE **£1·50** per doz. Post paid (Minimum 1 doz).

## LIGHT SOURCE AND PHOTO CELL MOUNTING



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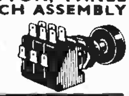

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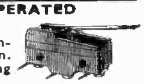

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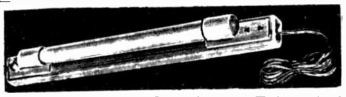

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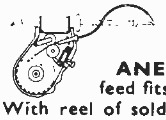

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