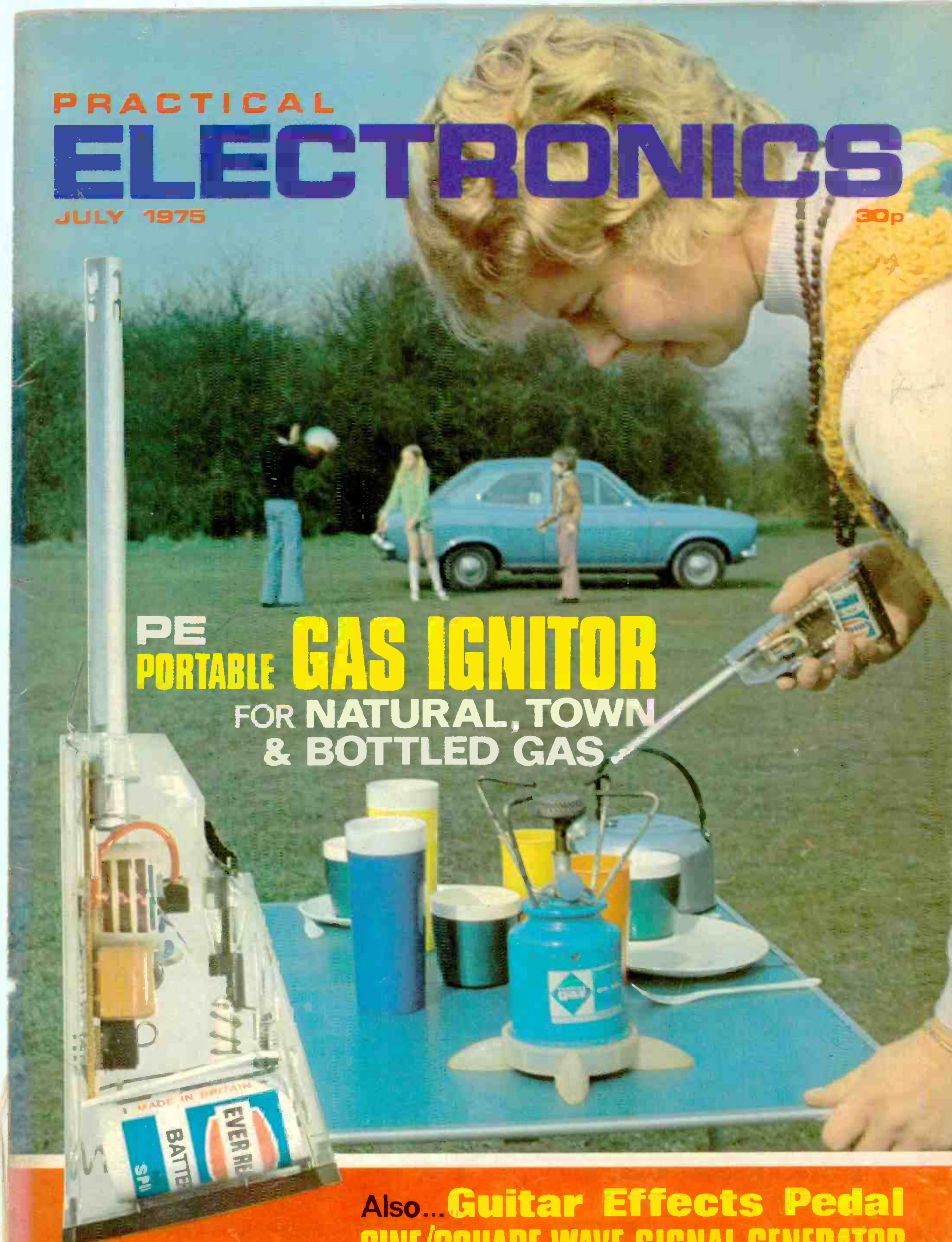
PRACTICAL

ELECTRONICS

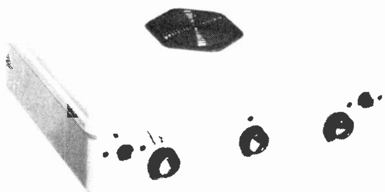
JULY 1975

30p



PE PORTABLE **GAS IGNITOR**
FOR NATURAL, TOWN & BOTTLED GAS

Also... **Guitar Effects Pedal**
SINE/SQUARE WAVE SIGNAL GENERATOR



NEW EDU-KIT MAJOR

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

- 4 Transistor Earpiece Radio
- Signal Tracer
- Signal Injector
- Transistor Tester NPN —PNP
- 4 Transistor Push Pull Amplifier
- 5 Transistor Push Pull Amplifier
- 7 Transistor Loudspeaker Radio MW/LW.
- 5 Transistor Short Wave Radio
- Electronic Metronome
- Electronic Noise Generator
- Batteryless Crystal Radio.
- One Transistor Radio
- 2 Transistor Regenerative Radio
- 3 Transistor Regenerative Radio
- Audible Continuity Tester
- Sensitive Pre-Amplifier

Components include:

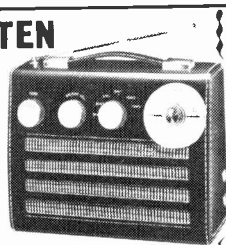
- 24 Resistors ● 21 Capacitors ● 10 Transistors ● 3½" Loudspeaker ● Earpiece ● Mica Baseboard
- 3 12-way Connectors ● 2 Volume Controls ● 2 Slider Switches ● 1 Tuning Condenser ● 3 Knobs
- Ready Wound MW/LW/SW Coils ● Ferrite Rod ● 6½ yards of wire ● 1 yard of sleeving, etc.
- Parts price list and plans 55p (free with parts)

TOTAL BUILDING COSTS

£7·23 (+25% VAT £1·80) **P.P. & Ins. 58p (Overseas Seamail P. & P. £3·40)**

ROAMER TEN Mk. II

WITH VHF INCLUDING AIRCRAFT



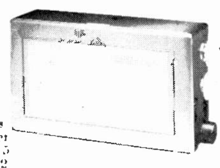
Now with free earpiece and switched socket.

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

Latest 4" 2 watt Ferrite Magnet Loudspeaker. Built-in ferrite rod aerial for MW/LW Chrome plated 6 section telescopic aerial, can be angled and rotated for peak short wave and VHF listening. Push-pull output using 600mW transistors. Car Aerial and tape record sockets. 10 transistors plus 3 diodes. Ganged tuning condenser with VHF section. Separate coil for Aircraft Band. Volume/on/off, wave change and tone controls. Attractive case in black with silver blocking. Size 9in × 7in × 4in. Easy to follow instructions and diagrams. Parts price list and plans 50p (FREE with parts).

TOTAL BUILDING COSTS £9·50 (+25% VAT £2·37) **P.P. & Ins. 65p (Overseas Seamail P. & P. £3·50)**

POCKET FIVE



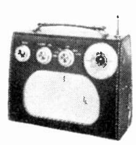
NOW WITH 3" LOUDSPEAKER

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

Total Building Costs £2·95 (+25% VAT 75p) **P.P. & Ins. 38p (Overseas Seamail P. & P. £2·30)**

ROAMER EIGHT Mk. I

NOW WITH VARIABLE TONE CONTROL

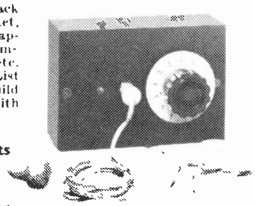


7 TUNABLE WAVEBANDS: MW1, MW2, LW, SW1, SW2, SW3 AND TRAWLER BAND. Built-in ferrite rod aerial for MW and LW. Chrome plated telescopic aerial can be angled and rotated for peak short-wave listening. Push-pull output using 600mW transistors. Car aerial and tape record sockets. Selectivity switch. 8 transistors plus 3 diodes. Latest 4" 2 watt Ferrite Magnet loudspeaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9in × 7in × 4in approx. Easy to follow instructions and diagrams. Parts price list and plans free with parts.

TOTAL BUILDING COSTS £6·98 (+25% VAT £1·75) **P.P. & Ins. 65p (Overseas Seamail P. & P. £3·50)**

NEW JIFFY TESTER

Easy to build and operate, fits in the pocket. A quick checker for continuity of resistors, chokes, diodes, transistors, circuit wiring (not mains) and loudspeakers. Also for checking short circuits of capacitors, tuning capacitors and many other uses not listed here. See instruction sheet free with kit.



Complete with earpiece, jack plug and socket, resistors, capacitors, components, etc. Parts Price List and Easy Build Plans free with Parts

Total Building Costs £2·25 (+25% VAT 56p) **P.P. & Ins. 22p (Overseas Seamail P. & P. £1·70)**

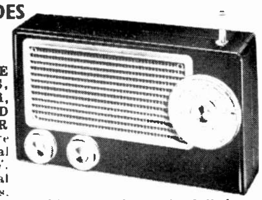
NEW EVERYDAY SERIES EV6

Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2¾ins. approx. 6 Transistors and 3 diodes. Powered by 9 volt Battery. Ferrite rod aerial, 3" loudspeaker, etc., MW/LW coverage. Push Pull Output. Parts price list and plans free with parts.

TOTAL BUILDING COSTS £3·98 (+25% VAT £1·00) **P.P. & Ins. 50p (Overseas Seamail P. & P. £2·30)**

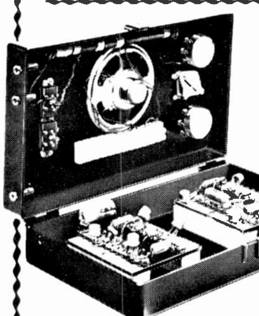
TRANS EIGHT

8 TRANSISTORS AND 3 DIODES



6 TUNABLE WAVEBANDS, MW, LW, SW1, SW2, SW3 AND TRAWLER BAND. Sensitive ferrite rod aerial for MW and LW. Telescopic aerial for short waves. 3in speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9in × 5½in × 2½in approx. Push-pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and plans free with parts.

TOTAL BUILDING COSTS £4·78 (+25% VAT £1·20) **P.P. & Ins. 50p (Overseas Seamail P. & P. £2·50)**



"Edu-Kit"

Build Radios, Amplifiers, etc., from easy stage diagrams. Five units including master unit to construct.

Components include: Tuning Condenser: 2 Volume Controls: 2 Slider Switches: Fine tone 3" moving coil Speaker: Terminal Strip: Ferrite Rod Aerial: Battery Clips: 4 Tag Boards: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three ½in Knobs. Units once constructed are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schools, Educational Authorities and all those interested in radio construction. Parts price list and plans free with parts.

TOTAL BUILDING COSTS £5·50 (+25% VAT £1·37) **P.P. & Ins. 50p (Overseas Seamail P. & P. £3·40)**

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POCKET FIVE	☐	EDU-KIT	☐

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PE7

PRACTICAL
ELECTRONICS
VOLUME 11 No. 7 JULY 1975

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

NEWS AND COMMENT

Our August issue will be published on Friday, July 11, 1975

CHROMASONIC electronics

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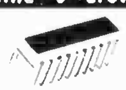

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Type 101 RED £2.26 ●

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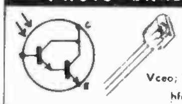

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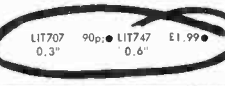
enables

LIT707 0.3" 90p; ● LIT747 0.6" £1.99 ●



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Pins	8	14	16	24	28	36	40	8	10
● Price	13p	15p	15p	26p	30p	39p	44p	31p	35p

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Litronix Double Digit Displays 0.5"; Common Anode ± 2 R/H D.P.'s
DL721 gives ± 1.9
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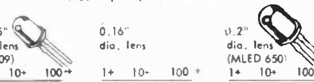
Suitable for Clocks; Instruments, T.V. Channel Indicator
Our Price £4.75 each. ●

L.E.D.'s

Free snap-on plastic retainer



	0.125" dia. lens (TIL209) 1+	10+	100+	0.16" dia. lens 1+	10+	100+	0.2" dia. lens (MLED 650) 1+	10+	100+
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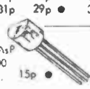
Green	27p	24p	22p ●	33p	30p	27p ●	30p	27p	25p ●
Orange	27p	24p	22p ●	33p	30p	27p ●	30p	27p	25p ●
Yellow	34p	31p	29p ●	35p	32p	29p ●	35p	33p	30p ●



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	ORANGE	MAN3610	MAN3620	MAN3630	MAN3640	£1.82 ●
	GREEN	XAN51	XAN52	-	XAN54	£1.49 ●
	RED	XAN71	XAN72	-	XAN74	£1.49 ●
	YELLOW	XAN81	XAN82	-	XAN84	£1.49 ●
0.4"	GREEN	MAN4510	MAN4520	MAN4530	MAN4540	£2.32 ●
	RED	MAN4710	MAN4720	MAN4730	MAN4740	£2.32 ●
	YELLOW	MAN4810	MAN4820	MAN4830	MAN4840	£2.32 ●
	ORANGE	MAN4610	MAN4620	MAN4630	MAN4640	£2.32 ●
		C.A. L/H Dec. Pt.	C.A. ± 1	C.C. L/H Dec. Pt.	C.C. ± 1	
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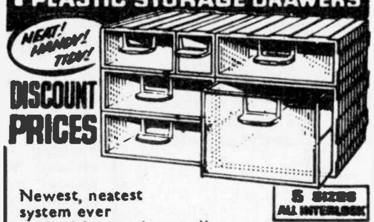

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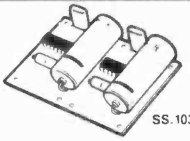

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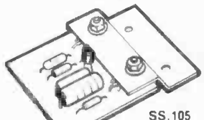

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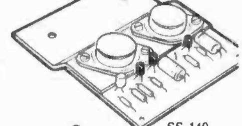
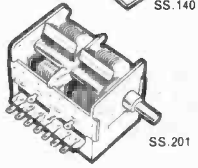


SS.140



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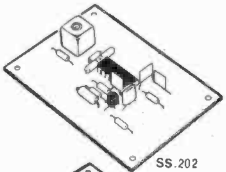

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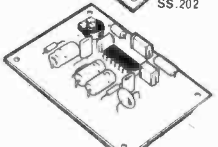

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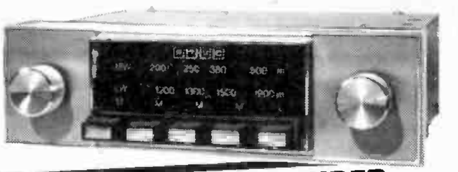

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INPUT SENSITIVITIES – Input – 1). Crystal mic. guitar or moving coil mic. 2 and 10mV. (Selector switch for desired sensitivity.) – Inputs – 2), 3), 4). Medium output equipment – ceramic cartridge, tuner, tape recorder, organs, etc. – all 250mV sensitivity. AC Mains, 240V operation. Size approx: 12½"×6"×3½".

£20.00+£1.35 p & p.

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Elegant self selector push button player for use with your stereo system. Compatible with Viscount IV system, Unisound module and the Stereo 21. Technical specification Mains input, 240V, Output sensitivity 125mV. Comparable unit sold elsewhere at £24.00 approx. Yours for only

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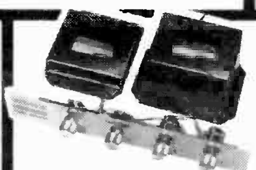

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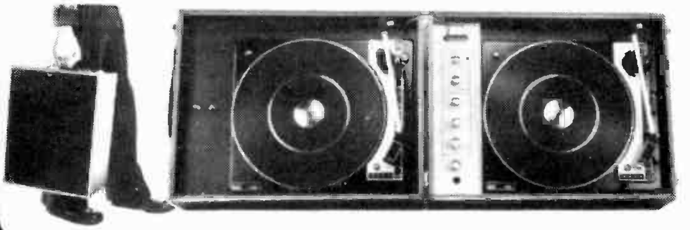
INCORPORATES: Pre-Amp with full mixing facilities, including switched input for mic with volume control, switched input for auxiliary with volume control, bass and treble controls, volume control and blend control for turntables. Two B.S.R. MP60 type single play professional series decks, fitted with crystal cartridges.



TECHNICAL SPECIFICATION:
Pre-amp – Output – 200mV. Auxiliary inputs – 200mV and 750mV into 1 meg. Mic input – 6mV into 100K. 240 volt operation. **Turntables capacity** – 7", 10" or 12" records. **Rumble, wow and flutter** Rumble Better than –35dB. Wow Better than 0.2%. Flutter Better than 0.06% (Gaumont kalee meter).
Finish – Satin black mainplate with black turntable mat inlaid with brushed aluminium trim. Tonearm and controls in black and brushed aluminium.

Console size –
Unit Closed – 17¾"×13¾"×8¾" (app.)
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This disco console is ideally matched for the Reliant IV and Disco 50 or any other quality amplifier.
The unit is finished in black PVC with contrasting simulated teak edging, diamond spun control knobs with matching control panel.

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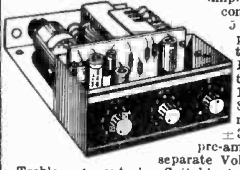

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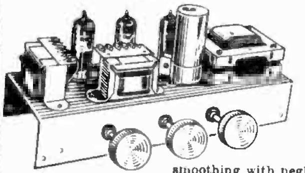
DE LUXE STEREO AMPLIFIER



A.C. mains 200-240 v. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line-up:-2 × ECL86 Triode Pentodes. 1 × EZ80 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300m/v for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11"w × 4"d. Overall height including valves 5". Ready built and tested to a high standard. £12·50. P. & P. 85p.

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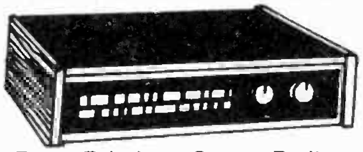

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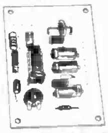

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Overall Size 12"w. × 8"d. × 2¾"h.
Fully detailed 7 page construction manual and parts list free with kit or send 25p plus large S.A.E.

AMPLIFIER KIT	£15·00	P. & P. 50p
(Magnetic input components 33p extra)		
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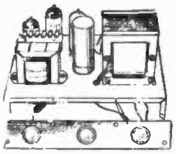
Full after sales service
Also available ready built and tested £32·50. Post Free.
Note: The above amplifier is suitable for feeding two mono sources into inputs (e.g. mike, radio, twin record decks, etc.) and will then provide mixing and fading facilities for medium powered Hi-Fi Discotheque use, etc.

3-VALVE AUDIO AMPLIFIER HA34 MK II.



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7¾"w. × 4"d. × 4½"h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only £7·75. P. & P. 70p.
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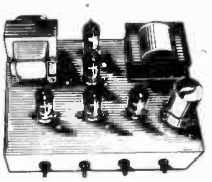
10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3–15Ω speaker and 2 independent volume controls, and separate base and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 25p × SAE (Free with parts). All parts sold separately. ONLY £12·00. P. & P. £1·00. Also available ready built and tested £16·50. P. & P. £1·00.

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7416	22	7485	80	74176	95
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7423	22	7491	71	74182	80
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7426	23	7493	44	74185	1·45
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7432	22	7496	55	74192	90
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7438	21	74105	60	74194	95
7440	11	74107	27	74195	80
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555	Timer	mDIP	44
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566	Function Gen	mDIP	1·20
567	Tone Decoder	mDIP	1·20
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710	Hi Speed Volt Comp	DIP	21
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739	Dual Hi Perf Op Amp	DIP	65
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748	Freq Adj 741	mDIP	27
1304	FM Mulpx Stereo Demod	DIP	65
1307	FM Mulpx Stereo Demod	DIP	45
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75452	Dual Peripheral Driver	mDIP	21
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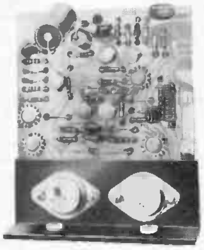
120 watt module complete with built-in supply—extra heavy duty £24·75 Carr. 60p



THE SA100 MODULE

POWER SUPPLIES

UNSTABILISED —READY WIRED AND FUSED

PU45	Suits 2 SA35 or 1 SA50 (4 ohm)	**£6·50**	Carriage 50p
PU70	Suits 2 SA50 or 2 SA100 (8 ohm)	**£9·50**	Carriage 60p

STABILISED

PS45	Suits 2 SA35 or 2 SA50 (4 ohm)	**£5·50**	Carriage free
MT45	Transformer for above	**£3·90**	Carriage 50p
PS70	Suits 2 SA100	**£6·50**	Carriage free
MT70	Transformer for above	**£5·50**	Carriage 60p

N.B. PS70 is not suitable for the SA50

Mk II STEREO DISCO MIXER £29·50

Carr. 50p

This well tried Pre-Amp mixes two decks, handles any ceramic cartridge, and features mic over-ride plus separate full range bass and treble controls on both mic and deck inputs. Ample headphone power is available for P.F.L. May be used for mono and is mains operated. Fitted with sturdy screening case. Controls: Mic vol, bass, treble. Left/Right fade, deck volume, bass, treble, h/phone select, vol, Mains. Size 17½in × 3in × 4in deep.

DISCO MODULE £12·50 Carr. 50p

Thousands sold of this extremely popular mono Pre-Amp. A mic input may be fitted using the VA30 (see below). Low consumption from a 9V battery. Features the same high standards of reproduction as the Stereo version. Controls: H/phone select, vol, Left deck vol, Right deck vol, bass, treble, master vol. Size 12¾in × 3in × 2in deep.

3-CHANNEL SOUND-LITE £24·75 Carr. 50p

Only SAXON can supply such incredible value for money. This unit features 3kW power handling, full-wave control, bass, middle, treble AND master controls. Twin loudspeaker jacks for "through" connections. It may be used free standing or will panel mount next to either of the above. Also features unique CUT-BACK circuitry for extra wide range response. Size 12in × 3in × 2¼in deep. Professional standards at a price you can afford!

SINGLE CHANNEL VERSION £7·90 Carr. free — High sensitivity, compact, handles 1kW. Full wave operation

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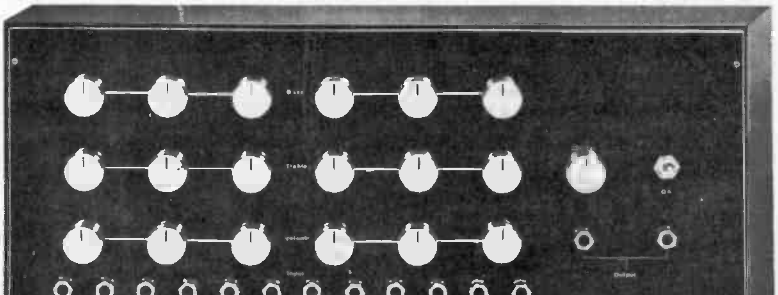
MULTI-PURPOSE MIXERS

M4HL **£25·00** Carr. 60p
M6HL **£35·00** Carr. 60p

Featuring multiples of our VA30 module, the M4HL and M6HL fulfil the requirements of all clubs, groups, etc. where a high quality mixer is required. Each channel has one high and one low impedance input, plus volume, treble and bass controls. Input impedances may, if required, be easily changed. The M4HL has four channels, and one output, and the M6HL six channels (12 inputs) and a master control and two outputs. Either unit may be used free-standing or panel mounted. These mixers will feed all types of amplifier. Recommended for their versatility and high performance, and excellent value for money.

VA30 CHANNEL MODULE £3·90 Carr. free

This is the basic channel module in the above mixers and may also be used for extra inputs on either the mono or stereo mixers. Fitted with volume, bass and treble controls, requires just a jack and supply (9–100V)



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COMPLETE AMPLIFIER

£39·90
Carr. 60p

100W of speech and music—Two separately controlled inputs. Wide range bass and treble controls. Sturdy and attractive vynide case. Twin outputs. Ideal for groups, discos, etc. Fully tested and guaranteed. 50W version identical in appearance.

CSE 50
£33·00 Carr. 60p

NEW!!

SAXON MULTIMIX 100 £57 CARR. £1·00

100W RMS **SLIDER** controls **PLUS** master slider.
Wide range bass and treble controls—fantastic value.
Ideal for complete Disco's, Groups, Clubs, etc.

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CH3. 7·5mH 31p CH4. 10mH 33p
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COILS
DRX1 Crystal set 31p DRR2 Dual range 45p

COIL FORMERS & CORES
NORMAN ¼" Cores & Formers 8p
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SWITCHES
DP/DT Toggle 36p SP/ST Toggle 30p

FUSES
1¼" and 20mm. 100mA, 200mA, 250mA, 500mA, 1A, 1·5A, 2A
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DYNAMIC MICROPHONES
B1223. 200 ohms plus on/off switch and 2·5mm and 3·5mm plugs £1·85

3-WAY STEREO HEAD-PHONE JUNCTION BOX
H1012 £1·87

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

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(Angled) £3·85 per pair.

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(Black Vinyl covered)

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BV2	11"	×	6"	×	3"	£1·75

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BA1	5¼"	×	2¼"	×	1½"	49p
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BA4	5¼"	×	4"	×	1½"	58p
BA5	4"	×	2½"	×	2"	49p
BA6	3"	×	2"	×	1"	42p
BA7	7"	×	5"	×	2½"	85p
BA8	8"	×	6"	×	3"	£1·10
BA9	6"	×	4"	×	2"	70p

P. & P. 15p on each box

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Model 42 £1·95
Chrome Finish
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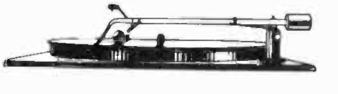

Ref. 36A. Record/Stylus Cleaning Kit 33p
Ref. 43. Record Care Kit £2·42
Ref. 31. Cassette Head Cleaner 58p
Ref. 32. Tape editing Kit £1·68
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CCN 240. 15 watt £2·48
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SOLDER: 18SWG Multicore 7oz £1·61
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Bits No.		
102	For model CN240 3/32"	42p
104	For model CN240 1/16"	42p
1100	For model CCN240 3/32"	42p
1101	For model CCN240 ⅛"	42p
1102	For model CCN240 ¼"	42p
1020	For model G240 3/32"	42p
1021	For model G240 ⅛"	42p
1022	For model G240 3/16"	42p
50	For model X25 3/32"	48p
51	For model X25 ⅛"	48p
52	For model X25 3/16"	48p

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EG 240 £1·07 EX 25 £1·16

ANTEX HEAT SINKS 10p

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

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Pack No.	Qty.	Description	Price
C1	200	Resistors mixed values approx. count by weight	0·54
C2	150	Capacitors mixed values approx. count by weight	0·54
C3	50	Precision Resistors mixed values	0·54
C4	75	⅛th W Resistors mixed preferred values	0·54
C5	5	Pieces assorted Ferrite Rods	0·54
C6	2	Tuning Gangs, MW/LW VHF	0·54
C7	1	Pack Wire 50 metres assorted colours	0·54
C8	10	Reed Switches	0·54
C9	3	Micro Switches	0·54
C10	15	Assorted Pots & Pre-Sets	0·54
C11	5	Jack Sockets 3 × 3·5m 2 × Standard Switch Type	0·54
C12	30	Paper Condensers preferred types mixed values	0·54
C13	20	Electrolytics Trans. types	0·54
C14	1	Pack assorted Hardware—Nuts/Bolts, Grommets, etc.	0·54
C15	5	Mains Slide Switches	0·54
C16	20	Assorted Tag Strips & Panels	0·54
C17	10	Assorted Control Knobs	0·54
C18	4	Rotary Wave Change Switches	0·54
C19	2	Relays 6—24V Operating	0·54
C20	1	Pack Sheets of Copper Laminate approx. 20 sq. ins.	0·54

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PLUGS		
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PS 2	D.I.N. 3 Pin	0·12
PS 3	D.I.N. 4 Pin	0·15
PS 4	D.I.N. 5 Pin 180°	0·16
PS 5	D.I.N. 5 Pin 240°	0·16
PS 6	D.I.N. 6 Pin	0·17
PS 7	D.I.N. 7 Pin	0·18
PS 8	Jack 2·5mm Screened	0·18
PS 9	Jack 3·5mm Plastic	0·12
PS 10	Jack 3·5mm Screened	0·18
PS 11	Jack ¼" Plastic	0·15
PS 12	Jack ¼" Screened	0·22
PS 13	Jack Stereo Screened	0·36
PS 14	Phono	0·10
PS 15	Car Aerial	0·22
PS 16	Co-Axial	0·15
INLINE SOCKETS		
PS 21	D.I.N. 2 Pin (Speaker)	0·14
PS 22	D.I.N. 3 Pin	0·20
PS 23	D.I.N. 5 Pin 180°	0·20
PS 24	D.I.N. 5 Pin 240°	0·20
PS 25	Jack 2·5mm Plastic	0·16
PS 26	Jack 3·5mm Plastic	0·16
PS 27	Jack ¼" Plastic	0·30
PS 28	Jack ¼" Screened	0·35
PS 29	Jack Stereo Plastic	0·30
PS 30	Jack Stereo Screened	0·38
PS 31	Phono Screened	0·18
PS 32	Car Aerial	0·22
PS 33	Co-Axial	0·22
SOCKETS		
PS 35	D.I.N. 2 Pin (Speaker)	0·08
PS 36	D.I.N. 3 Pin	0·11
PS 37	D.I.N. 5 Pin 180°	0·11
PS 38	D.I.N. 5 Pin 240°	0·11
PS 39	Jack 2·5mm Switched	0·12
PS 40	Jack 3·5mm Switched	0·12
PS 41	Jack ¼" Switched	0·20
PS 42	Jack Stereo Switched	0·30
PS 43	Phono Single	0·08
PS 44	Phono Double	0·10
PS 46	Co-Axial Surface	0·10
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LEADS
LS 1 Speaker Lead 2 pin D.I.N. plug to open ends approx 3 metres long (coded) 0·20

CABLES

CP 1	Single Lapped Screen	0·07
CP 2	Twin Common Screen	0·11
CP 3	Stereo Screened	0·12
CP 4	Four Core Common Screen	0·23
PC 5	Four Core Individually Screened	0·30
CP 6	Microphone Fully Braided Cable	0·10
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CP 8	Twin Oval Mains Cable	0·07
CP 9	Speaker Cable	0·05
CP 10	Low Loss Co-Axial	0·18

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Log and Lin
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VC 2	Single D.P. Switch	0·28
VC 3	Tandem Less Switch	0·46
VC 4	1K Lin Less Switch	0·15
VC 5	100 K anti-Log	0·46

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240V. Primary. Secondary voltages available from selected tappings 4V, 7V, 8V, 10V, 14V, 15V, 17V, 19V, 21V, 25V, 31V, 33V, 40, 50 and 25V–0–25V.

Type	Amps	Price	P. & P.
MT50/1	1	£2·42	48p
MT50/2	2	£3·30	60p

CARTRIDGES
ACOS

GP91-18C 200mV at 1·2cm/sec	£1·35
GP93-1 280mV at 1cm/sec	£1·85
GP96-1 100mV at 1cm/sec	£2·80
J-2005 Crystal/Hi Output	£1·05
J-2010C Crystal/Hi Output Compatible	£1·20
J-2006S Stereo/Hi Output	£1·75
J-2105 Ceramic/Med Output	£1·95
J-2203 Magnetic 5mV/5cm/sec, including stylus	£4·95
J-2203S Replacement stylus for above	£3·00
AT-55 Audio-technica magnetic cartridge 4mV/5cm/sec	£3·30

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

R1	50 Mixed 100 ohms–820 ohms	50p
R2	50 Mixed 1kΩ–8·2kΩ	50p
R3	50 Mixed 10kΩ–82kΩ	50p
R4	50 Mixed 100kΩ–1MΩ	50p

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

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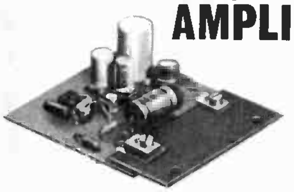
AL10/AL20/AL30 AUDIO AMPLIFIER MODULES



The AL10, AL20 and AL30 units are similar in their appearance and in their general specification. However, careful selection of the plastic power devices has resulted in a range of output powers from 3 to 10 watts R.M.S.
The versatility of their design makes them ideal for use in record players, tape recorders, stereo amplifiers and cassette and cartridge tape players in the car and at home.

Parameter	Conditions	Performance
HARMONIC DISTORTION	Po = 3 WATTS f = 1KHz	0·25%
LOAD IMPEDANCE	—	8–16 Ω
INPUT IMPEDANCE	f = 1KHz	100 k Ω
FREQUENCY RESPONSE —3dB	Po = 2 WATTS	50 Hz–25KHz
SENSITIVITY for RATED O/P	Vs=25V. Rl=8 Ω f=1KHz	75mV. RMS
DIMENSIONS	—	3" × 2½" = 1"

The above table relates to the AL10, AL20 and AL30 modules. The following table outlines the differences in their working conditions.

Parameter	AL10	AL20	AL30
Maximum Supply Voltage	25	30	30
Power out for 2% T.H.D. (RL = 8 Ω f = 1KHz)	3 watts RMS Min.	5 watts RMS Min.	10 watts RMS Min.

AUDIO AMPLIFIER MODULES

AL 10. 3 watts £2·50
AL 20. 5 watts £2·85
AL 30. 10 watts £3·20

PRE-AMPLIFIERS

PA 12. (Use with AL10, AL20 and AL30) £4·35
PA 100. (Use with AL60) £13·15

POWER SUPPLIES

PS 12. (Use with AL10, AL20, AL30) 95p
SPM 80. (Use with AL60) £3·25
FRONT PANELS FP 12 with Knobs £1·00

TRANSFORMERS

T461 (Use with AL10) £1·60 P & P 22p
T538 (Use with AL20, AL30) £2·30 P & P 22p
BMT80 (Use with AL60) £2·75 P & P 37p

PA12 PRE-AMPLIFIER SPECIFICATION

The PA12 pre-amplifier has been designed to match into most budget stereo systems. It is compatible with the AL 10, AL 20 and AL 30 audio power amplifiers and it can be supplied from their associated power supplies. There are two stereo inputs, one has been designed for use with *Ceramic cartridges while the auxiliary input will suit most †Magnetic cartridges. Full details are given in the specification table. The four controls are, from left to right: Volume and on/off switch, balance, bass and treble. Size 152mm × 84mm × 35mm.

Frequency response—20Hz–50KHz (—3dD)
Bass control—± 12dB at 60Hz
Treble control—± 14dB at 14KHz
*Input 1. Impedance 1 Meg. ohm, Sensitivity 300mV
†Input 2. Impedance 30 K ohms, Sensitivity 4mV

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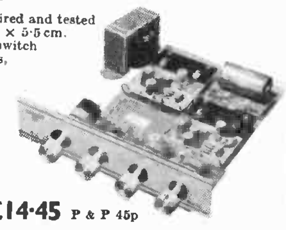
The STEREO 20



The "Stereo 20" amplifier is mounted, ready wired and tested on a one-piece chassis measuring 20 cm × 14 cm × 5·5 cm. This compact unit comes complete with on/off switch volume control, balance, bass and treble controls, Transformer, Power supply and Power amps. Attractively printed front panel and matching control knobs. The "Stereo 20" has been designed to fit into most turntable plinths without interfering with the mechanism or, alternatively, into a separate cabinet. Output power 20w peak. Input 1 (Cer.) 300mV into 1M. Freq. res. 25Hz-25kHz. Input 2 (Aux.) 4mV into 30K. Harmonic distortion. Bass control ± 12dB at 60Hz typically 0·25% at 1 watt. Treble con. ± 14dB at 14kHz.

£14·45 P & P 45p

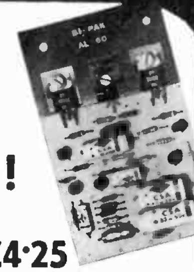
TC20 TEAK VENEERED CABINET

For Stereo 20 (front board undrilled) Size 10¼" × 8½" × 3", £3·95 plus 45p postage.

SHP80 STEREO HEADPHONES

4-16 ohms impedance. Frequency response 20 to 20,000Hz. Stereo/mono switch and volume controls, £4·95

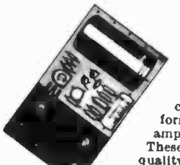
NOW WE GIVE YOU 50w PEAK (25w R.M.S.) *PLUS* THERMAL PROTECTION! The *NEW* AL60 Hi-Fi Audio Amplifier FOR ONLY £4·25



- Max Heat Sink temp 90°C.
- Frequency Response 20Hz to 100KHz
- Distortion better than 0·1% at 1KHz
- Supply voltage 15–50 volts
- Thermal Feedback
- Latest Design Improvements
- Load — 3, 4, 8 or 16 ohms
- Signal to noise ratio 80dB
- Overall size 63mm × 105mm × 13mm

Especially designed to a strict specification. Only the finest components have been used and the latest solid state circuitry incorporated in this powerful little amplifier which should satisfy the most critical A.F. enthusiast.

STABILISED POWER MODULE SPM80

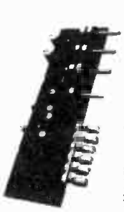


SPM80 is especially designed to power 2 of the AL60 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer BMT80, the unit will provide outputs of up to 1·5 amps at 35 volts. Size: 63mm × 105mm × 30mm. These units enable you to build Audio Systems of the highest quality at a hitherto unobtainable price. Also ideal for many other applications including:—Disco Systems, Public Address, Intercom Units, etc. Handbook available 10p **PRICE £3·25**

TRANSFORMER BMT80 £2·75 p. & p. 40p

STEREO PRE-AMPLIFIER TYPE PA100

Built to a specification and NOT a price, and yet still the greatest value on the market, the PA100 stereo pre-amplifier has been conceived from the latest circuit techniques. Designed for use with the AL60 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise NPN devices for use in the input stages.
Three switched stereo inputs, and rumble and scratch filters are features of the PA100, which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble controls.



SPECIFICATION

Frequency Response	20Hz—20KHz ± 1dB
Harmonic Distortion	better than 0·1%
Inputs: 1. Tape Head	3·25 mV into 50K Ω
2. Radio, Tuner	75 mV into 50K Ω
3. Magnetic P.U.	3 mV into 50K Ω

All input voltages are for an output of 250mV. Tape and P.U. inputs equalised to RIAA curve within ± 1dB. from 20Hz to 20KHz.

Bass Control	± 15dB at 20Hz
Treble Control	± 15dB at 20KHz
Filters: Rumble (High Pass)	100Hz
Scratch (Low Pass)	8KHz
Signal/Noise Ratio	better than —65dB
Input overload	+ 26dB
Supply	+ 35 volts at 20mA
Dimensions	292mm × 82mm × 35mm

ONLY £14·25

MK 60 AUDIO KIT

Comprising: 2 × AL60, 1 × SPM80, 1 × BTM80, 1 × PA 100, 1 front panel, 1 kit of parts to include on-off switch, neon indicator, stereo headphone sockets plus instruction booklets. Complete Price: £29·75 plus 45p postage.

TEAK 60 AUDIO KIT

Comprising: Teak veneered cabinet size 16¾" × 11½" × 3¾", other parts include aluminium chassis, heatsink and front panel bracket, plus back panel and appropriate sockets, etc. Kit price: £9·95 plus 45p postage.

Giro No. 388-7006
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AN INDISCRIMINATE TAX

THE electronics constructor has suffered a substantial blow from the April Budget, since the new V.A.T. rate of 25 per cent applies to all electronic parts and accessories which can be used in or with radio, television, or audio equipment, electronic musical instruments, and a wide range of electrically operated domestic appliances. Very few circuit devices will escape this definition; though just how in practice the authorities will determine the finer points of distinction is currently a subject of much interest and speculation.

In fact, the whole scheme for a higher rate of V.A.T. effecting electronic components has been greeted with dismay by the manufacturers, distributors, and retailers alike. Confusion runs rife; already conflicting interpretations are reported from different tax offices up and down the country, and the Chancellor is under pressure from industrial and trade organisations to modify this unworkable and illogical scheme.

As it stands, in the original form, we must assume that very few components will be allowed to slip through at the lower rate of 8 per cent.

Hearing aids and electronic calculators are excluded from the higher rate. But what does the retailer charge for a resistor or semiconductor required to repair one of these instruments? Does he demand an affidavit that this component will not be used to build or service a radio set or amplifier?

Impending or future developments could very well embrace certain components which at this particular moment may not have any plausible connection with the classes of goods that are subject to the higher rate. In terms of technical feasibility there is scarcely anywhere where it is prudent to draw the line. Thus practically all active and passive components designed for use in the field of electronic engineering could conceivably be applied sensibly in electronic equipment suitable for domestic or recreational use, or in certain domestic appliances, (if not today, quite probably tomorrow).

This is not to argue a case on behalf of Customs and Excise for a blanket imposition of the higher rate of V.A.T. upon all electronic components. It is to illustrate the ludicrous situation brought about by those responsible for drafting the new Budget proposals. The authors seem to be oblivious of the fact that electronics is the common base of a multitude of products which may differ widely in all other respects. Complete equipments, sets, and machines can indeed be divided arbitrarily into classes as "luxury items" or otherwise, if so desired. But their component parts and related accessories cannot, for the greater part, be segregated in this same neat and tidy way.

We support all those who claim that the new system is unfair and largely unworkable. In particular we are concerned at the indiscriminate way in which this higher rate of tax, supposedly created in order to curb public spending on luxury goods, penalises the home constructor no matter what kind of project he happens to be building. Many home assembled units and equipments are clearly in the non-luxury class; others, due to some strange quirk of our legislators, have to be considered luxury items and they include the like of d.c. to a.c. converters, electronic power controllers, and control systems for central heating systems, for example. The very kind of equipments that should be welcomed and encouraged by the Government as valuable weapons in the battle against the waste of energy!

And just why *have* components been brought into this higher rate? It must be because, we presume, a few individuals will be tempted to build the so-called luxury goods themselves and thus cheat the Exchequer of a few paltry pounds.

All the indications are that the far reaching repercussions of this extra tax imposition upon (in effect) all electronic components were never foreseen by those responsible for compiling this part of the Budget proposals. This is a charitable interpretation, but it cannot give the taxpayer cause for confidence in those who originate new tax schemes.

(See *Market Place* for some further information on the new V.A.T. situation.)

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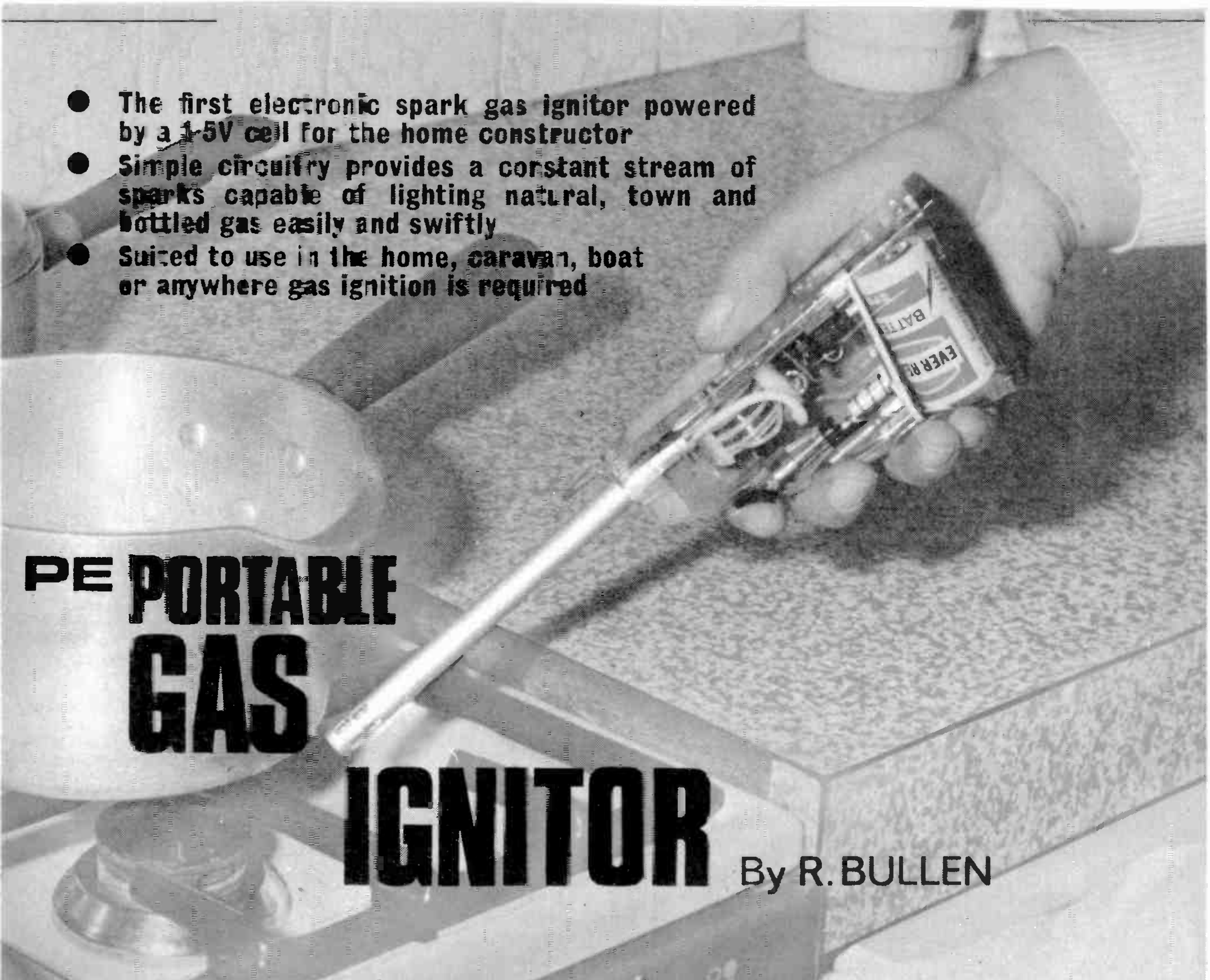


- The first electronic spark gas ignitor powered by a 1·5V cell for the home constructor
- Simple circuitry provides a constant stream of sparks capable of lighting natural, town and bottled gas easily and swiftly
- Suited to use in the home, caravan, boat or anywhere gas ignition is required

PE PORTABLE GAS IGNITOR

By R. BULLEN

FOR THOUSANDS of years a spark has been the conventional means of obtaining ignition, and the conventional means of generating the spark has been a flint. However, attempting to ignite natural gas using a flint would have posed our ancestors with a rather tedious problem. Compared to even ordinary town gas the energy required to ignite natural gas is considerably higher and the combustion limits of the gas/air mixture are considerably narrower, see Fig. 1.

Fortunately there is an effective electronic solution—the following design will provide a portable gas ignitor, which will light easily and effectively both natural, town and bottled gases.

The application of a high voltage across a pair of electrodes produces a field in the gas between them, this can lead to ionisation and breakdown of the gas and produce a spark across the gap. The ignitor featured here relies on this principle to produce a continuous stream of high voltage sparks from a 1·5V dry cell battery.

CIRCUIT CONSIDERATIONS

The method of achieving the spark from a low voltage source is outlined in Fig. 2. The power source feeds a d.c. to d.c. converter. When the switch shown in the central block is actuated the stored energy is released into the primary winding of a step-up transformer and sufficient voltage is generated at the electrodes to cause air breakdown. The oscillation caused by the discharge of an associated capacitor is sufficient to maintain the breakdown for several tens of microseconds.

POWER AND D.C./D.C. CONVERSION

Power is supplied from 1·5V dry cell battery noted as B1 in Fig. 3 which shows the complete circuit of the ignitor. The oscillator circuit is a ringing choke type which utilises feedback between base (AB) and collector (CD) windings for its operation.

When the circuit is switched on by S1, most of the rail voltage will appear across CD as the collector current increases exponentially. The base winding AB is wound in the opposite direction to the collector winding and so the inductive coupling from the collector winding tends to drive the base positive thus driving the transistor TR1 into saturation.

When the collector current reaches saturation the induced voltage in the base falls to zero causing a reduction in base current. This tends to reduce the collector current and induce a reverse voltage in the collector winding. The overall effect is to bring the transistor out of saturation.

The regenerative effect continues until the transistor enters the cut-off region. The discharge of winding capacitance is sufficient to generate a voltage across the collector winding which causes the cycle to be repeated. Hence whilst the switch remains closed a series of pulses are generated at the collector. Figs. 4a and b show the collector current and voltage waveforms.

A tertiary winding EF, wound in phase with the collector winding, steps up the voltage appearing across CD to a level of approximately 600V. The resulting pulses are used to charge C1.

The transistor used should have a low V_{cc} (sat) to minimise the energy loss and also have a good collector-to-base breakdown voltage.

WINDINGS

The design of windings is related to the transistor used. The base and collector windings should be optimised to achieve maximum output without drawing too large a collector current. For this design, using a Microelectronics type ME 8001 transistor or its equivalent (BFY 50, 2N2297), a base winding of 12 turns of 37 s.w.g. and a collector winding of 18 turns of 33 s.w.g. will be found suitable.

The collector voltage should be approximately 28V, choice of 600 turns of 44 s.w.g. for the secondary provides the requisite intermediate voltage.

The oscillator windings are housed in a 14mm pot core. The main requirement for the ferrite material is that the saturation level is not too low.

SWITCHING AND DISCHARGE CIRCUIT

Charging the capacitor is achieved through a rectifying diode D1 which should be an 800V type. The diode should also have a fast switch-off time to minimise leakage from the capacitor. A BA157 is chosen as a suitable component.

The main discharge capacitor is a 250V type the capacitance of which is governed by the energy requirements of the spark. Generally a 0·47μF is suitable for the application. The I.T.T. range of PMT capacitors is recommended as they appear to withstand the high current discharges which occur during the oscillation.

THE SWITCH

The switch used is a device known as a surge voltage protector. This component originated as a protection for equipment which was liable to high voltage spikes. The device is similar to a neon in that a pair of electrodes are contained in a glass envelope which is filled with an inert gas.

When sufficient electrical stress appears across the electrodes breakdown will occur and current of up to several tens of amps will be allowed to pass under pulse conditions. Subsequent to breakdown a voltage of about 25V exists across the device. The type used in this case has a breakdown of about 220V, thus the capacitor charges to 220V, the protector flashes over and the resulting oscillation generates the high voltage for the spark.

TRANSFORMER DESIGN

The number of primary turns required may be estimated on the basis of impedance matching and energy input to the transformer. From this the secondary turns may be estimated from simple transformer theory. For the size of electrode gap used here an output of 8kV will be required.

A primary of 40 turns of 30 s.w.g. and a secondary of 3000 turns of 40 s.w.g. will be found suitable. The

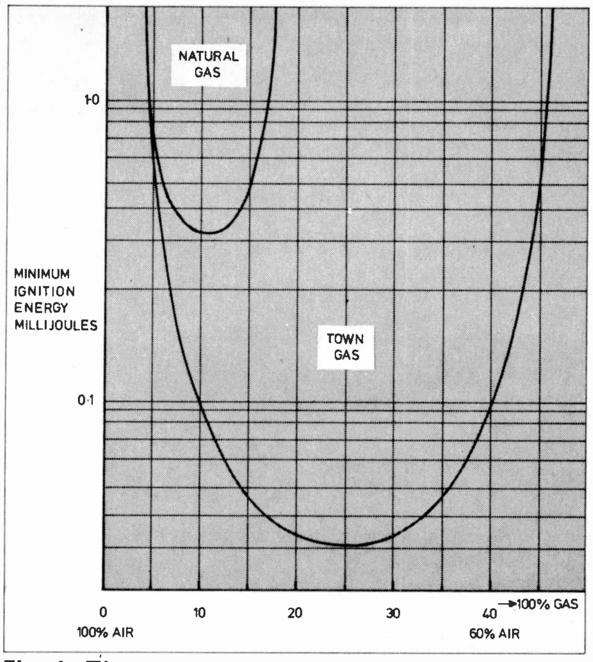


Fig. 1. The energy required to ignite natural gas/air mixtures compared with that required to ignite a town gas/air mixture

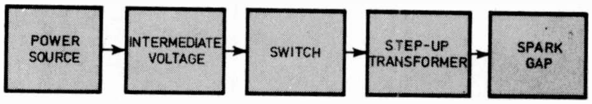


Fig. 2. System diagram of the high voltage production concept using a low voltage source

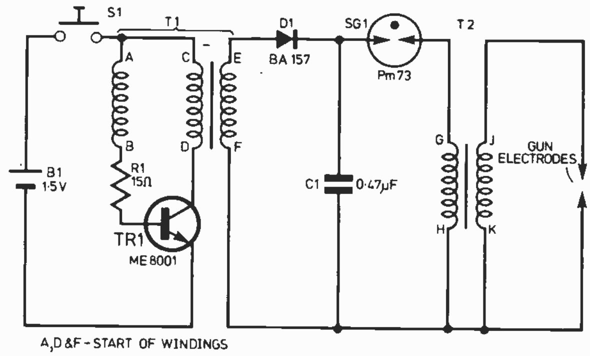


Fig. 3. Circuit diagram of the gas ignitor

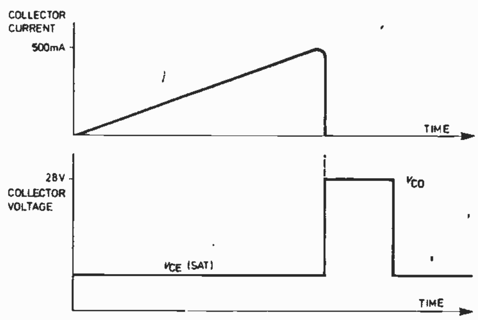


Fig. 4. Collector current (above) and voltage (below) waveforms for TR1 in Fig. 3.

MATRIX BOARD VERSION

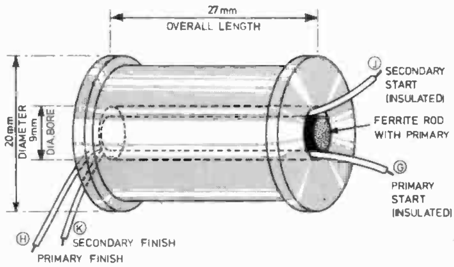


Fig. 5. Constructional details of the output transformer T2

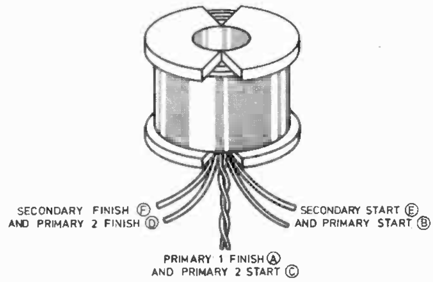


Fig. 6. Details of the oscillator transformer T1

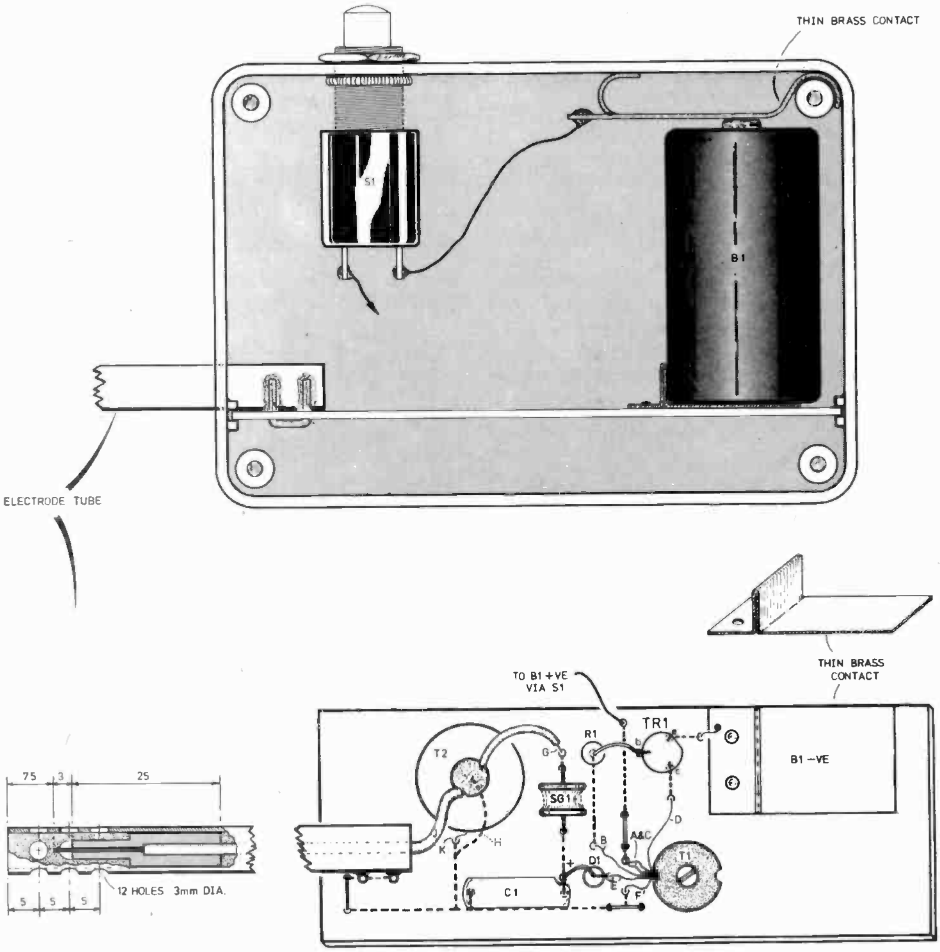


Fig. 7. Construction and component layout for the matrix board and case, together with details of the electrode tube

COMPONENTS...

Resistor
R1 15Ω, ¼W carbon

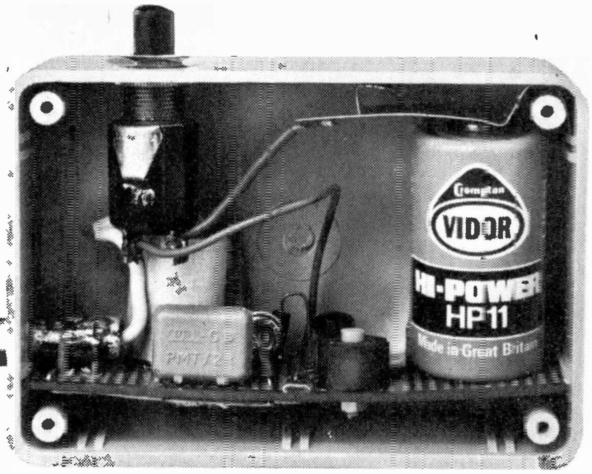
Capacitor
C1 0·47μF, 750VW, d.c.

Transistor
TR1 ME8001

Diode
D1 BA157

Coils
Oscillator coil: Single section 14mm bobbin, 14mm ferrite core, FX 3594, 1g of 44 s.w.g. enamelled copper wire, 0·1g of 37 s.w.g. and 0·3g of 33 s.w.g., tape to suit.
Output transformer: Ferrite rod, 27mm by 8mm; bobbin, see text; 1g 30 s.w.g. enamelled copper wire, 1g 44 sw.g.; tape to suit.
Electrode tube: Brass or copper tube, 9mm o.d., 0·5 to 1mm wall thickness, 150mm; 20 s.w.g. tinned copper wire insulated with 1mm wall-thickness silicone rubber tube or equiv.; epoxy putty, fire clay etc. as needed.

Miscellaneous
Matrix board, 0·1 or 0·15in. hole spacing; S1, push-to-make switch; Voltage protector, Siemens KASO2; plastic box ref. 1005; solder, wire etc. as required.
For the fully described version the plastic case can be obtained from Crescent Radio Ltd., 11 Mayes Road, London, N.22. The case and a complete kit for the second proprietary version can be obtained from Greenweld, 51 Shirley Park Road, Southampton, SO1 4FX, Tel. 772501. The Siemens voltage protector can be obtained from Jermyn Distribution, Vestry Way, Sevenoaks, Kent.



magnetic core for the transformer should be a ferrite rod which will fit inside the former on which the secondary in wound.

The primary winding can be wound directly on to the ferrite rod which can then be inserted inside the secondary winding, see Fig. 5.

This coil is constructed in two separate parts to ensure adequate insulation between primary and secondary. Again both windings are in the same direction. The primary is wound using 30 s.w.g. enamelled copper wire directly onto the ferrite rod and consists of 40 turns close wound in a single layer wire so as to ensure a firm fit into the bore of the secondary bobbin.

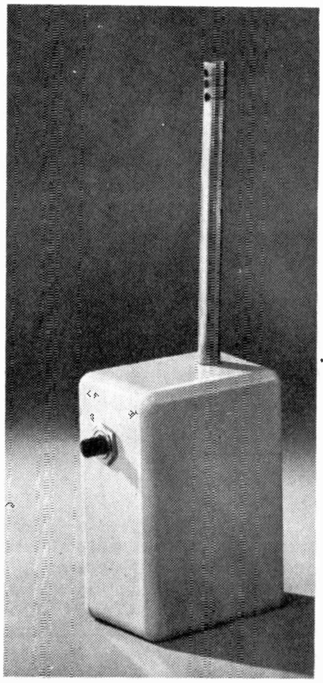
The secondary requires a suitable plastic bobbin which approximates to the dimensions shown in Fig. 5, onto which are wound 3,000 turns of 40 s.w.g. enamelled copper wire. The start wire is brought out through a hole in the cheek and due to the thinness of the wire, re-inforcement of the lead is recommended, either by skeining or by soldering a more substantial insulated lead onto the wire prior to winding. In the latter case, the joint should be well insulated and secured inside the winding with adhesive tape. To reduce the possibility of breakdown due to the voltage gradient across the coil, tape layers should be introduced at approximate intervals of 750 turns.

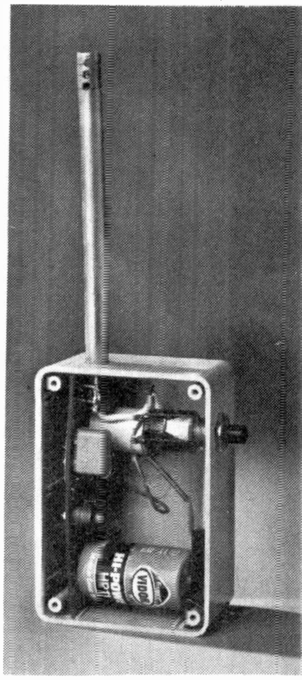
Finally the primary coil should be fitted into the bore of the secondary bobbin with a good fit.

OSCILLATOR COIL

This coil is wound on a proprietary bobbin in the form of three separate windings although when connected, the two primaries become a single winding with a tap. The windings should be as even as possible, reasonably tight and in the order shown in Fig. 6.

Insulation between windings is not necessary but a layer of tape may be usefully used. A final wrap of tape is recommended to secure the windings. All windings should be in the same direction to ensure correct phasing, with the ends left sufficiently long to allow connection. Turns details are given under windings.





P.C.B. VERSION

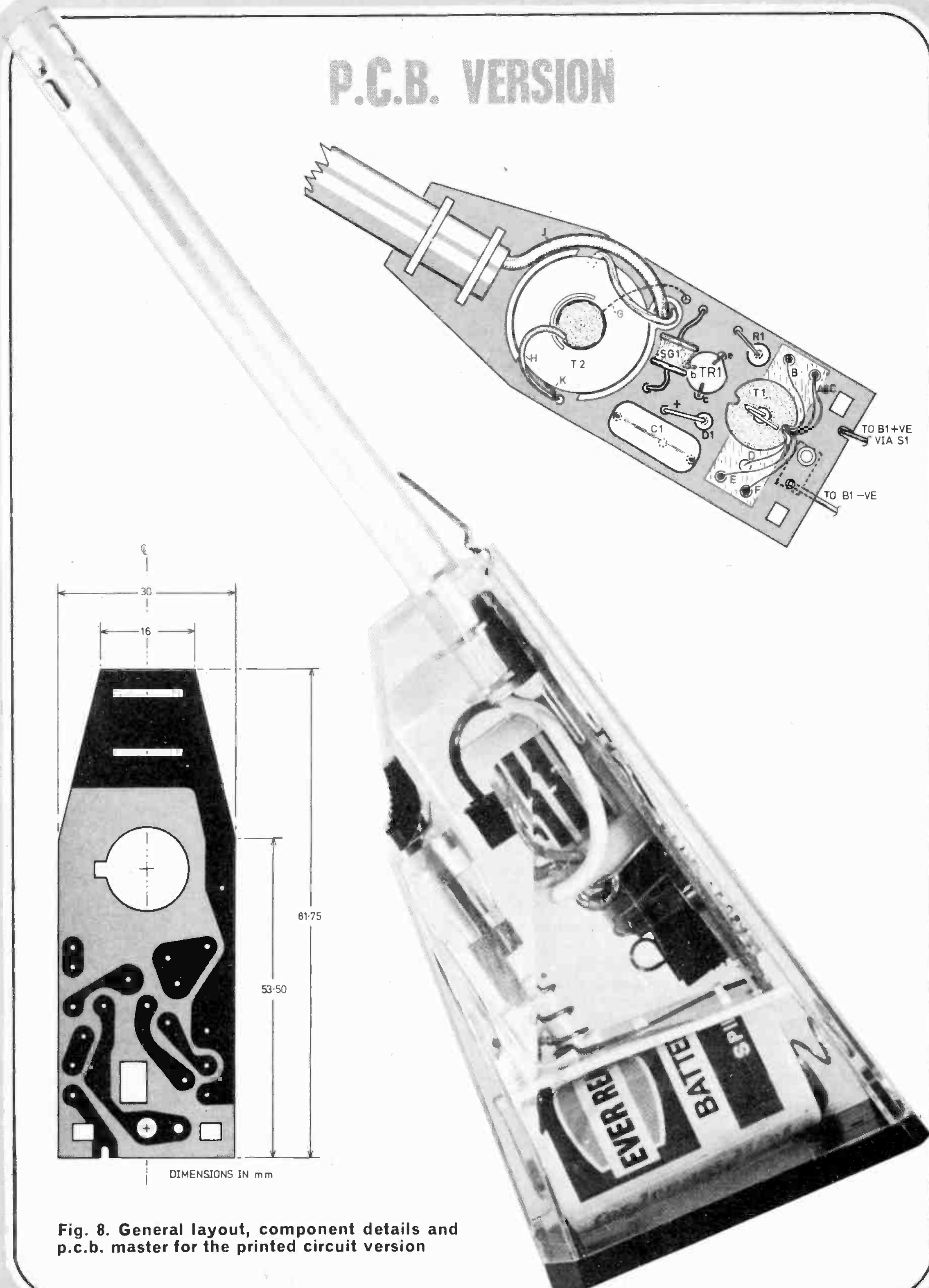


Fig. 8. General layout, component details and p.c.b. master for the printed circuit version

ELECTRODE TUBE ASSEMBLY

Since it is the function of this unit to ignite gas virtually instantly, this part should be constructed in such a way that the best possible spark gap is produced and that gas is able to surround the electrode easily. Materials should be heat resistant, the tube being conductive and preferably solderable. For this purpose brass or copper are recommended.

Basically the assembly consists of a well insulated wire, the end of which is bared to discharge the spark across an air gap of 3 to 4mm to the outer tube. An essential part of the structure is a heat resistant inner insulating tube which positions longitudinally and centralises the electrode wire.

For the model this part was constructed from a 2-part epoxy putty which cures hard, resists heat and adheres to the inside of the tube. This part could equally well be produced from clay or fabricated from fire brick, etc. and secured in position with an epoxy adhesive or the like.

Fig. 7 shows the electrode tube assembly.

ASSEMBLY AND MOUNTING

The first stage is to cut a 100 × 37mm section of matrix board to size, drill additional holes and fit the spring battery connection (28 s.w.g. brass or simiiar) as shown in Fig. 7. The components are mounted as shown, securing the oscillator ferrite core halves together and to the board with a 6 B.A. brass screw. The output transformer was fixed in position with two layers of double-sided adhesive tape although a suitable adhesive would have been quite adequate.

Next the board assembly is slid into a plastic box in which two holes have been drilled as shown and the electrode tube positioned through one hole before soldering it to the double bar of 16 s.w.g. tinned copper wire for retention and connection. The output wire is soldered to the electrode from J on the output winding and the joint well insulated. The switch is fitted and connections made to the board and the second battery spring which is bent to engage a pillar in the box chosen.

The battery is located between the two springs as shown in the accompanying photographs noting the polarity.

APPLICATION

Ignition is normally best obtained by touching the tip of the electrode tube against the gas burner and allowing 1 or 2 seconds after opening the burner before operating the igniter.

It has been suggested that in the absence of ignition after a few sparks, turn the gas off and blow away the surplus before trying again. Some experiment may be required before the best spark-to-burner distance is accurately achieved.

You will find this igniter ideal for camping, boating, caravanning as well as for use in the kitchen. It will provide you with many years of normal use.

PRINTED CIRCUIT VERSION

For those who wish, a second version of the ignitor is proposed here using a printed circuit board, a diagram of which appears in Fig. 8.

This version makes use of a proprietary clear plastic case with self-contained "trigger" switch, battery retaining members, ignitor tube and even a spring clip with which the ignitor can be hung up on a hook.

Of course, there is nothing to stop anyone from using p.c.b. techniques in the manufacture of the first version or, for that matter, Veroboard techniques.

The clear plastic case version makes use of a complex moulding which holds the trigger tube in place with snap-action clips. The tube holds the p.c.b. in place using two metal clips which engage through the board, and the whole is held in place finally with a moulded plastic element which acts as an end plate against which the battery is pressed by a cover.

The moulding includes an access through which a trigger passes to engage with a spring and suitable contacts on the end plate. The mouldings and various parts are available from Greenweld. ★

NEWS BRIEFS

Electronics For School Teachers

THE University of Essex is holding its fourth Electronics Summer School for teachers from July 7–11. This will take the form of two courses which will be run simultaneously.

The first course, ESS 8—Linear Circuit Design—is concerned with the use of transistors and operational amplifiers in linear applications such as amplifiers, filters and power supplies. The second course, ESS 9—Digital Circuit Design—concentrates on the use of the transistor as a switch and develops design using integrated logic circuits.

A full laboratory programme backs up the topics covered in the lectures, and tutorials are held to discuss the design for the practical sessions.

Further details can be obtained by writing to Bob Mack at The Department of Electrical Engineering Science, University of Essex, Wivenhoe Park, Colchester, Essex, CO4 3SQ.

Queen's Award

THE Queen's Award to Industry, 1975 in recognition of its export achievement and for technological innovation in scientific electronic calculators has been awarded to Sinclair Radionics for their "Sinclair Scientific".

During a three year period ending in April 1974 the company, which is claimed to be Europe's largest manufacturer of electronic calculators, increased its exports tenfold to £2,232,040 p.a. or 56 per cent of turnover.

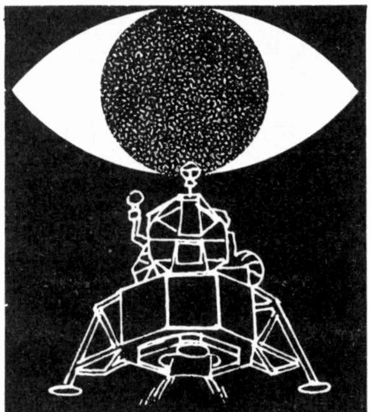
Sinclair is one of only two companies that have won the award in both categories this year. In the previous three years only three companies have been successful in both categories.

JUST THE IDEA!

VALUABLE PRIZES TO BE WON

A competition for the most novel ideas for practical applications of a particular circuit in this issue.

Details Next Month.



SPACEWATCH

BY FRANK W. HYDE

CHRISTMAS PRESENT

The name of Jocelyn Bell became recognised by the scientific world when her observations of the first pulsar were announced. Since then she has changed both her location and her name. Her new location is the Mullard Space Science Laboratory at Dorking and her new name Jocelyn Bell Burnell.

With the team at Dorking, John Ives, Peter Sanford, Jocelyn Bell Burnell is engaged on carrying out the task of reducing data from *Ariel* 5, the United Kingdom's first X-ray Satellite. The whole of the programme of this satellite is devoted to observations of existing X-ray sources and the search for new ones.

One new star which flared up at Christmas was named, by Jocelyn Bell Burnell, Cen-Xmas. It was observed from December 19 to January 27. This star may well supply the clue to a class of X-ray sources not previously known.

Cen-Xmas was discovered in the constellation of Centauras near to an already known source Cen X-3. Cen-Xmas flared up on Christmas day and showed a light curve much like that which appears at optical wavelengths by fast moving Novae.

The team observed that there was a regular rising and falling of intensity every 6·755 minutes. This was a point of great interest since the usual periods of variation for X-ray binary systems is hours or even days and the periods for pulsars a few seconds or less. It does not seem likely that it was a slowly rotating neutron star.

OPINION

The team are of the opinion that the source may be a binary system of two collapsed objects. These could be perhaps a white dwarf and a neutron star. Another possibility has been put forward and that is the objects could be a white dwarf and a black hole. Clearly the object is unusual in the present catalogue. The official catalogue number is Ariel 1118-61.

A search is now being made in the data of the *Copernicus* satellite to see whether there have been earlier bursts. A request has been made that *Copernicus,* which has better pointing facilities than *Ariel,* should specially observe this area of the sky.

Satellite *Ariel* 5 has more than justified its launch in this valuable study of X-ray sources.

ANOTHER DISCOVERY

A second bonus is the discovery of a very bright source near the galactic centre. This, according to Professor K. A. Pounds of Leicester, a pioneer in these observations, was not visible in November when that area was studied. The new source is second only in brightness to a source called Sco X-1.

This new source as yet un-named is at such a vast distance that its intensity must be at the upper limit for normal galactic X-ray sources. Both Cambridge and the Jodrell Bank teams have been asked to watch the area in case the X-ray flare up should be followed by radio bursts.

FURTHER EXPERIMENT

Another experiment aboard the satellite also controlled by Leicester, with the team led by Professor Pounds has indicated that an excess of heavy elements such as iron have been found in the super nova remnants of Tycho and Cassiopeia A. As this is the first report of the X-ray detection of spectral lines from a cosmic source it adds weight to the growing feeling that the heavy elements in the universe may be produced at the time of the explosions associated with supernovae.

It would seem that the fluctuating nature of X-ray sources is a common factor. Professor Pounds thinks that they may account for 30 per cent of the known sources. There are now more than two hundred recorded.

FADE-OUT!

A notable feature, derived from data received from *Ariel,* is the number of sources that do not last all the time. During the present period of observation some 16 sources have disappeared from the areas. This may be because they are now out of the limits of detection or that there has been a change of such a nature that there are no longer X-ray types of emmission. The sixteen sources that have disappeared were originally detected by the *Uhuru* satellite.

It is expected that *Ariel* 5 will be able to continue operations for a year with the gas available on board. Thereafter it will be a waiting period till the next British X-ray satellite is launched in 1977.

SATELLITE DETAILS

The data handling system of the *Ariel* 5 satellite is effectively a fixed programme computer with two core stores. This enables the integration of experimental data so that the best may be made of the low data rate of transmission from the spacecraft. Only by keeping the data rate low is it possible to utilise long ground data-links.

The details of the satellite are:

Dimensions	Diameter 38 in, length 34 in, weight 298 lbs
Stabilisation	Spin 10 ± 2r.p.m.
Attitude control	Propane gas jets
Power supply	Solar array 35W
Telemetry	PCM
Frequency	137·68MHz
Real time power	85mW
Real time rate	2048 bits/second
Playback power	80W
Playback rate	2048 bits/second
Stations	Quito and Ascension (Nasa stations)
Telecommand	Digital tone
Frequency	148·25MHz

NEWS FROM RUSSIA

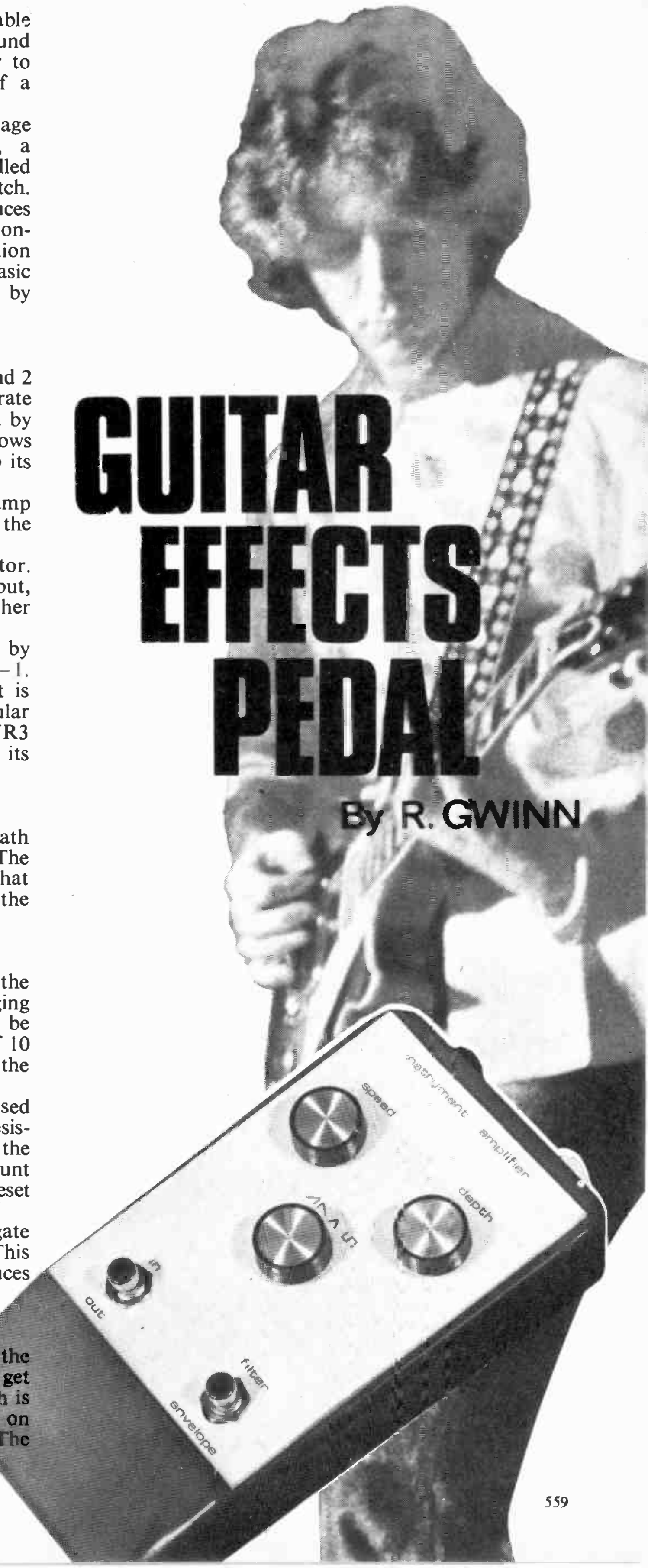
India's first satellite is being prepared for launching from a Soviet site. Academician Boris Petrov, chairman of the Intercosmos council, said that the joint work of the Soviet scientists and experts had produced an elaborate spacecraft for experiments connected with research in the short wave radiation of celestial bodies, together with studies of the ionosphere.

Launched on March 27, *Intercosmos 13* is a joint socialist countries enterprise. The main aim is to study dynamic processes in the magnetosphere and the polar ionosphere. Research is also directed to low frequency electromagnetic waves.

The satellite carries instrumentation from the Soviet Union and Czechoslovakia. The participating observation points are in Bulgaria, the German Democratic Republic, the Soviet Union and Czechoslovakia.

GUITAR EFFECTS PEDAL

By R. GWINN



THERE are numerous guitar effects pedals available today, but there are still many areas of sound treatment in which it is possible for the amateur to produce something which is not just a copy of a commercial effect.

The pedal to be described makes use of voltage control techniques. There are two treatments, a voltage controlled amplifier and a voltage controlled filter; either of which can be selected by a switch. These are controlled by an oscillator which produces triangle, square and rising and falling ramps at controllable frequency and amplitude. The combination of four waveforms and two treatments gives eight basic effects, all of which can be considerably modified by adjustment of the controls.

WAVEFORM GENERATOR

The basic rising ramp wave is generated by IC1 and 2 (see Fig. 1). Integrator IC1 ramps upwards at a rate set by the speed control until it exceeds a limit set by comparator IC2. Then, a large reset current flows through D1 and R2 until the integrator is back to its starting point.

When the waveform switch is in the falling ramp position, IC3 acts as a unity gain inverter to give the required waveform.

In the square position, IC3 acts as a comparator. This gives a square wave of $\pm$ 8V at the i.c. output, which is reduced by R14 to the same level as the other waveforms.

The triangle wave is shaped from the ramp wave by TR1. When out of saturation, this has a gain of -1. It is biased by VR2 so that for half the cycle it is saturated, when it has a gain of $+1$. The triangular wave at the collector of TR1 is amplified by IC3. VR3 is adjusted to offset the d.c. introduced by TR1 and its associated components.

VOLTAGE CONTROLLED FILTER

When S2 is in the filter position, IC5 has multipath feedback with a minimum at a single frequency. The overall response is then bandpass peaking at that frequency, which can be changed by changing the voltage on the gate of the f.e.t.

VOLTAGE CONTROLLED AMPLIFIER

R22 and TR2 form an attenuator, and since the effective resistance of the f.e.t. can be varied by changing the gate voltage, the degree of attenuation can be changed. IC5 becomes an amplifier with a gain of 10 with S2 in the envelope position; this amplifies the previously attenuated signal.

In both the v.c.a. and the v.c.f. the f.e.t. is being used as a voltage controlled resistor. The effective resistance between the drain and source depends on the amount of negative bias on the gate. As the amount required varies from transistor to transistor, preset VR5 is included.

The control voltage from VR4 is also fed to the gate via a low-pass filter R15, R16, C5 and C6. This removes the sharp edges from the signal and so reduces the breakthrough of the control into the output.

BATTERY SWITCHING

There are two batteries to be switched on by the insertion of a jack plug to SK1. It is possible to get sockets which have a single make connection, which is used to turn on the positive supply. This turns on TR3, which then turns on the negative rail. The leakage through TR3 when it is off is negligible.

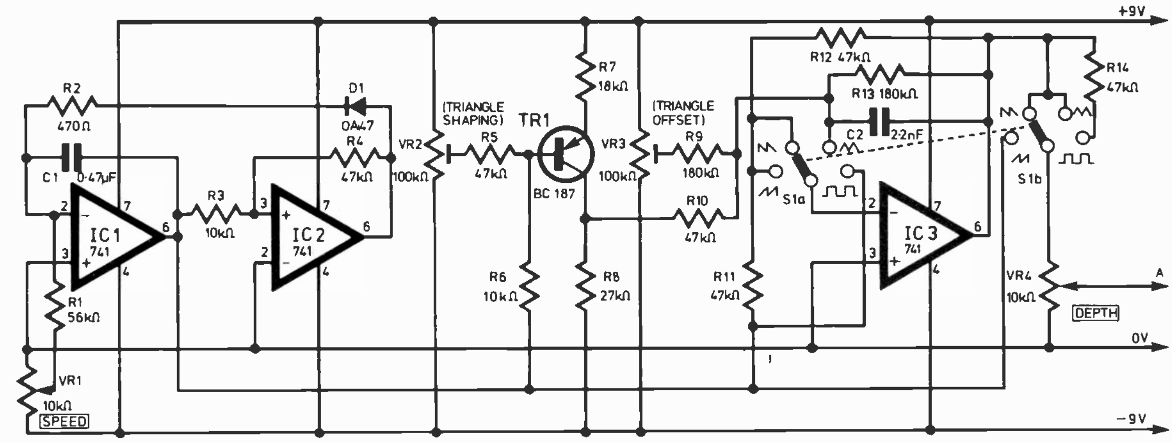


Fig. 1. Circuit of the Effects Pedal

CONSTRUCTION

Most of the components are mounted on a piece of Veroboard 67mm × 112mm (Fig. 2). These are rather tightly packed as there is a lot to be fitted on. The board is screwed into a plastic bracket to hold it in place.

The unit can be housed in any convenient case, which should be earthed to prevent hum. This could be done by soldering onto the back of a pot.

The batteries are prevented from moving with a sheet of foam rubber.

SETTING UP

Turn all presets to mid-positions. While monitoring the waveform at the output of IC3, with the waveform switch set to "triangle", adjust VR2 for the best triangle wave shape. A scope is useful for this. Now set VR3 for 0V d.c. at IC3 output.

Set S2 to "filter". With the depth control at maximum, adjust VR5 for the best sound—a smooth change in filter frequency without it breaking into oscillation.

Finally set VR6 so that the volume of the treated signal is the same as in the straight through position.

PLAYING TECHNIQUE

All the effects are repetitive, so it is best used on sustained chords or single notes. Apart from that, there are no set rules to stick to.

It will be noticed that rising and falling ramps have opposite effects on the two treatments; this is so that subjectively more interesting changes can be made simply by switching effects with one's feet. Thus a rising ramp selected on the switch will produce a decaying sound on the v.c.a.

A fast decaying ramp on the v.c.a. produces a sound like a mandolin; the same control into the filter gives a bubbling, which slows down into a repeated "Waa-Waa". A very slow triangle into the filter can be applied to any playing including fast runs.

The unit can of course be used to treat any instrument, with due attention to the matching of signal levels. ★

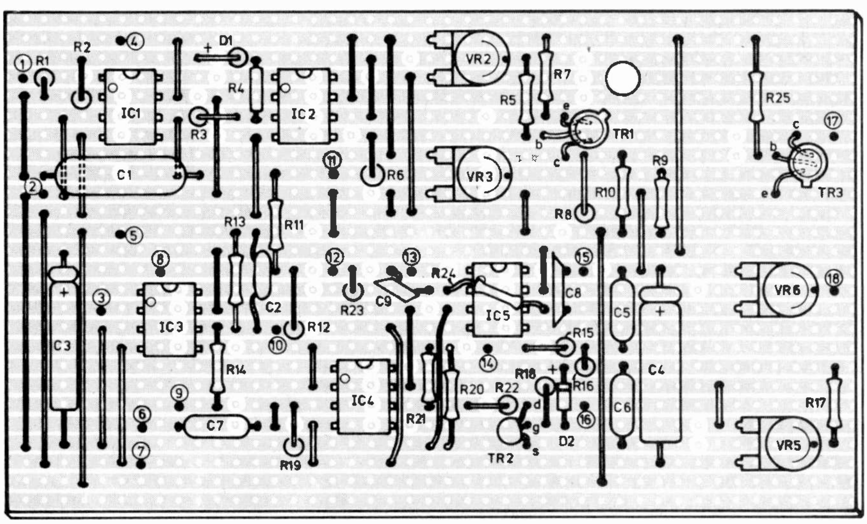
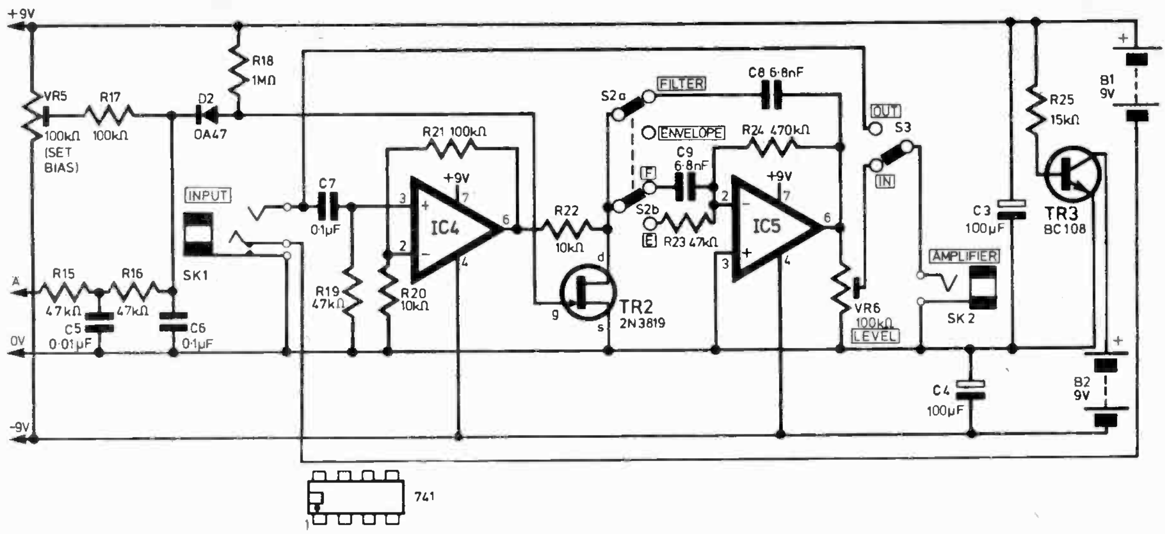


Fig. 2. Component layout and track cuts



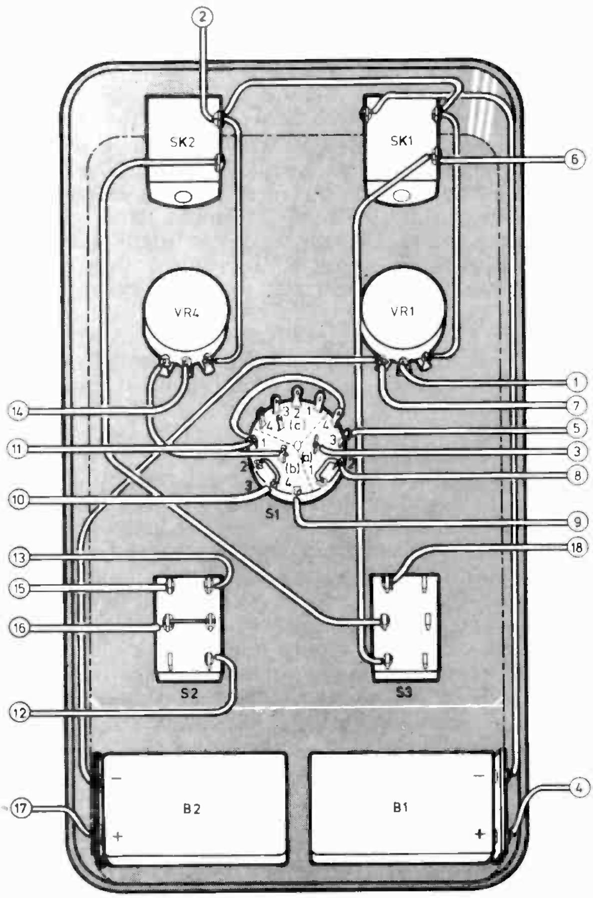


Fig. 3. Control panel wiring details

COMPONENTS . . .

Resistors

R1	56kΩ	R14	47kΩ
R2	470Ω	R15	47kΩ
R3	10kΩ	R16	47kΩ
R4	47kΩ	R17	100kΩ
R5	47kΩ	R18	1MΩ
R6	10kΩ	R19	47kΩ
R7	18kΩ	R20	10kΩ
R8	27kΩ	R21	100kΩ
R9	180kΩ	R22	10kΩ
R10	47kΩ	R23	47kΩ
R11	47kΩ	R24	470kΩ
R12	47kΩ	R25	15kΩ
R13	180kΩ		

All ½ watt 10% carbon

Potentiometers

VR1 10kΩ log
VR2 100kΩ linear
VR3 100kΩ linear
VR4 10kΩ linear
VR5 100kΩ linear
VR6 100kΩ linear

Capacitors

C1 0·47μF
C2 2·2nF
C3–C4 100μF elect. 25V (2 off)
C5 0·01μF
C6 0·1μF
C7 0·1μF
C8–C9 6·8nF (2 off)

Semiconductors

IC1–IC5 741 (5 off)
TR1 BC187
TR2 2N3819
TR3 BC108
D1–D2 OA47 (2 off)

Miscellaneous

B1–B2 9V PP3 (2 off), S1—2 pole, 4 way switch, S2—2 pole, 2 way switch, S3—single pole change-over, SK1—jacket socket with make contacts, SK2—standard jack socket.

TRANSDUCERS

PART 4 Inductive Devices & Physical Parameters

BY P. R. ALLCOCK*

Force Load Sound Frequency Distance Heat

THE second section on inductive devices is concerned mainly with synchronous and stepping transducers.

SYNCHRO TRANSFORMERS

This group includes a wide variety of devices such as torque-producing synchros, control synchros, resolvers and related devices. These devices are widely used in systems involving angular displacement and angular position control and are similar in construction to small three phase alternators of fractional horse power rating.

They are often classified according to their intended application, construction or manufacturers' trade names.

The form of the rotor and the arrangement of the rotor winding identify the type of synchro and its function. Generally the syncro stator is a cylindrical slotted structure made up of laminations and having three separate windings arranged in slots which are displaced, spatially, by 120° from each other.

The slots are often skewed one slot pitch to avoid any tendency for slot locking and the resulting angular displacement error. Sometimes the stator slots are parallel to the rotor axis in which case the rotor laminations are normally skewed for the above reasons. Unlike the usual three phase system the voltages associated with the three stator windings are all in step or phase with each other as far as their voltage-time variation is concerned.

The rotor of a control or torque synchro usually carries a single winding and often has a salient-pole form, the coil connections being made available via slip rings. Resolvers on the other hand usually have two rotor and stator coils.

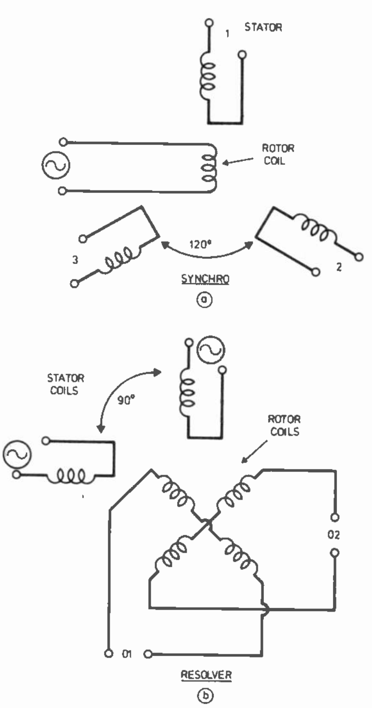


Fig. 4.1. The principle of the synchro/resolver system for transmitting rotary position information

PRINCIPLE

The synchro principle is illustrated in Fig. 4.1. The magnitude of the voltages induced into the three stator coils depends on the rotor position and varies sinusoidally with shaft displacement from some reference position. The system is essentially a transformer with three output coils in which the degree of coupling to the primary rotor coil varies with rotor position.

There is always an output from the system whether the rotor is in motion or not—consequently slowly varying or static angular displacement can be determined.

The resolver usually operates as a two phase system as illustrated at Fig. 4.1b. The rotor coils provide output voltages which vary as the cosine and sine of the angular displacement, by virtue of the variation of coupling and the relative coil displacements. When output from coil O1 is maximum, that from coil O2 will be zero. A rotation of 90° will cause the output of coil O1 to be zero whilst that of coil O2 reaches its maximum.

In some applications only one coil may be used in which case the unused coil is normally short circuited. With two primary and two secondary coils four vector combinations are possible for both coil sets according to the sense of the coils.

Synchros and resolvers are usually designed to operate at 50, 60 or 400Hz, often at specified voltage levels and in all cases it is essential to follow the manufacturers' advice and ratings if the best accuracy is to be achieved. For further details the reader should consult the references listed, together with manufacturers' data/application sheets.

* North Staffordshire Polytechnic

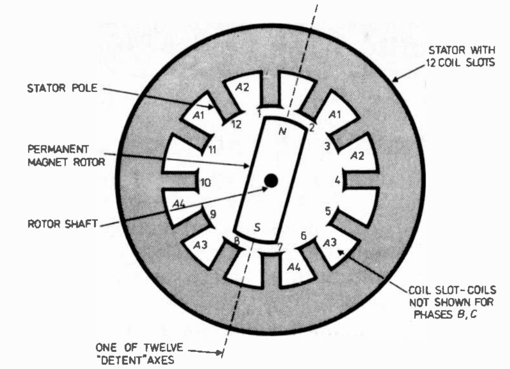


Fig. 4.2. The stepper motor concept in diagrammatic form

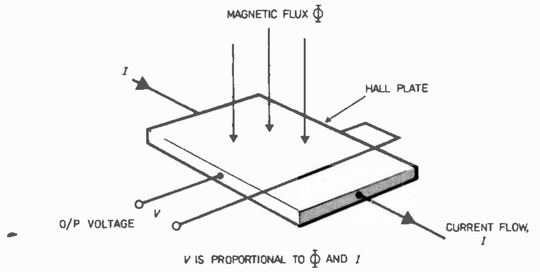


Fig. 4.5. Principle of operation of a Hall Effect probe

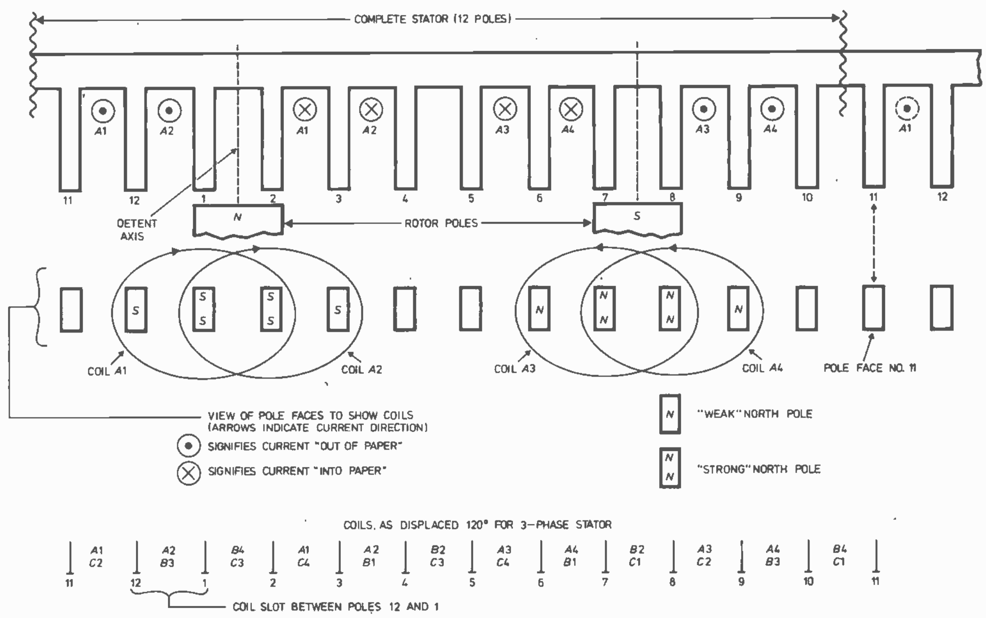
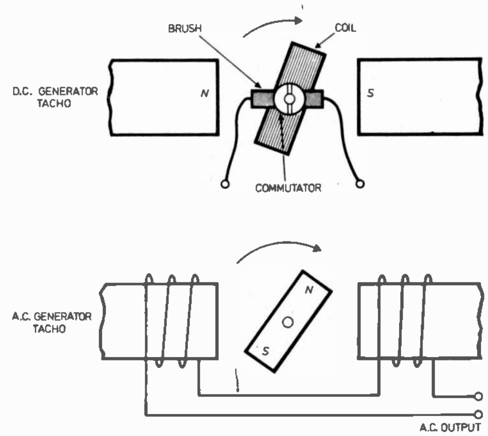


Fig. 4.3. The motor of Fig. 4.2 opened out to show the coil and pole orientation



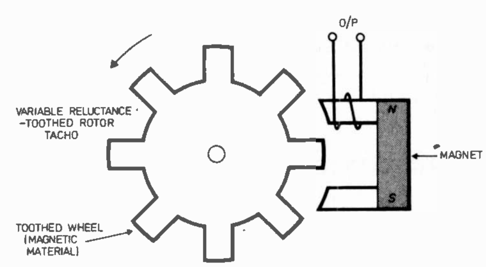


Fig. 4.4. Three versions of the electromagnetic tachometer principle, the d.c. generator, a.c. generator and toothed rotor

STEPPER MOTORS

Several devices have been invented for imparting a given amount of angular movement to a shaft, in response to an electrical input. Two common examples are the stepping uniselector mechanism and the Ledex solenoid system, both of which involve a form of ratchet action. The stepper motor, however, does not use a mechanical ratchet but achieves its position latching feature by virtue of its special magnetic system.

Two main types exist, those using permanent magnet rotors and those using variable reluctance techniques. The variable reluctance group can be further subdivided into vernier and non vernier types. (vernier motors achieve more steps per revolution than might be indicated by the number of teeth on the rotor or stator.)

Stepper motors do not have brushes or slip rings and are consequently robust and reliable with a low maintenance requirement. The electrical excitation is provided by a two, three or four phase coil system on the stator portion of the motor.

Fig. 4.2 illustrates the operation of a permanent magnet rotor, three phase stator, type of construction. The rotor only has two poles and with the stator un-energised, the motor has 12 magnetic "detent" positions as illustrated where the rotor is aligned on an axis midway between adjacent pairs of stator poles.

If the shaft of such a motor is rotated by hand these detent positions can easily be felt since the rotor tends to pull into the nearest available detent position as the shaft turns.

To illustrate the stepping action under drive conditions the motor stator is shown opened out into a straight line in Fig. 4.3. Each of the three separate stator coil sets is made up of four coils in series such as *A*1, *A*2, *A*3, *A*4 for the "*A*" phase. The sense of the currents that flow in these four coils is shown by arrows and it can be seen that coils *A*1, *A*2 produce four south poles whilst coils *A*3, *A*4 produce four north poles.

The flux of the innermost two poles in each group of four is greater than that of the outermost poles since two aiding coils encircle the inner poles but only one coil encircles each of the outermost poles. The rotor thus aligns itself as illustrated in Fig. 4.3 if only the *A* phase is energised.

The *B* and *C* phases also employ four coils each, in exactly the same pattern as for phase *A*. However, the slots used are displaced by 120° in each case. Thus coil *A*1 is displaced 120° from *B*1 which in turn is displaced 120° from *C*1. Likewise coils *A*2, *B*2, *C*2 are displaced 120° apart and so on. The effect of this is that each of the 12 coil slots in the stator carries two coils from different phase coil-groups.

STEPPING ACTION

The stepping action is determined, for a given construction and coil system, by the manner in which the various phases are energised. If the phases are energised singly in the sequence *A*, *B*, *C* the rotor will take three steps to complete one complete revolution of 360°. Energising the *A* phase brings the rotor north pole to midway between poles 1 and 2. Subsequent energisation of the *B* phase pulls the rotor north pole to an equivalent position with regard to coils *B*1, *B*2 which gives an axis midway between poles 5 and 6, a rotation of four poles or 120°. Subsequent energisation of the *C* phase gives a rotor axis midway between poles 9 and 10.

Smaller angular steps can be achieved by controlling the phases in the sequence *A* only; *A* and *B*, *B* only, *B* and *C*, *C* only, *C* and *A*, etc. This gives six steps of 60° each.

ELECTROMAGNETIC TACHOMETERS

The most common tachometer arrangements are illustrated in Fig. 4.4. The d.c. tachometer uses a permanent magnet stator in conjunction with a rotor coil and commutator. The connections to the coil are made via the commutator and associated brushes and the output voltage is proportional to the angular velocity. Reversing the direction of rotation reverses the output voltage polarity and this is a useful characteristic in some applications. The brush/commutator arragement requires periodic maintenance if reliable operation is to be obtained.

The a.c. tachometer uses a rotating magnet and fixed stator coil thus avoiding the need for brushes and commutator. Both the amplitude and frequency of the output depend on angular velocity and in modern systems an electronic frequency meter is usually employed to give the shaft speed directly, in, say, rev/min, as this avoids the inaccuracies associated with measurement of voltage.

Variable-reluctance pulse generating systems are also widely used due to their simplicity and reliability, the number of output pulses per revolution in this case depends on the number of teeth on the rotor wheel or disc.

INTERFERENCE

All magnetic devices can be influenced to some extent by external magnetic fields due to solenoids operating, mains wiring and stray fields of transformers and motors. In some instances the interfering field cannot be removed and the only course of action is to employ magnetic screening and select the best orientation of the transducer to minimise the unwanted coupling. In some situations hum-cancellation coils can be fitted to introduce an opposing interfering voltage into the output circuit. Connecting leads from low-output devices should be tightly twisted and screened to minimise the effective loop area available for flux linkage with the stray field.

HALL EFFECT DEVICES

When a conductor carries a current at right angles to a magnetic field a charge difference is set up on the surface of the conductor in a direction which is mutually perpendicular to both the magnetic field and the current. Modern high mobility semiconducting materials such as Indium Arsenide and Indium Antimonide have made the Hall Effect a useful practical phenomenon due to the magnitude of the voltage available with reasonable levels of magnetic flux density and current. Fig. 4.5 illustrates the basic principles which can be incorporated into a transducer in various ways.

Either the current or magnetic field can be varied to give a change in the output voltage and Hall Effect plates, together with varying magnetic fields, have been used in flowmeters, tachometers, wattmeters, accelerometers and displacement transducers.

Next month: Piezoelectric devices.

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. Any idea published will be awarded payment according to its merits. Why not submit YOUR IDEA?

TUNNEL DIODE B.F.O. I.F. MARKER

CIRCUIT 1 shows a tunnel diode beat frequency oscillator, which was designed for reception of s.s.b. and c.w. in conjunction with a short-wave a.m. receiver. It also served as an i.f. marker by f.m. modulating the anode of the tunnel diode via a coupling capacitor.

By setting up a potential divider (R1/R2) across the main d.c. supply rail, a low impedance voltage of around 150mV can be supplied to the tunnel diode which will oscillate when the current rises to about 5mA. The frequency of oscillation is determined by the i.f. transformer which is chosen to suit the receiver i.f.

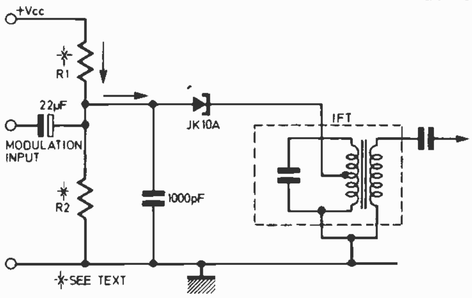


Fig. 1

To obtain a fine beat-frequency control a 10pF air spaced variable capacitor can be connected across the i.f.t. primary. Beat frequency may also be adjusted by varying the bias voltage on the tunnel diode, this can be achieved by substituting R1 for a linear pot and a fixed resistor in series.

If no centre tap primary is available on the transformer the diode may be connected to one end of the primary, the other end being grounded.

The output of the b.f.o. can be taken from the i.f.t. secondary via a small ceramic capacitor to the last i.f.t. of the a.m. receiver.

Component values would have to be selected individually, but about 10mA should be allowed through R1. R2 should be no greater than the negative resistance of the tunnel diode. Typical values for a 6V rail, being R1 approximately 600R and R2, 15R where R is the negative resistance of the diode.

The tunnel diode can be any general purpose 5mA germanium device.

A. Morter,
Norwich

ADDING CIRCUIT

THE adding circuit of Fig. 1 outputs a number of pulses equal to the binary number set up at the control inputs. If the output is connected to a conventional decimal counter with decoder and display a simple adding circuit can be constructed giving the sum of the binary numbers set up on the inputs.

The first binary number is set up on the control inputs and entered by pulsing the 7473 J-K flip-flop once with a bounce-free pulse. The next number can then be set up on the input, the 7473 pulsed and the sum will appear on the display of the associated counter.

The 7490 b.c.d. counter outputs are compared with the binary input numbers by the EXCLUSIVE OR gates G3 to G6 and the outputs of the latter are connected to a 4-input NOR gate made up from three 2-input NOR gates G7, G9 and G11 and two inverters G8 and G10.

When the 7490 ouputs and the control inputs are equal the 4-input NOR gate gives a pulse which clears the 7473 and the 7490. When the 7473 output goes low the NAND gate cuts off the clock pulses to the 7490 and the output.

A 7400 can be used for the NAND gate G1 and the inverters G8, G10 and G2. A 7402 can be used for the NOR gates G7, G9 and G11 and a 7486 for the EXCLUSIVE OR gates G3 to G6.

G. W. J. van der Berg,
Pretoria, South Africa.

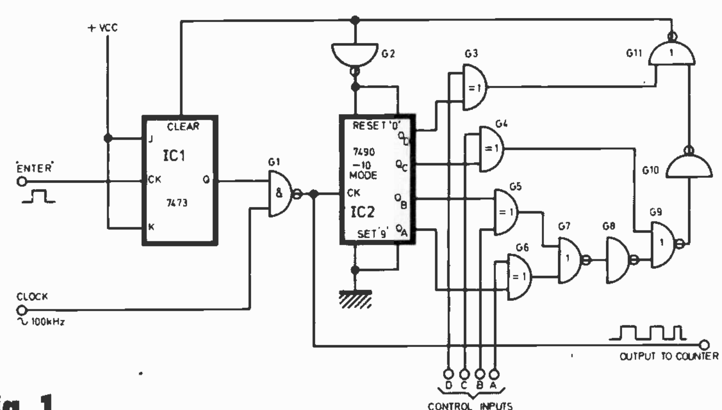
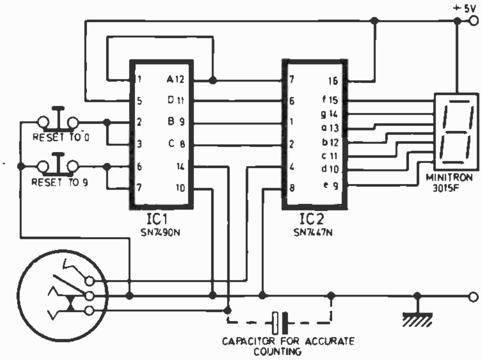


Fig. 1

Fig. 1



RANDOM NUMBER GENERATOR

A SIMPLE random number generator using TTL is shown in Fig. 1. This may be of interest to anyone experimenting in "psychokinesis" and associated e.s.p. phenomena.

A telephone dial is used to generate pulses which are fed to the A input of an SN7490 decade counter. This counts round from 0 to 9 and gives an output in b.c.d. which is fed to an SN7447 b.c.d.-to-seven segment decoder-driver. The latter drives a Minitron 3015F indicator.

Dial switch contact bounce ensures that the number of pulses counted by the circuit is always greater than the number dialled and completely random. Thus if a 10 is dialled something like 20 to 30 pulses are applied to the counter which cycles and finally comes to rest on an effectively random figure.

If required, a pair of the normally open contacts in the dial can be used to blank the display whilst dialling. An "0" is applied to the blanking input of the SN7447 whilst the dial is moving. In addition, the ability to reset to "0" and "9" is useful in experimental work.

The circuit may be used as a "wide-range" dice, operated by dialling 10.

If it is required to generate a specific number of pulses then the insertion of a large capacitor, about 125µF, across the pulsing switch, should dispose of the effects of switch bounce and convert the circuit to normal counting.

N. J. C. Ray, Northampton.

DESOLDERING COMPONENTS

MANY constructors are faced with the problem of removing i.c.s from circuit boards for various reasons without doing damage to the associated printed circuit track and, of course, the component itself.

The following method has been used for some time to save the outlay on special de-soldering tools.

Strip the end from a length of scrap p.v.c. wire and dip it in Fry's Fluxite soldering paste (available in most hardware stores), apply the wire and a hot iron to the joint to be cleaned and the solder will be drawn up the wire by capillary action. With large blobs of solder it may require more than one application of clear wire and of course care should be exercised over the amount of heat applied to the joint.

After removal of the bulk of the solder the component may be lifted of without undue physical strain to the leads or thermal strain to the i.c.

Any residual flux should be removed from the component and the board to avoid corrosion problems.

J. Barvie-Smith,
Fareham, Hants.

TRANSFORMERS

SAFETY MAINS ISOLATING TRANSFORMERS
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Ref. No.	VA (Watts)	Weight lb	Weight oz	Size cm.	P & P £	P & P p
07	20	1	8	7·0 × 6·0 × 6·0	2·80	38
149	60	3	12	9·9 × 7·7 × 8·6	4·37	45
150	100	5	8	9·9 × 8·9 × 8·6	4·89	45
151	200	8	0	12·1 × 9·3 × 10·2	8·13	53
152	250	13	12	12·1 × 11·8 × 10·2	9·83	73
153	350	15	0	14·0 × 10·8 × 11·8	11·88	73
154	500	19	8	14·0 × 13·4 × 11·8	13·65	91
155	750	29	0	17·2 × 14·0 × 14·0	20·51	*
156	1000	38	0	17·2 × 16·6 × 14·0	29·15	*
157	1500	46	0	21·6 × 13·4 × 18·1	33·23	*
158	2000	60	0	21·6 × 15·3 × 18·1	37·07	*

AUTO TRANSFORMERS

Ref. No.	VA (Watts)	Weight lb	Weight oz	Size cm.	Auto Taps	P & P £	P & P p
113	20	1	0	5·8 × 5·1 × 4·5	0-115-210-240	1·67	30
64	75	2	4	7·0 × 6·7 × 6·1	0-115-210-240	2·90	38
4	150	3	4	8·9 × 7·7 × 7·7	0-115-200-220-240	4·12	45
66	300	6	4	9·9 × 9·6 × 8·6	,, ,,	5·82	53
67	500	12	8	12·1 × 11·2 × 10·2	,, ,,	8·82	67
84	1000	19	8	14·0 × 13·4 × 14·3	,, ,,	13·68	91
93	1500	30	4	14·0 × 15·9 × 14·3	,, ,,	18·31	*
95	2000	32	0	17·2 × 16·6 × 14·0	,, ,,	24·20	*
73	3000	40	0	21·6 × 13·4 × 18·1	,, ,,	35·09	*

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111	0·5	0·25		8	4·8 × 2·9 × 3·5	0-12V at 0·25A × 2	1·35	23
213	1·0	0·5	1	4	6·1 × 5·8 × 4·8	0-12V at 0·5A × 2	1·74	30
71	2	1	1	12	7·0 × 6 4 × 6·1	0-12V at 1A × 2	2·29	38
18	4	2	2	12	8·3 × 7·7 × 7·0	0-12V at 2A × 2	2·86	38
70	6	3	3	8	8·9 × 8·0 × 7·7	0-12V at 3A × 2	4·12	45
108	8	4	5	8	9·9 × 8·9 × 8·6	0-12V at 4A × 2	4·56	45
72	10	5	6	4	9·9 × 9·6 × 8·6	0-12V at 5A × 2	5·14	53
116	12	6	6	12	9·9 × 10·2 × 8·6	0-12V at 6A × 2	5·52	53
17	16	8	8	12	12·1 × 9·9 × 10·2	0-12V at 8A × 2	7·26	60
115	20	10	11	8	14·0 × 9·6 × 11·8	0-12V at 10A × 2	10·39	73
187	30	15	15	8	14·0 × 12·1 × 11·8	0-12V at 15A × 2	13·59	85
226	60	30	32	0	17·2 × 15·3 × 14·0	0-12V at 30A × 2	16·83	*

30 VOLT RANGE

Ref. No.	Amps	Weight lb	Weight oz	Size cm.	Secondary Taps	P & P £	P & P p
112	0·5	1	4	6·1 × 5·8 × 4·8	0-12-15-20-24-30V	1·81	30
79	1·0	2	4	7·0 × 6·7 × 6·1	,, ,,	2·40	38
3	2·0	3	4	8·9 × 7·7 × 7·7	,, ,,	3 49	38
20	3·0	4	8	9·9 × 8·3 × 8·6	,, ,,	4·53	45
21	4·0	6	4	9·9 × 9·6 × 8·6	,, ,,	5·13	53
51	5·0	6	12	12·1 × 8·6 × 10·2	,, ,,	6·41	53
117	6·0	8	0	12·1 × 9·3 × 10·2	,, ,,	7·15	60
88	8·0	12	0	12·1 × 11·8 × 10·2	,, ,,	9·90	67
89	10·0	13	12	14·0 × 10·2 × 11·8	,, ,,	9.87	73

50 VOLT RANGE

Ref. No.	Amps.	Weight lb	Weight oz	Size cm.	Secondary Taps	P & P £	P & P p
102	0·5	1	12	7·0 × 6·4 × 6·1	0-19-25-33-40-50V	2·58	30
103	1·0	2	12	8·3 × 7·4 × 7·0	,, ,,	3·38	38
104	2·0	5	8	7·9 × 8·9 × 8·6	,, ,,	4·68	45
105	3·0	6	12	9·9 × 10·2 × 8·6	,, ,,	5·81	53
106	4·0	10	0	12·1 × 10·5 × 10·2	,, ,,	7·60	67
107	6·0	12	0	14·0 × 10·2 × 11·8	,, ,,	12·10	67
118	8·0	18	0	14·0 × 12·7 × 11·8	,, ,,	12·98	85
119	10·0	25	0	17·2 × 12·7 × 14·0	,, ,,	16·99	*

60 VOLT RANGE

Ref. No.	Amps.	Weight lb	Weight oz	Size cm.	Secondary Taps	P & P £	P & P p
124	0·5	2	4	7·0 × 6·7 × 6·1	0-24-30-40-48-60V	2·33	38
126	1·0	3	4	8·9 × 7·7 × 7·7	,, ,,	3·41	38
127	2·0	6	4	9·9 × 9·6 × 8·6	,, ,,	5·08	45
125	3·0	8	12	12·1 × 9·9 × 10·2	,, ,,	7·52	60
123	4·0	13	12	12·1 × 11·8 × 10·2	,, ,,	8·75	67
40	5·0	12	00	14·0 × 10·2 × 11·8	,, ,,	9·75	73
120	6·0	15	8	14·0 × 12·1 × 11·8	,, ,,	11·30	85
121	8·0	25	00	14·0 × 14·7 × 11·8	,, ,,	15·00	*
122	10·0	25	0	17·2 × 12·7 × 14 0	,, ,,	17·52	*
189	12·0	29	00	17·2 × 14·0 × 14·0	,, ,,	19·98	*

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Ref. No.	mA	Weight lb	Weight oz	Size cm.	Volts	P & P £	P & P p
238	200		2	2·8 × 2·6 × 2·0	3-0-3	1·54	10
212	1A, 1A	1	4	6·1 × 5·8 × 4·8	0-6, 0-6	1·84	30
13	100		4	3·9 × 2·6 × 2·9	9-0-9	1·41	13
235	330, 330		4	4·8 × 2·9 × 3·5	0-9, 0-9	1·56	19
207	500, 500	1	00	6·1 × 5·4 × 4·8	0-8-9, 0-8-9	1·92	30
208	1A, 1A	1	12	7·0 × 6·4 × 6·1	0-8-9, 0-8-9	3·30	38
236	200,200		4	4·8 × 2·9 × 3·5	0-15, 0-15	1·43	19
214	300, 300	1	4	6·1 × 5·8 × 4·8	0-20, 0-20	1·93	30
221	700 (d.c.)	1	8	7·0 × 6·1 × 6·1	20-12-0-12-20	2·17	38
206	1A, 1A	2	12	8·3 × 7·7 × 7·0	0-15-20, 0-15-20	3·46	38
203	500,500	2	4	8·3 × 7·0 × 7·0	0-15-27, 0-15-27	3·00	38
204	1A, 1A	3	4	8·9 × 7·7 × 7·7	0-15-27, 0-15-27	3·85	38

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ZTX213	18p	ZTX383	19p	ZS121	19p	ZS276	38p
ZTX214	22p	ZTX384	21p	ZS122	22p	ZS278	61p
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ELECTRONIC IGNITION

Well-known for their "Sparkrite" capacitive discharge ignition systems, Electronics Design Associates, of Walsall, have extended the range recently by the addition of two new models, the Sparkrite G.T. (12V −ve and +ve earth) and the Sparkrite G.T.3 (12V −ve earth only).

Both these new models, which are a development of the Sparkrite Mk 2, incorporate a high voltage a.c. accessory outlet socket into which can be plugged the Sparkrite G.T. Fluorescent Inspection Light (extremely useful for emergency repairs at night) and the Sparkrite G.T. Xenon Dynamic Timing Light for those who wish to accurately "time" the engine to help obtain the best fuel consumption and performance. Also, both models can be used with all types of tachometer.

The G.T.3 version has two indicator lamps, one to tell you the system is wired in correctly and the other a static timing light which only lights if the unit is wired in correctly with the points open. Full details of the use of the latter are included with the comprehensive instructions accompanying each unit.

One other feature on the G.T.3 version is the inclusion of an automatic contact breaker cleaning circuit which burns oil and dirt from the surfaces of the points. Thus the life of the points is increased, pitting and burning being virtually eliminated.

The G.T.3, which is suitable for all vehicles with conventional coil/contact breaker ignition up to eight cylinders, was fitted to an Audi 100LS in need of an engine tune. Also the car battery was in a poor condition and there was a bad connection to one of the sparking plugs. Before fitting the unit, starting —especially in the early morning— was, needless to say, difficult, and occasionally needed a bump start. After starting, it was not unusual for the spark plug with the faulty lead to foul up for a while.

After fitting the unit, which took about half an hour, the difference was incredible. The car did not start first time, but when it did, at the third attempt, it was running smooth and quiet and purred like a tiger. Response to the accelerator was instant. The car was immediately taken for a trial run and found to have a lively response to accelerator demands with greatly increased acceleration. If it can transform a neglected engine to a lively powerful vehicle, just think what it can do for a tuned engine!

The device has been fitted to the car for about 1,000 miles. No precise quantitative measurements have been recorded during this period as far as fuel consumption is concerned, but it has been noticed that the number of visits to the garage for petrol has decreased. Since fitting the G.T.3 no plug foul up has occurred and the car has always started at the first or second attempt.

For further details and price of the Sparkrite range of ignition systems and accessories, contact **Electronics Design Associates, 82 Bath Street, Walsall, WS1 3DE.**

GT3 Ignition from Electronics Design Associates

MODEL RAILWAY CONTROLLER

For those of our readers who are keen model railway enthusiasts, Routier (Electronic Engineers) Ltd., are producing a new power unit and controllers for gauge 00 and gauge N tracks.

Called the Brakeman Power-Pak and Brakeman Controllers, the units are of modular design, the controllers plugging in to the sides of the power units. A power unit can be used alone, with one or two controllers for gauge 00 or with up to six controllers for N gauge tracks.

Each controller has a forward, reverse and central off slide-lever control which governs the motion of one locomotive.

The Power-Pak is fitted with a double insulated transformer (no earth lead required) and an automatic resetting cut-out gives overload protection for all outputs. Two independent isolated output windings of 12V d.c. provide 1A on either side in addition to which a 16V a.c. output with two wander plugs is located at the front panel to provide power for points, motors, signals, etc.

Further information and prices for the Power-Pak and Controller can be obtained from **Routier (Electronic Engineers) Ltd., Ion House, Sheep Lane, London, E8 4QS.**

LOUDSPEAKER KIT

You don't have to be a good carpenter to build the Easikit loudspeaker kits from Studio Electronics.

The teak veneer or white cabinets are ready built and the kit consists of 4 drive units, 4 tweeters, 2 Declon foam fronts, cabinet wadding and sealant, and a p.c.b. crossover pack.

Capable of handling up to 20W, the frequency response of the enclosure is 30Hz to 20kHz ±5dB.

Full details and price list of the Easikit enclosures can be obtained from **Studio Electronics Ltd., P.O. Box 18, Harlow, Essex, CM18 6SH.**

COMPONENTS AND V.A.T.

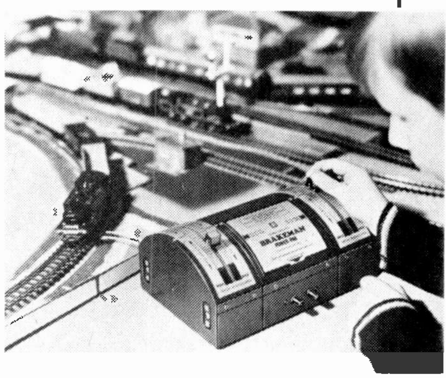
How, precisely, the new V.A.T. rules will be interpreted is far from clear at the time of writing. But one thing is sure. Suppliers of components are in the front line and they have our sympathy. They face the wrath or indignation of their customers when they apply the higher rate of V.A.T. to all components (with perhaps those few unarguable exceptions). The suppliers are, of course, accountable to the tax authorities, so they cannot take chances. In short, when in doubt, the higher rate of 25 per cent is bound to be applied.

The individual customer has no option but to accept the increased price, though if he does feel there is a particular case for exemption from the higher rate he can take the matter up with his local V.A.T. office. This is the only advice we can offer our readers at this time. Some clarification of the situation must emerge before long, though it is doubtful whether much or any relief will be forthcoming.

Soldering irons (and other tools) remain at 8 per cent; so do electronic calculators and hearing aids. Multimeters should by our reckoning also remain as before, but any meter movement capable of being incorporated in radio or audio equipment is subject to the higher rate.

There are many other questionable items . . .

Brakeman model railway power supply and controllers from Routier



PE JOANNA PART 3

By A.J. BOOTHMAN B.Sc.

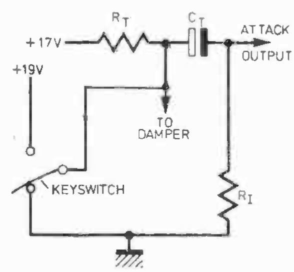
In order to achieve independent operation for each note in the Piano it is necessary to provide a complete envelope generation system linked to each key on the keyboard. Each envelope shaper consists of a Touch Sensitive circuit followed by a Decay circuit. The latter is also designed to mix in the required pitch and to simulate the sustain pedal and damper action of a conventional piano.

TOUCH SENSITIVITY

The touch characteristics are shown in Fig. 3.1, together with the circuitry used to achieve the effect. The keyswitch is normally at ground potential until a note is played, such that the voltage across capacitor C_T is zero. On depression of a key, the switch leaves the ground busbar and starts to travel towards the rail (19 volts) busbar. This allows capacitor C_T to charge through the resistor R_T, such that the voltage on the positive plate of C_T follows curve A, according to the time constant $R_T C_T$ to the final touch level voltage on R_T of approximately 17 volts.

When the key completes its travel a 19 volt pulse is applied to C_T, which for a very short time raises the voltage at the junction of C_T and R_T by an amount equal to 19 volts minus the voltage across C_T at that time. This results in an output which follows curve B, over the range of normal key-travel times of between 40ms and 2ms, offering a variable attack voltage which is passed on to the Decay circuitry.

A closer investigation of the attack pulse shows that two pulses do in fact occur. The first pulse is very small, and occurs at the moment when the keyswitch leaves the ground busbar, and is kept to a minimum by the choice of a high ratio for $R_T : R_I$. Later components in the Decay circuit ensure that this pulse does not get through to the preamplifiers. The values established for R_T are critical in obtaining maximum touch feel, and since they obviously take a fairly high current drain in the rest position, consumption has been minimised by the use of slightly higher values than optimum at the extreme ends of the keyboard. The attack trigger decays very quickly ($C_T R_I$) due to the necessarily low value of R_I. The attack level is proportional to the average speed of depression of the key over the full travel, which is a very similar situation to the final key velocity characteristic of a conventional piano since the latter is normally achieved by an even application of energy.



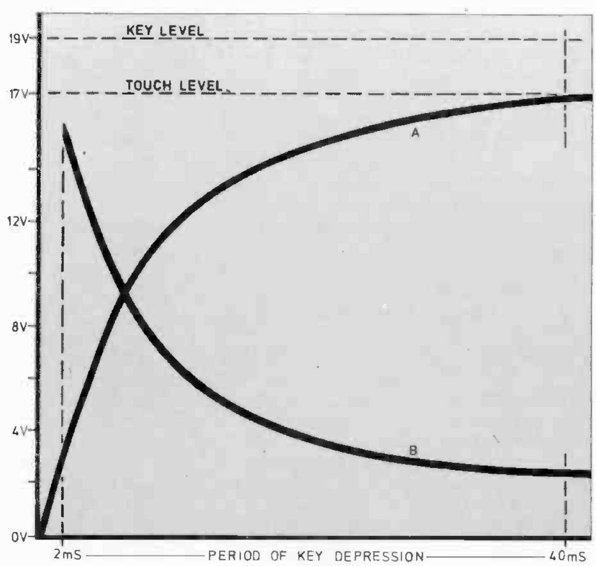
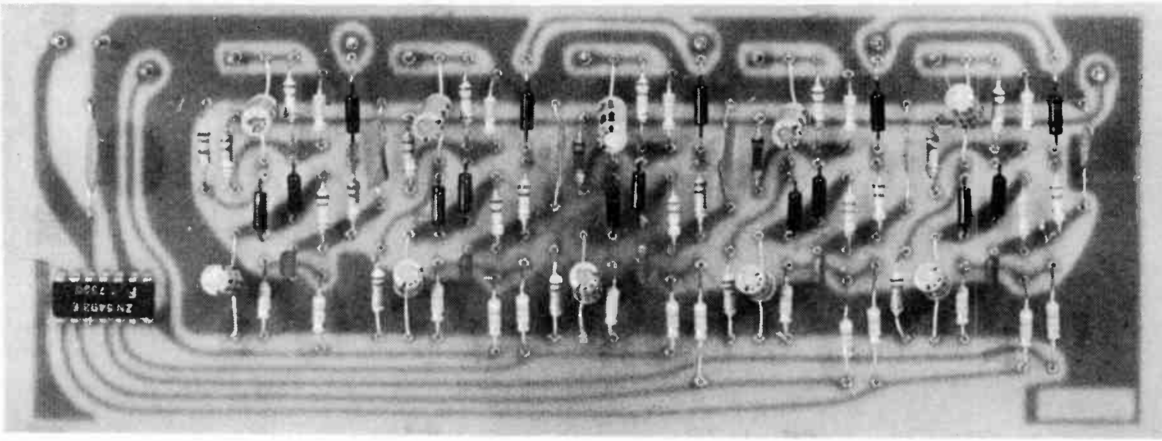


Fig. 3.1. Basic Touch circuitry and explanatory curves



Complete Envelope Board assembly

DECAY CHARACTERISTIC

The Decay circuitry is shown in Fig. 3.2 together with the resulting characteristics in the various modes of operation. The circuit consists of a capacitor C_S, which stores the energy passed to it from the attack pulse, a Damper and Early Decay circuit, and a chopper circuit via which the envelope is modulated to introduce the pitch.

At the moment when the keyswitch reaches the rail busbar, as described in the previous section, the rail voltage is applied to the Damper circuit and the attack pulse appears at the isolating diode D_I in Fig. 3.2. Damper diode D_D normally holds the voltage across capacitor C_S to nearly zero via the damper resistor R_D, but the application of the rail voltage lifts the voltage on the cathode of D_D to approximately three volts. Thus as the attack pulse is applied to C_S through diode D_I the capacitor is allowed to charge to a voltage determined by the ratio of C_S to C_T, followed by a quick decay to a level of three volts plus the forward volt drop of diode D_D. This action is termed the "early decay", and whilst it is fast compared with the final decay action, it is long compared with the collapse of the attack pulse (C_T R_I), such that it is not influenced by the touch portion of the circuit which is isolated by diode D_I immediately after the attack voltage has appeared. The early decay characteristic emphasises the percussive nature of the instrument.

Assuming the key remains depressed the voltage across C_S will continue to decay, but at the much slower rate defined by resistors R_A and R_B. It will be shown later that the chopper transistor works on a 1 : 3 mark space ratio, such that for three quarters of the period the decay time is determined by R_A, and for the remaining quarter of the period it is defined by the sum of R_A and R_B. Different values of R_A and R_B are used for each octave to give a variation in decay time of from approximately 6 seconds to 3 seconds across the compass.

If the key is released before the voltage has fully decayed, the damper resistor R_D will determine the rate of final decay. This action will however be overridden if the sustain pedal is used since the voltage on the cathode of D_D is pulled up by the sustain voltage in a similar manner to the damper release action described above. Release of the sustain pedal brings back the C_S R_D decay as before.

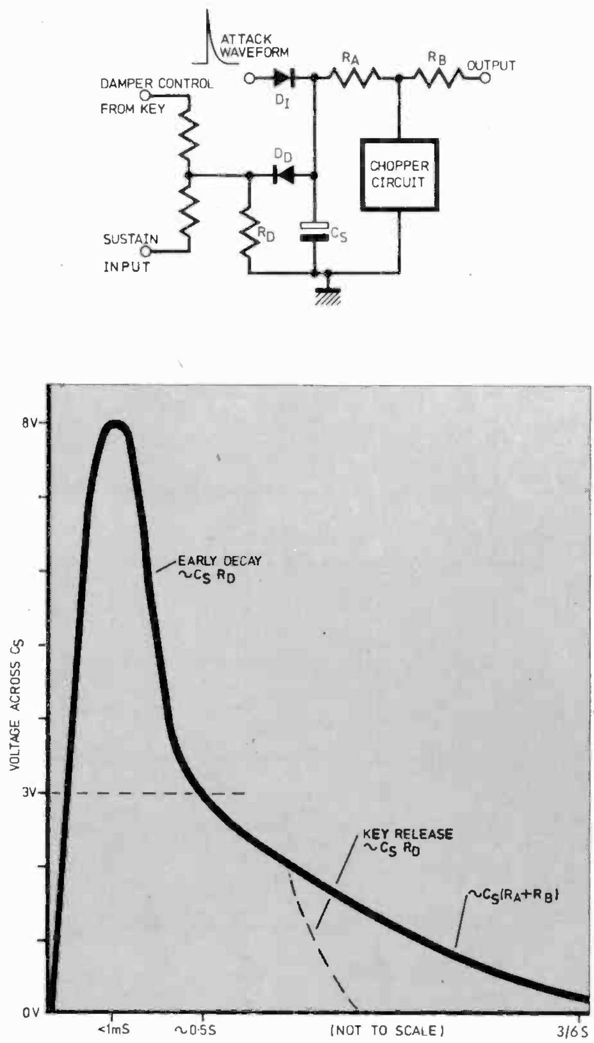


Fig. 3.2. Basic Decay circuit and curve

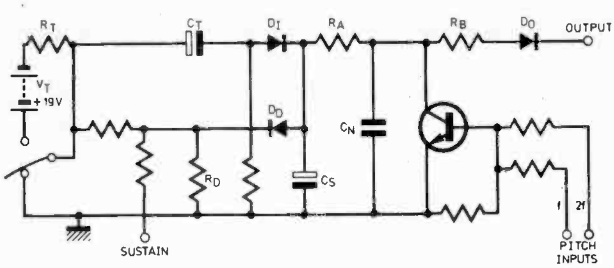
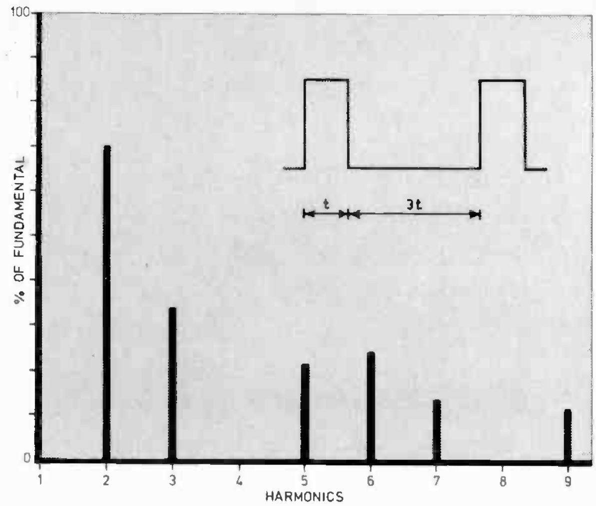


Fig. 3.3. Complete Envelope circuit

Fig. 3.4. Harmonic spectrum of basic waveform is shown on right



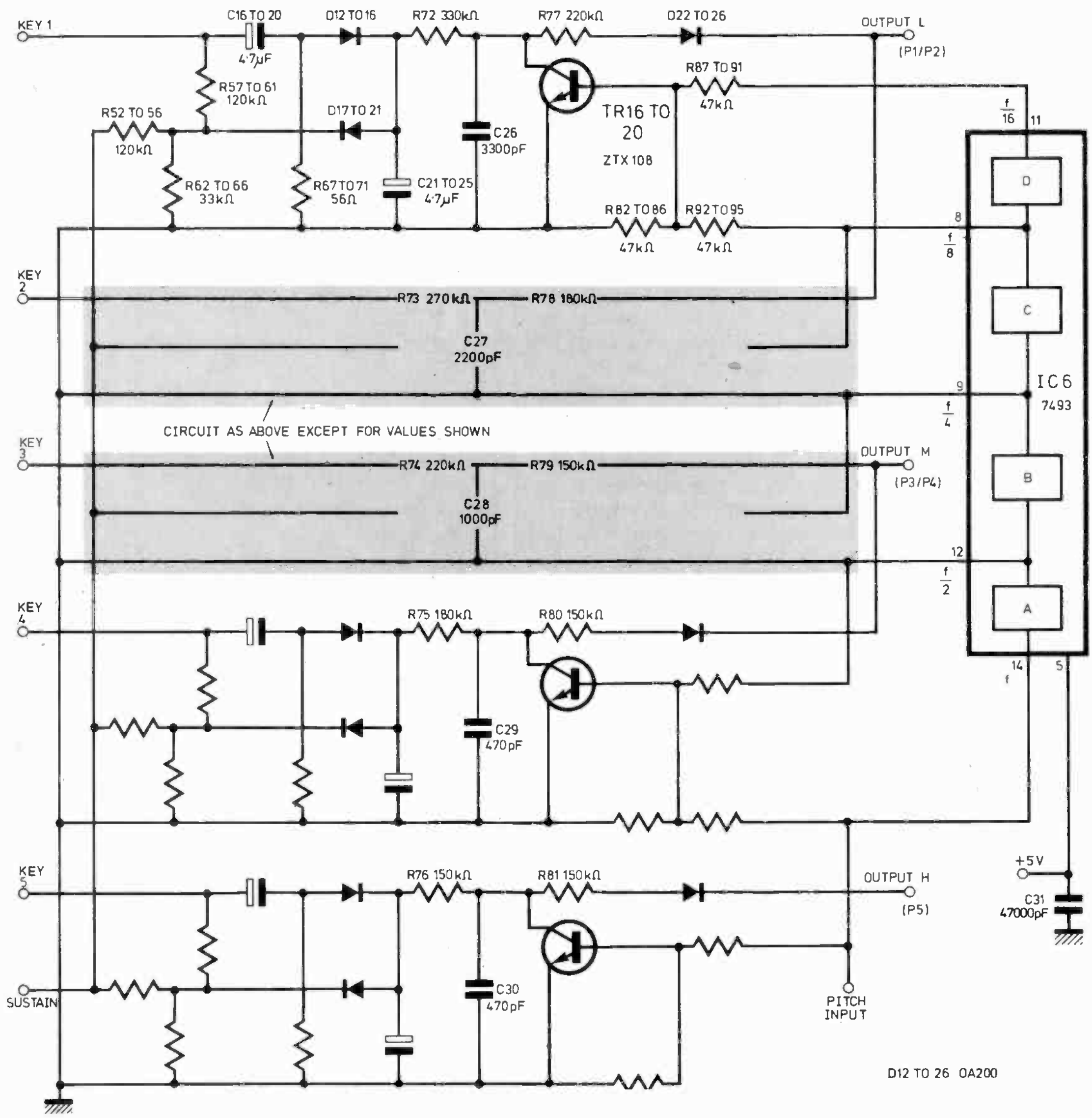


Fig. 3.5. Circuit of an Envelope Board

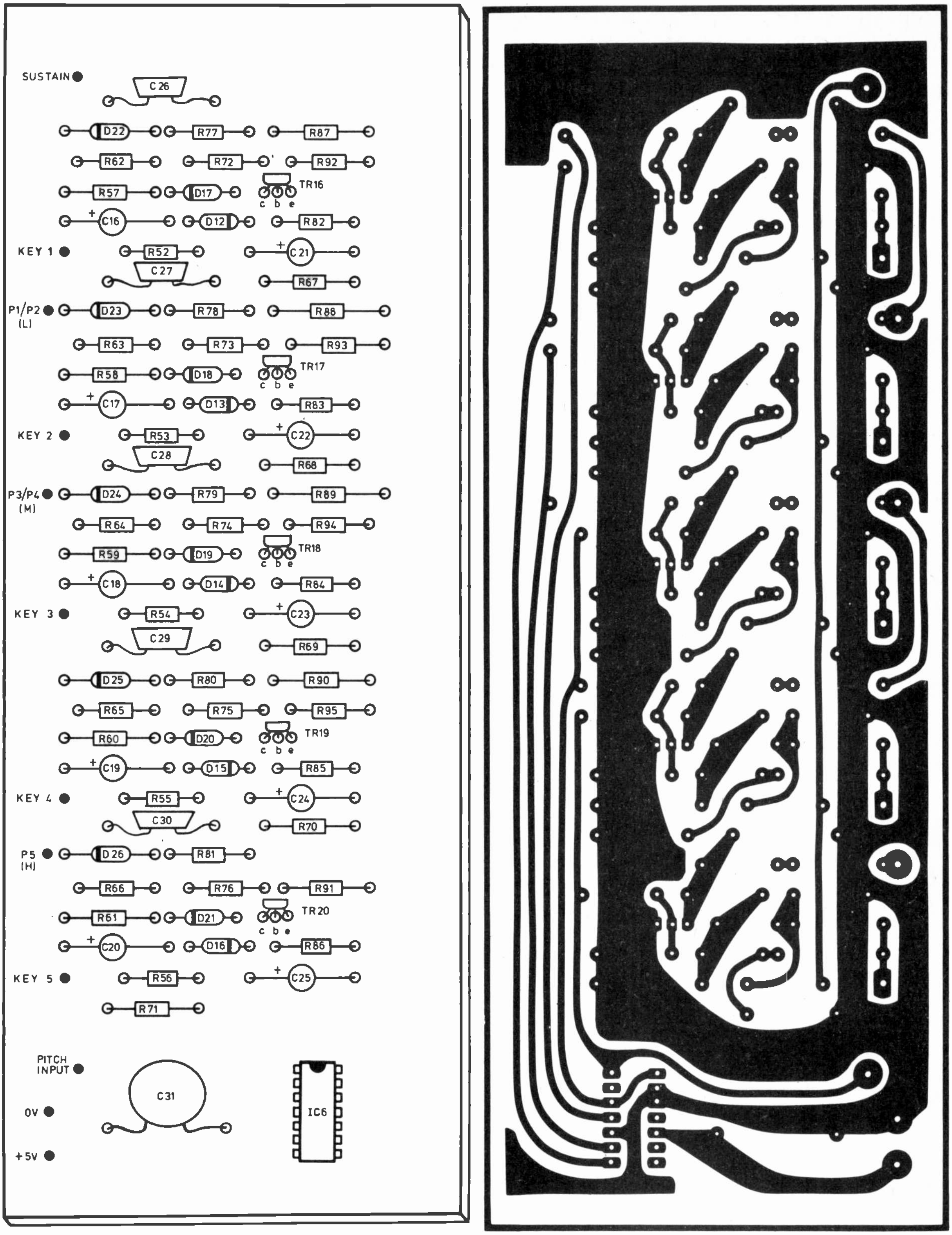


Fig. 3.6. Component layout and etching details for one Envelope Board

COMPONENTS . . .

ENVELOPE BOARD (12 REQUIRED)

Resistors

R52–61	120kΩ	R75	180kΩ
R62–66	33kΩ	R76	150kΩ
R67–71	56Ω	R77	220kΩ
R72	330kΩ	R78	180kΩ
R73	270kΩ	R79–81	150kΩ
R74	220kΩ	R82–95	47kΩ

All ¼ watt 5% carbon

Capacitors

C16–20	4·7μF 25V	C28	1nF
C21–25	4·7μF 16V	C29–30	470pF
C26	3·3nF	C31	47nF
C27	2·2nF		

Diodes

D12–26 Cheap Silicon Diodes (e.g. 1S44, OA200 types)

Transistors

TR16–20 ZTX108

Integrated Circuit

IC6 7493

Miscellaneous

Terminal Pins—12 off.

Glass fibre printed circuit boards, and complete component kits, are available for this project from Clef Products, 31 Mountfield Road, Bramhall, Stockport, Cheshire SK7 1LY.

CHOPPER ACTION

The complete Envelope circuit is shown in Fig. 3.3, which also gives the chopper circuitry. The transistor is driven by two waveforms taken from the quad divider. The two basic frequencies are the fundamental and the second harmonic, both in the form of square waves. The resulting waveform on the collector of the transistor is shown in Fig. 3.4, together with its harmonic spectrum. This is a relatively easy waveform to handle in circuits which are inherently non-linear a more usual staircase type of waveform is completely unsuitable, producing a harmonic change over the period of the decay which is the inverse of the conventional piano tone. The fast edges of this waveform can be dangerous in their tendency to produce "beehive" breakthrough—i.e. a continuous background of every note in the instrument. Capacitor C_N slows the leading edge of the waveform to reduce this effect, and the output diode D_O also acts as a noise reducing element. Further beehive reduction is incorporated in the Voice circuits.

FREQUENCY DIVIDERS

The square waves to drive the chopper transistors are produced by a divide-by-sixteen counter, which has four outputs at half (A), one quarter (B), one eighth (C), and one sixteenth (D) of the input frequency. The divider input is obtained from the gate outputs on the Tone Generator Board, described earlier, and is fed into the circuit shown in Fig. 3.5. The input frequency is also used to produce the top octave pitch waveforms which are simple 1 : 1 square waves.

PRACTICAL ENVELOPE CIRCUIT

The Envelope circuits are grouped as five per board, together with one quad-divider. Each of these combinations copes with all octaves of one semitone across the keyboard, leading to 12 identical Envelope Boards being required. The full circuitry for one board is shown in Fig. 3.5. The board contains five key inputs, one sustain input, and one pitch input. The outputs are grouped to cover the bottom two octaves, the middle two octaves, and the top octave, at separate output terminals. The board requires only one 5 volt supply, to power the divider.

ENVELOPE BOARD CONSTRUCTION

Each group of Envelope circuits is constructed on a printed circuit board 203 × 76mm, the etching and drilling details for which are given in Fig. 3.6 together with component details.

To assemble the board the terminal pins should be fitted, followed by resistors, capacitors, diodes, transistors and integrated circuit. It is important that both the transistors and the integrated circuit should be inserted with the correct orientation.

DIODES

The author has used diodes in the prototype which can be described loosely as manufacturer's rejects, of silicon planar type in DO-7 encapsulation. To test the diodes a multimeter was used with 20kΩ/volt sensitivity (1kΩ range). Diodes were rejected where a movement of the needle was observed in the reverse polarity position, whilst the forward resistance was generally of the order of 12kΩ, although no specification was applied to this parameter. Occasionally a diode selected in this way gave some trouble if used in the output position (breakthrough) but the success rate was very high, after the diodes had passed the test. The forward resistance is measured when the negative lead of the multimeter is connected to the anode, and the positive lead to the cathode of the diode.

TESTING THE ENVELOPE BOARDS

The Envelope Boards can be tested one at a time using the jig described in earlier articles. Since the power supplies are unregulated (apart from the 5 volt logic supply) the warning is repeated to keep a check on the supply levels, particularly to the Tone Generator Board, whilst performing any partial check-out experiments.

NOTE: in Fig. 2.3 the 9V and 17V legends should be reversed.

Next month: Voice Filters and final circuitry

POINTS ARISING

ULTRASONIC DOPPLER SHIFT INTRUDER ALARM *(March 1975)*

The battery and S1 connections as shown in Fig. 5, page 208, should be reversed to agree with the circuit diagram of Fig. 2.

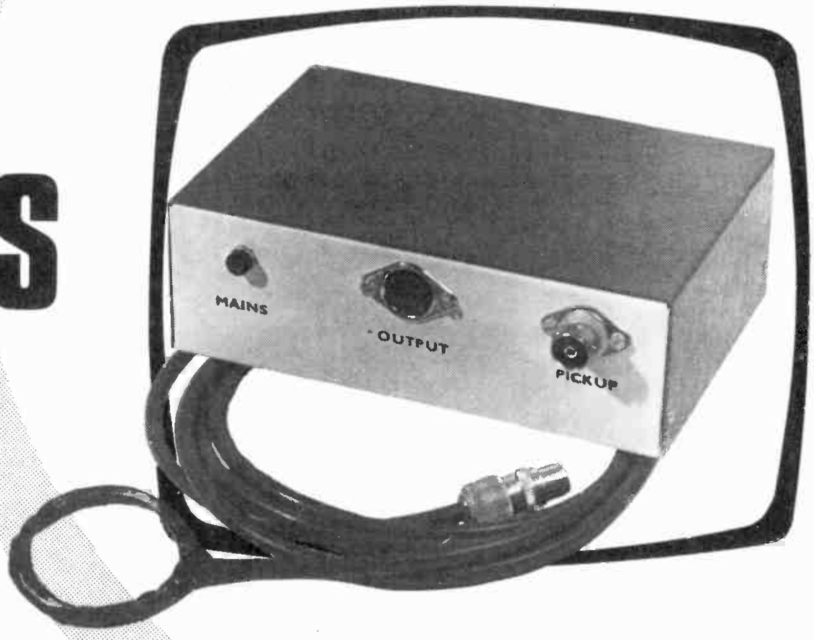
LIGHT PIPE *(January 1975)*

Parts list, page 31, Veroboard dimensions should be 24 strips by 37 holes.

THERMOMETER/CONTROLLER *(December 1974)*

In the component layout of Fig. 2 the circuit points 1 and 8 should be reversed together with their polarities. In the Veroboard cutting details there is no need for a cut at B5, Fig. 2. In Fig. 3, the switch positions 3 and 4 should be identified 0 to −100°C and 0 to +100°C respectively.

IN NEXT MONTH'S ISSUE....

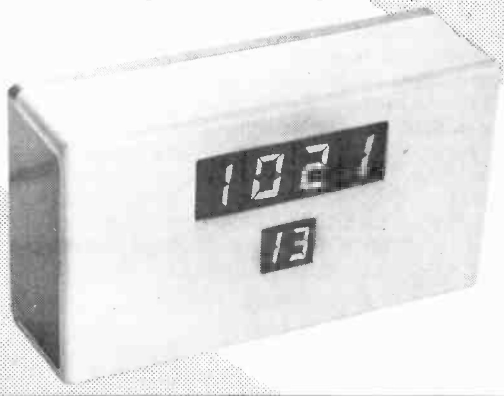


T.V. SOUND UNIT

A sound unit designed to detect the 6MHz radiation from a t.v. set i.f. strip and convert this into quality sound output suited to processing in the normal domestic hi-fi equipment, thus avoiding the hum and narrow band-width problems normally associated with t.v. sets

8-Channel Logic Trace Multiplier

Converts normal single-beam oscilloscope into an 8-channel unit for logic waveform examination; or a double-beam unit into a 9-beam instrument capable of displaying one channel of analogue data and eight of logic



DIGITAL CLOCK

An electronic clock using proprietary components to achieve a simple and sensible design suited to use on 50 or 60Hz mains as either a 12 or a 24-hour unit with equal facility

SYMBIOSIS...

A composition for the PE MINISONIC

By M. POINTON B.Mus.

THIS is the second and final part for setting up the Minisonic for performing the specially prepared composition "Symbiosis".

SEQUENCE I TO O

This is the central section of the piece and the one requiring the most careful setting up. The pitches (which appear on the score as thick horizontal lines tapered at the end) are crucial to the effect produced.

Firstly the keyboard must have its Span set to give an equal-tempered scale (i.e. 12 equal divisions of pitch from one note to its counterpart an octave higher). Set KBD CON Span to 5, adjust KBD CON Tune to a comfortable mid-range level (about 6 with VCO2 Freq at 6·2). Set the note a at Concert A pitch (440Hz) using some external musical instrument. When you have this, insert a spare 3·5mm jack into the keyboard over-ride plug of VCO1. Now tune VCO1 to an octave below the note on VCO2. This is now your standard reference frequency. By gradually adjusting KBD CON Tune and Span you will eventually reach a perfect octave span. This will take quite a long time to achieve, so do not be dismayed if things do not go well right away. Once the Span is fixed the niggling problems are over. Make quite sure that you do not accidentally move KBD CON Span whilst working on this sequence or all the blood, sweat and tears will have to be re-lived.

Remove the jack plug from VCO1 keyboard over-ride and re-tune the oscillator to an octave below VCO2. The two v.c.o.s will track each other quite faithfully over a large part of the keyboard's range. The rest of the settings can now be made quite quickly. For controls:

VCA1 and 2	Level 11
ES1	Attack 2
	Decay 3·8
ES2	Attack 1
	Decay 4
VCF	Level 11
	Q 9
	Freq 7·5
CE	Fully clockwise
VCOs, KBD CON	as above

For patch-cords:

3D to 5C; 3C to 3F

As you will see from the score there are 15 repetitions, lasting eight seconds each, of a simple two-note figure along the bottom line. The first (A) lasts for two seconds, the second (A♯) lasts for six seconds. As you play these two notes, touch the keyboard for only about half a second to allow the resultant harmonics to sing through. With the control settings given the A♯ will last about nine seconds, so the continuity of line is built in.

ADDING REVERBERATION

The last refinement concerns the tape machine. Arrange your input and output levels on both the mixer and the stereo machine (track one) so that a small touch of tape reverberation is added to the sound. Too much will muddy the signal, too little will take away its resonance. Make two separate recordings of this sequence of events; the second one will be used again towards the end of the piece.

At letter L you are free to choose which notes you play provided: (a) they begin at about one per second and accelerate to no more than three per second, and (b) they do not wander very far in pitch from the four or five notes immediately above A♯. At letter M you increase the amount of tape feedback until the sounds you are making distort into a general mess of reverberant tape noise; this reaches its peak after four seconds, and over the next ten seconds ease the feedback down to a level where the sound dies away of its own accord.

Having laid down one line on track one, change over to record on track two and set up the synthesiser for the line of thick horizontal strokes and the wedge-shapes above them. This musical line is dealt with in a similar way to the material just completed, although the control settings and patches are different—except, of course, for KBD CON Span and VCO2. For controls:

VCA1	Level 11
VCA2	Level 1
ES1	Attack 1; Decay 3·2
ES2	Attack 1; Decay 1
VCO1	Level 1
VCF	Level 11
	Q 11
	Freq 6·8
CE	Fully Clockwise
N	Level 3

For patch-cords:

3C to 3F; 3A to 3E; 3D to 1A

Set the previously recorded channel running. As soon as you have heard the first two notes of the recorded sequence, add the next two notes (c′ and c♯′) in equal time—i.e. two seconds after the prerecorded second note and lasting two and six seconds respectively meanwhile increasing the level on the mixer from silence to a comfortable maximum over 24 seconds. When you arrive at letter L try to follow the speed of the notes in the recorded channel without wandering too far in pitch from c♯′ and again, at M increase the reverberation as before until it overwhelms the system and then is allowed to die away.

The final overlay does not require tape reverberation, so feed both the recorded channels through the mixer into the second tape machine.

IMPROVISATION

The score at this point allows for some freedom of melodic line; for 40 seconds you improvise on the notes f,a,a♯,c♯′, and d♯, and for 48 further seconds the notes f♯,g♯,a♯,c♯,d♯′. At letter L you stop playing until letter N where two slow notes appear amidst the aftermath of the tape reverberation—g♯ followed by g. The settings for this line of music are:

VCO1 and 2	As previous setting
KBD CON	Ditto
ES1	Attack 2·5; Delay 4·5
CE	Fully clockwise
VCF	Level 11; Q 11; Freq 3·5

For patch-cords: 3D to 1A; 3C to 3F; 5D to 3E. At letter O the tape is cut.

The final triangular block in this sequence is a cataclysmic slam of white noise which is tape reverberated and allowed to die at its own rate, recorded separately and spliced on to the previous recording. The control setting is:

VCA1	Level 11
VCO1	Level 1
ES1	Attack 1; Decay 4
N	Level 10

For patch-cord: 3A to 1A.

FINAL SEQUENCE: P TO END

Between P and R three separate kinds of sounds are heard in counterpoint. The first to appear (small black arrowheads in the score) is a sequence of band-pass filtered white noise; the second (shown as a wavy line) is a modulated and filtered VCO signal; the third (small egg shapes) is a short-lived "Wah-Wah" sound.

The recording procedure is identical to that used in Sequence D to I but, of course, this time you need to make three separate control settings and patches. If you are to save time in producing this Sequence then pretty precise timing will be required between P and S; the arrowhead sign appears consistently between P and Q, once only between Q and R, and very exposed between R and S—and all this over almost two minutes' duration. Similarly the occurrence of the other two symbols which appear at various times after Q.

The KBD CON Span is not critical in this Sequence since the randomness works much in the same way as the counterpoint beginning at D. However, the egg-shaped symbols must be kept around mid-range and the overall speed of events is slower than before.

Begin by recording, with the aid of a watch with a seconds hand, the arrowheads at a fairly high dynamic level throughout; the lowering of dynamic at Q et seq. can be effected on the final dub using a mixer control. The single arrowhead between Q and R will appear at approximately 71 seconds from the beginning. Record the whole of this line of music on your *second* tape machine. "Arrowhead" control settings are:

VCA1	Level 11
ES1	Attack 1; Decay 2·5
VCO1 and 2	Level 1
N	Level 9
VCF	Level 11
	Q 11
	Freq 7
KBD CON	Tune 10; Span 11

For patch-cords:
3D to 1A: 3A to 3E; 2E to 3F

Next play back the recording from the second tape machine through the mixer on to track one of the stereo tape machine along with the egg-shaped symbols. Again you will need to "watch the clock". Do not forget to let the tape run well over the 113 seconds required before switching off otherwise unwanted clicks will occur in the finished sequence.

"Egg-shaped" control settings:

VCA1 and 2	Level 1
ES1	Attack 2; Decay 2·5
VCO1	Level 10; Freq 7
VCO2	Level 10; Freq 6·5
VCF	Level 11
	Q 11
	Freq 4
CE	Fully clockwise
KBD CON	Tune 4; Span 5

For patch-cords:
3D to 1C; 1D to 3E to 5D; 3F to 3C

The next overlay will be recorded on to track two of the stereo tape machine. Your second tape machine has the tape made earlier of the eight-second note patterns in Sequence I to P. This will be fed in at R, rather quietly, just after you have finished your last bit of stylus work on the wavy line. For "Wavy Line" controls:

VCA1 and 2	Level 1
ES1	Attack 1; Decay 2·3
VCO1	Level 11; Freq 4·5
VCO2	Level 11; Freq 7
VCF	Level 11
	Q 11
	Freq 4
CE	Fully clockwise
RMOD	Level 10
KBD CON	Tune 6·5; Span 11

Patch-cords:
F1 (over-ride plug); 3E to 4D; 3C to 3F;
4E to 5D; 3D to 1C

VCO1 frequency may need slight adjustment in order to give this sound a distinctive stuttering effect.

The last three surges of white noise are dealt with manually by means of the VCF frequency control and then spliced on to the rest of the work. For white sound controls:

N	Level 9
VCF	Level 11
	Q1
	Freq as required.

All other units level 1.

Patch-cords:
3D to 1C; 3A to 3E

And that completes "Symbiosis". ★

NEW DEVICES ...APPLICATIONS

SOLID-STATE POWER CONTROL

THE CONTROL of power to fairly large unity power factor loads, that is loads which do not normally include inductive and capacitive items, such as electrode water heaters and radiant heating processes, has always been difficult for two basic reasons.

The already well-known phase control technique which is used for power control in resistive loads, as shown in Fig. 1, is just out of the question since it causes disturbances in the supply waveform as in Fig. 2.

Such disturbances can be avoided by using zero-crossover switching, Fig. 3, when the power is controlled by allowing more or less cycles of the supply to pass to the load. Switching of the selected cycles occurs as the voltage (or current) passes through the zero condition, thus avoiding r.f.i. problems.

However, if a wide area of control is to be achieved as from zero to 100 per cent with a three-phase supply, then a new problem appears; lamp flicker can be induced because of subharmonics met in the various combinations of switching. Equally, conduction sequences can introduce periods of d.c. in the load which, for electrode water heaters, would cause electrolysis.

Two workers at the University of Nottingham, R. M. Davis and B. R. Downing, have developed a solid state svstem for control of power under such circumstances which avoids the problems.

SWITCHING SEQUENCE

Taking the case of three phase resistive loads and in particular an electrode water heater as an example, their method can be described with reference to Figs. 4 and 5. With the load in a star-delta configuration and the contraint that the triacs be switched only at zero crossing, a switching sequence was developed.

With a switching sequence which repeated itself every three cycles the number of different permutations in which the three triacs could be switched can be shown to be in excess of 2×10^6 but this number includes many identical power levels and many sequences which would produce a d.c. component.

A computer selection programme was utilised to remove these problem sources altogether, together with those other sequences which might produce 16Hz or 25Hz lamp flicker, and a final set of 24 acceptable power levels were produced.

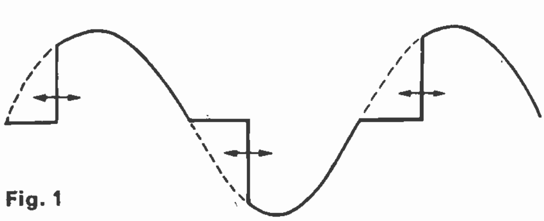


Fig. 1

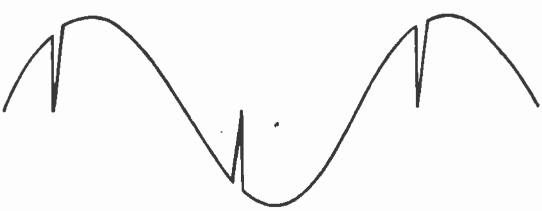


Fig. 2

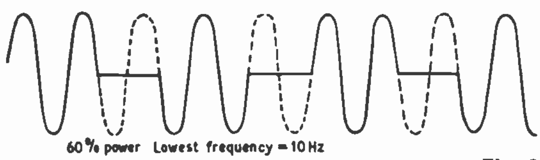


Fig. 3

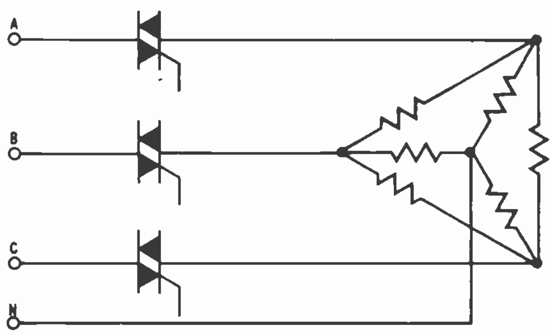


Fig. 4

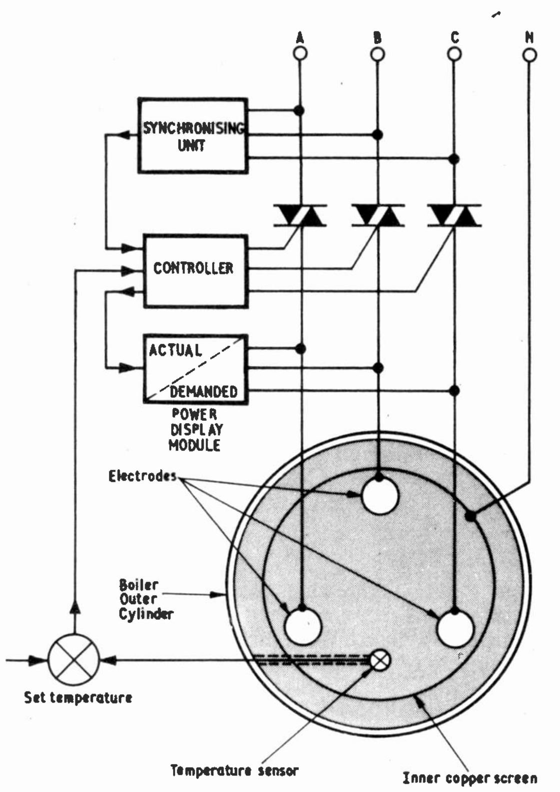


Fig. 5

From these some 19 were selected to give an even 0 to 100 per cent power control.

Currently a 75kW version of the controller is in use with an electrode water heater. The temperature of the water is continuously monitored and fed back to the controller to provide temperature maintenance to a required level. The system is cheap, simple and compact, and other areas of application will include such items as paint-drying ovens, three-phase immersion heaters, ovens and so on.

Further information can be obtained from **Electrical Engineering & Electronics Group, NRDC, Kingsgate House, 66–74 Victoria Street, London, SW1E 6SL.**

ULTRASONIC I.C.

Remote control of T.V. sets, particularly colour sets, is a subject which has gained particular interest in manufacturing circles for some time now. Various methods of linking the hand-held control unit to the set have been proposed ranging from the obvious hard-wired style through to infra-red and ultrasonic linking.

Each method has associated advantages and disadvantages but obviously any solution using hard wiring is out. Of the others, a great deal depends on the sound or light characteristics of the domestic environ.

After much deliberation and research, ITT Semiconductors have come up with an integrated circuit ultrasonic solution to the problem using two basic chips, a transmitter and a receiver. These are available in 15-channel and a 30-channel form as pairs and can be used to effect both discrete switching functions for channel changing, and analogue (gradual) adjustments to such parameters as volume, colour and brilliance.

The new devices use discrete frequency steps in the 30kHz to 45kHz band and these are crystal-controlled at both transmitter and receiver to avoid incorrect triggering. Cost is envisaged to be in the region of £10/pair for 15 channels and £15/pair for the 30 channel. The final cost to the set user would of course be more.

Further details from **ITT Semiconductors, Footscray, Sidcup, Kent.**

SINGLE IC TV SOUND CHANNEL

The TDA 1190 is a new integrated circuit from SGS-ATES which, with the addition of a few external components, forms a complete TV sound channel taking the sound i.f. from the tuner and producing up to 4·2W into a 16 ohm load.

The input limiting voltage of the i.f. section is only 30μV and the electrical characteristics remain constant over the range 4·5 to 6MHz making the i.c. suitable for use with all television standards.

A single resistor is used to set the a.f. amplifier gain and a single capacitor sets the upper cut-off frequency. There is d.c. volume control which can be achieved by connecting a variable resistor between an i.c. pin and earth. This gives a control range of typically 90dB.

Supply voltage can be anywhere between 9 and 28V.

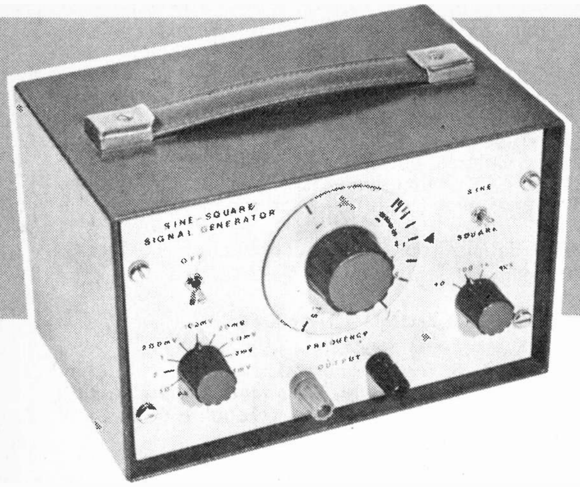
Further details from **SGS-ATES, Planar House, Walton Street, Aylesbury, Bucks.**

QUAD 80-BIT STATIC SHIFT REGISTER

Another new i.c. from **SGS-ATES** is the M142, a quad, 80-bit static shift register. Most semiconductor manufacturers produce quad 80-bit MOS devices, but the M142 is unusual in that it only requires a single 5V supply line. This completely eliminates the need for interface circuits when using the device with TTL.

Each of the four 80-bit shift registers has an independent input, output and recirculate control, though the single clock line is common to all four registers.

The data can be shifted into or out of the registers at anything up to 3MHz. Total power dissipation is a mere 125mW.



SINE/SQUARE WAVE SIGNAL GENERATOR

By J. SMITH

A GENERAL purpose oscillator is a useful item of test gear in any electronic workshop. The instrument described in this article is intended for audio, digital and general purpose use. The design employs simple components which are readily available from component suppliers. Output frequency is continuously variable over four decade ranges from 10Hz to 100kHz and the output signal, which is 10V peak-to-peak, can be attenuated with a switched attenuator down to 1mV.

The output will drive loads down to 600Ω on the 1 to 10mV ranges and 100kΩ on the ranges above 20mV.

The oscillator requires a positive and a negative 15V supply. Readers having suitable external power supplies can economise by using such a source. However, the full design incorporates a suitable power supply since we believe that most people will prefer a compact, self-contained instrument.

OSCILLATOR

Fig. 1 shows the sine oscillator circuit. In this circuit an SN 72709 integrated circuit IC1 is wired as a thermistor-stabilised Wein Bridge oscillator, the main requirements of which are to produce positive feedback with unity gain. In this instance the Wein Bridge supplies the positive feedback required, but in doing so attenuates by 1/3. Therefore, to sustain oscillation the resistor ratio R5 to R3 achieves the required gain of

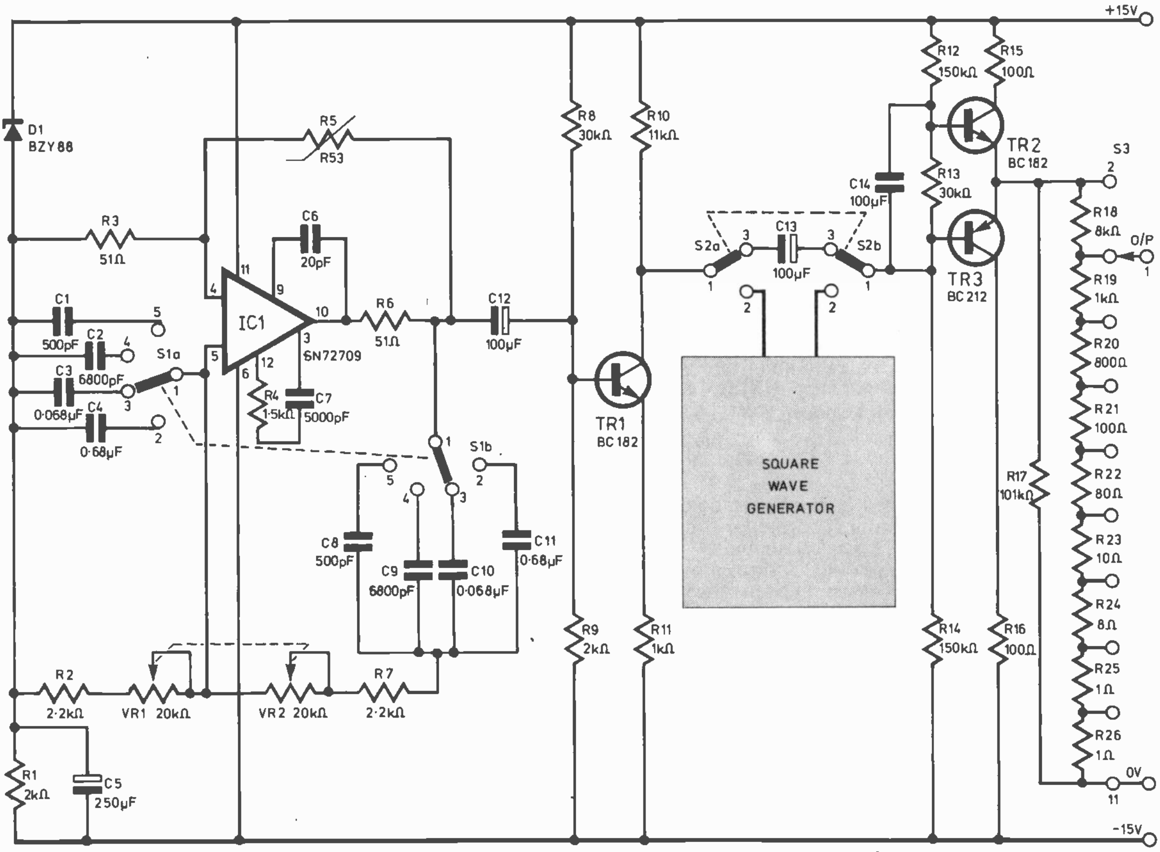


Fig. 1. Circuit diagram of the sinewave generator and output amplifier/attenuator

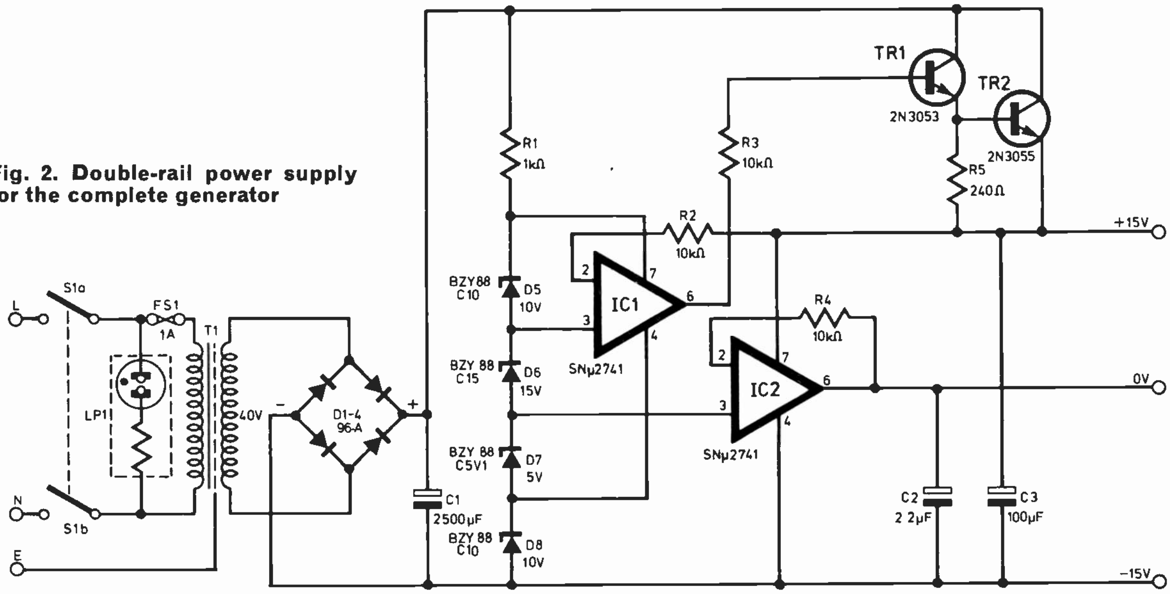


Fig. 2. Double-rail power supply for the complete generator

3; here R5 is a thermistor. The circuit incorporates frequency compensating components C7, C6 and R4 to form a basic stable amplifier.

The stabilisation thermistor, R5, controls the output voltage level: an increase in voltage will heat up the thermistor, so decreasing its resistance, and reducing the gain. Conversly, a fall in output voltage reduces the power dissipated in R5, so it cools down, and its resistance increases. This arrangement stabilises the output level of the oscillator. This output feeds the positive feedback loop via the frequency selective components C8 to C11 and VR2 to pin 5 of IC1.

The product of capacitance C and resistance R determines the frequency of oscillator output according to the formula:

$$\text{Frequency} = \frac{1}{2\pi CR}$$

Since in this oscillator both the series resistance R7 and the variable resistance VR2 affect the frequency, we must substitute (VR2 + R7) for R in the formula, so that in this instance:

$$\text{Frequency} = \frac{1}{2\pi C\,(\text{VR2} + \text{R7})}$$

Because of its limited slew rate the 72709 operational amplifier IC1 will produce a distorted large signal output at high frequencies, so the output swing is limited to a few volts. The Zener chain, R1, D1, ensures that the swing is either side of earth potential.

Coupling the limited output from IC1 to a transistor amplifier TR1 through capacitor C12 produces a high signal level. The amplified oscillator signal appears across R10, the collector load of TR1. This signal passes from the amplifier via switch S2 and C13 to the output driver circuit TR2/TR3.

OUTPUT ATTENUATION

The square wave generator is an add-on circuit which one can omit readily by coupling directly through C13, so leaving out the sine/square switch S2. TR2 and TR3 feed the output signal to a simple attenuator circuit, which gives off-load peak voltages from 10V down to 1mV in a 10, 2, 1 sequence.

Loads down to 600Ω on the 1 to 10mV ranges and loads of 100kΩ or more on the 20mV to 10V ranges will have little effect on these output voltages.

Readers who have suitably stable power supplies to attach to it will find that the circuit shown in Fig. 1 makes an extremely simple and useful instrument in its own right. Anyone requiring more accurate control of the output voltage can easily fit a meter circuit measuring the 10V peak across R17. In such an arrangement varying R10 or R11 by a small amount before making each measurement will adjust the output voltage to a pre-set level. We have not included such an arrangement since the instrument is stable enough for the majority of applications.

POWER SUPPLY

As many readers who decide to construct this instrument will require a self-contained unit, a suitable stable power supply is given. Fig. 2 shows the circuit diagram for this supply.

In this circuit 40V output transformer T1 together with diode bridge D1–D4 and the smoothing capacitor C1 provide a roughly smoothed output of 55V. This voltage feeds the Zener chain D5 to D8 through resistor R1 to provide the reference voltages shown on the circuit diagram.

The roughly smoothed d.c. also passes to a series regulator TR2. Primarily this section of the instrument provides a 30V stabilised supply. IC2 samples the output voltage through R2 and compares it with a reference voltage of 30V developed at the junction of D5 and D6. The error signal passes via R3 to amplifier TR1 which drives the series regulator TR2, thus forming a conventional 30V stabilised supply. IC2 changes the 30V supply into the ±15V supply required to drive the oscillator.

Because IC3 will only function correctly with the balanced load of the oscillator, this arrangement is quite unsuitable as a general purpose power supply and on no account should be used as such.

The two circuits shown in Figs. 1 and 2 together make a very compact instrument for constructors, who do not wish to incorporate the square wave circuits.

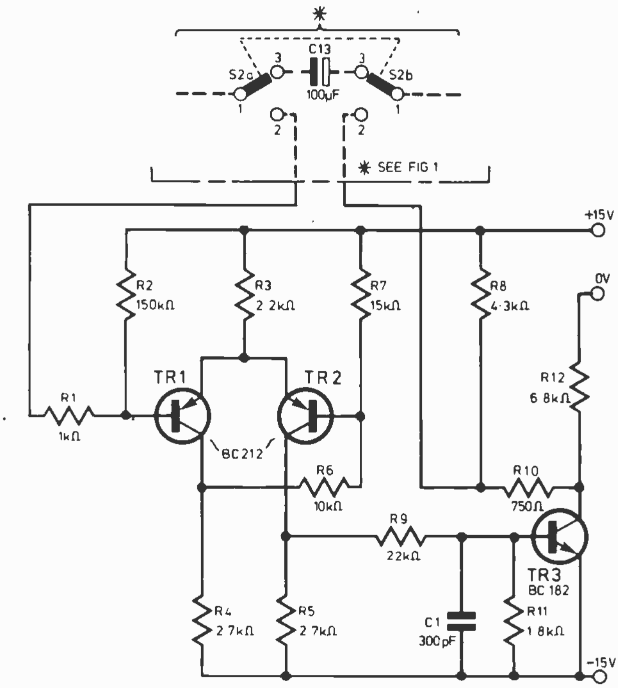


Fig. 3. The squarewave generator section circuit

SQUARE WAVE GENERATION

The sine wave oscillator is designed so that the square wave circuit is add-on, as it were. This enables users not immediately interested in square waves to use the signal generator and to add the squaring facility later. Fig. 3 shows the circuit diagram of the square wave generator with details of S2, Fig. 1, included.

When S2 is switched to square-wave, the sine wave signal passes to a Schmitt trigger circuit consisting of TR1 and TR2. In this trigger circuit TR1 is normally off and TR2 is fully conducting since its base is driven from the −15V line via R4 and R6; the circuit remains in this condition as long as a positive half-cycle is applied to TR1 via R1.

When the sine wave input falls through zero to a negative potential, TR1 starts to conduct and the potential at its collector starts to fall, so reducing the current through R5. This change in current is transferred via the emitter of TR2 to the emitter of TR1 and encourages TR1 to "switch on" even faster, so the circuit "changes over" regeneratively.

A similar regenerative action occurs as the sine wave passes from negative to positive. The collectors of both TR1 and TR2 show a square wave signal and that from TR2 passes to amplifier TR3 which ensures that the output signal switches between ±10V.

COMPONENTS . . .

SQUAREWAVE GENERATOR

Resistors

R1	1kΩ	All 5% ¼W carbon
R2	150kΩ	
R3	2·2kΩ	
R4	2·7Ω	
R5	2·7Ω	
R6	10kΩ	
R7	15kΩ	
R8	4·3kΩ	
R9	22kΩ	
R10	750Ω	
R11	1·8kΩ	
R12	6·8kΩ	

Capacitors

C1 300pF

Semiconductors

TR1/TR2 BC212, 2-off
TR3 BC182

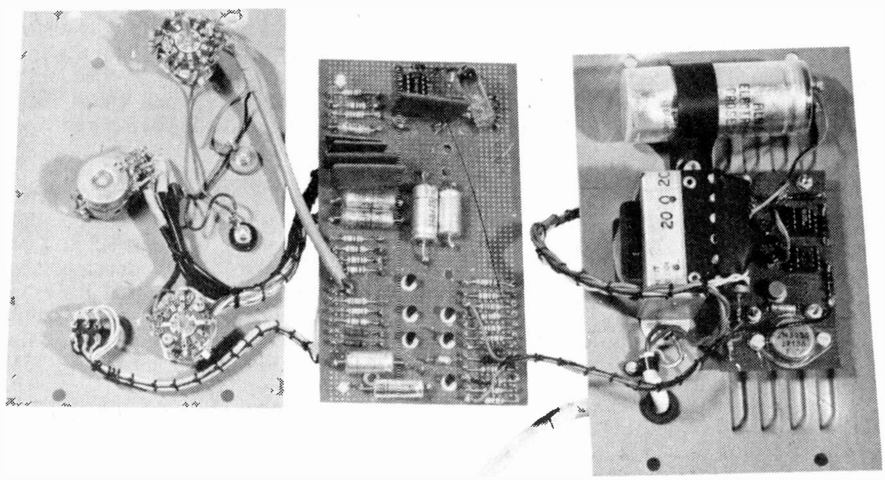


Fig. 4. General arrangement of the circuit boards and main components on the front and back panels

COMPONENTS . . .

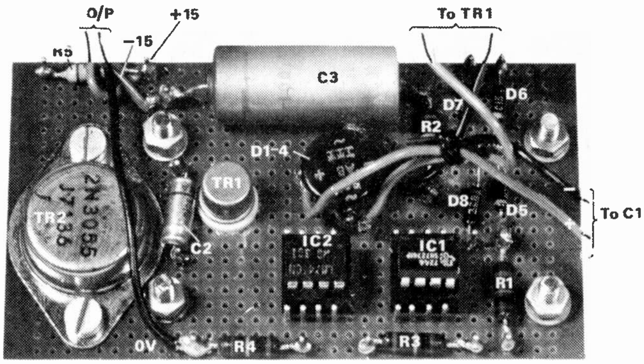
POWER SUPPLY

Resistors
- R1 1kΩ
- R2 10kΩ
- R3 10kΩ
- R4 10kΩ
- R5 240Ω
- All 5% ¼W carbon

Capacitors
- C1 2,500μF, 64V
- C2 2·2μF
- C3 100μF, 50V

Semiconductors
- IC1/IC2 SN72741, 2-off
- TR1 ZN3053, 2N3053
- TR2 ZN3055, 2N3055
- D1, 2, 3, 4 100 V p.i.v. bridge, 40mA (96A, ITT)
- D5 BZY88 C10
- D6 BZY88 C15
- D7 BZY88 C5V1
- D8 BZY88 C10

Miscellaneous
- S1 2-pole mains on/off
- FS1 1A cartridge fuse and holder
- LP1 Neon indicator unit
- TR1 Mains (240) to 40V (20–0–20), 40mA transformer
- Matrix board, 95 × 55mm



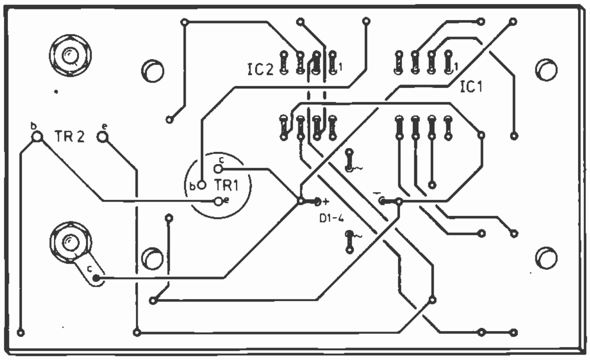


Fig. 5 (top). Component layout for the power supply board

Fig. 6 (bottom). Wiring details for the layout of Fig. 5

CONSTRUCTION

A standard instrument case measuring 8½×5½×5½in (216×140×140mm), provides a suitable unit in which to house the generator. The photograph of Fig. 4 shows the general arrangement of the three main sections, front panel, main board and back panel.

First the power supply components are mounted as shown in Figs. 5 and 6, with the exception of the capacitor C1 and mains transformer, on a 55×95mm, 0·1in matrix board. The matrix is mounted on the back panel using 4BA spacers to give the required board clearance. Next mount the transformer and capacitor directly on to the back panel using a "P" clip to fasten the capacitor as in Fig. 4. FS1 and LP1 are omitted in the prototype.

The oscillator assembly is made up on a 175×95mm matrix board as in Figs. 7 and 8. This assembly includes the components which comprise the oscillator and square wave generator. This board is mounted on the bottom of the unit, again using 4BA spacers to provide the required board clearance.

Fig. 1 shows the oscillator as two distinct sections, oscillator and output amplifier, and the square wave generator. The recommended layout shown in Figs. 7 and 8 preserves these distinctions.

Board wiring is not critical providing one adopts a sensible approach. Mount all other components having control functions on the front panel, for example the attenuator output switch, S3, with the resistors R18 to R26 mounted on the switch itself.

Finally, attach the flexible interconnecting leads to the oscillator board, power supply and front panel. Keep the transformer wiring separate and connect it directly to the mains switch S1 and bridge rectifier connections. Make the mains earth connection to the chassis. Run the two wires from the output terminals directly to the output switch S3 pins 1 and 11.

The remaining interconnecting wiring in the prototype was divided into three distinct looms, wire idents providing individual wire identification. The first loom consisted of three power supply wires, the second of the wiring concerned with the sine-square switch S2, and the third included the Wein bridge potentiometer wires and the output wiring to the attenuator switch S3. These wires must be screened and the screens connected to the chassis via a tag on the front panel. Keep wire lengths to a minimum, but long enough to enable back and front panels to be laid flat for wiring and test purposes.

COMPONENTS

Close tolerance capacitors in the timing circuits will yield the best results; silver mica capacitors are particularly suitable. Also the twin ganged potentiometer VR1, VR2 needs to be of good quality. Because single screened wire has an inherent capacitance, this affects the frequency output in the 100kHz range, and to compensate for the value of the capacitor, C8 is varied from that determined by the formula. Readers who do not have accurate resistance or frequency measuring test gear should obtain the best possible twin potentiometers they can afford, together with 1 or 2 per cent capacitors in the timing circuits. This helps to increase the accuracy of calibration.

COMPONENTS . . .

SINEWAVE GENERATOR

Resistors

R1 2kΩ 5%
R2 2·2kΩ 2%
R3 51Ω 2%
R4 1·5kΩ 5%
R5 STC Thermistor, R53
R6 51Ω 5%
R7 2·2kΩ 2%
R8 30kΩ 5%
R9 2kΩ 5%
R10 11kΩ 5%
R11 1kΩ 5%
R12 150kΩ 5%
R13 30kΩ 5%
R14 150kΩ 5%
R15 100Ω 5%
R16 100Ω 5%
R17 1kΩ 1%
R18 8kΩ 1%
R19 1kΩ 1%
R20 800Ω 1%
R21 100Ω 1%
R22 80Ω 5%
R23 10Ω 5%
R24 8Ω 5%
R25 1Ω 5%
R26 1Ω 5%

Potentiometers

VR1/2 2-gang linear 20kΩ pot., ±10% tol., ±1% linearity

Capacitors

C1 500pF 1%
C2 6,800pF 1%
C3 0·068µF 5%
C4 0·68µF 5%
C5 250µF, 25V
C6 20pF
C7 5,000pF
C8 500pF 1%
C9 6,800pF 1%
C10 0·068µF 5%
C11 0·68µF 5%
C12 100µF, 50V
C13 100µF, 50V
C14 100µF 5V

Semiconductors

TR1/2 BC182, 2-off
TR3 BC212
D1 BZY88 C15
IC1 SN72709

Switches

S1 2-pole, 4-way
S2 2-pole changeover
S3 1-pole, 9-way

Miscellaneous

Matrix board, 175 × 95mm.
Suitable case, wire, solder

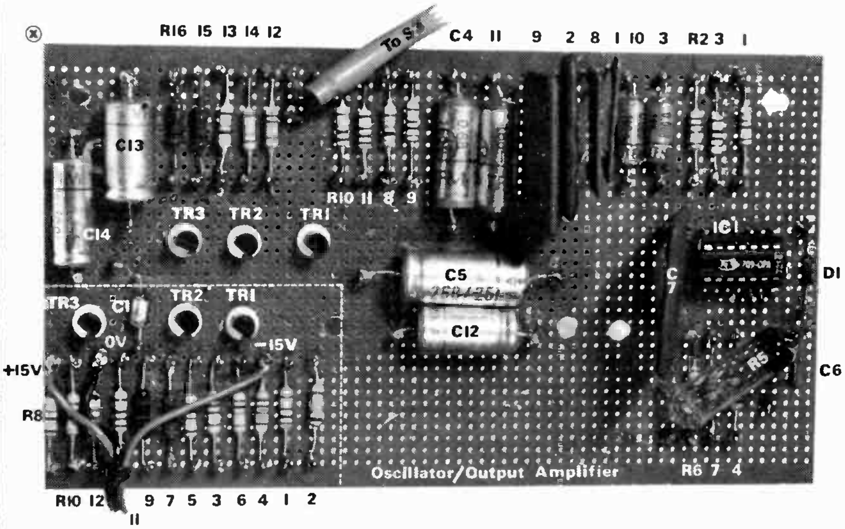


Fig. 7. Component layout for the oscillator board

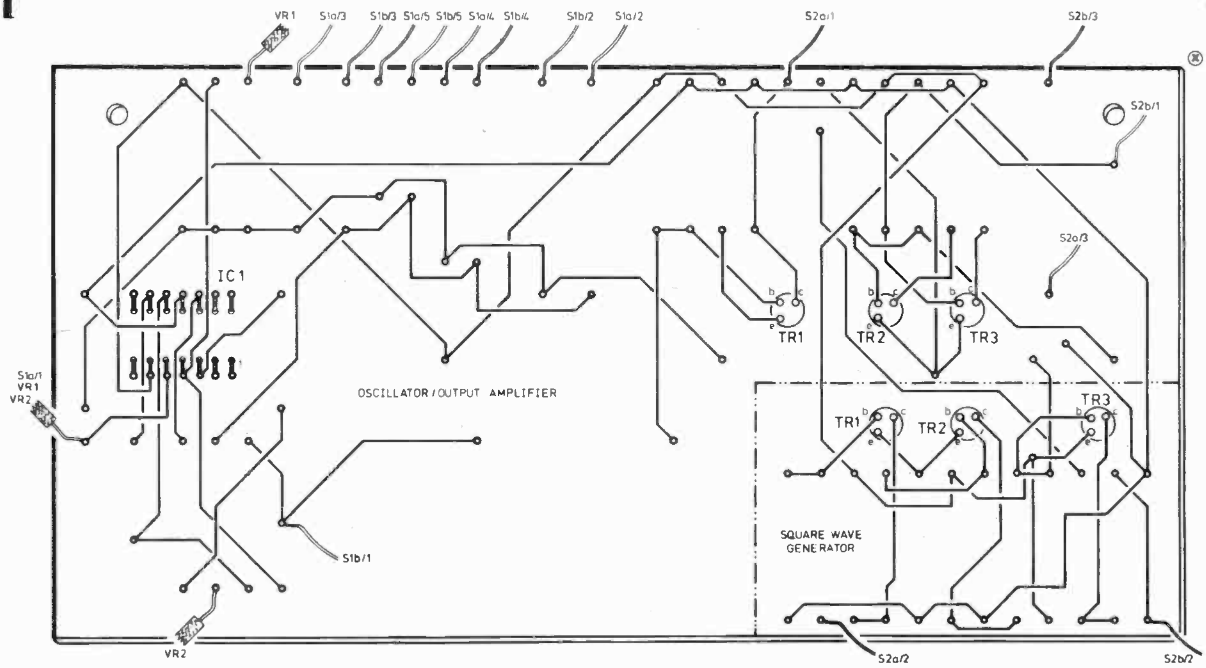


Fig. 8. Wiring details for the layout of Fig. 7

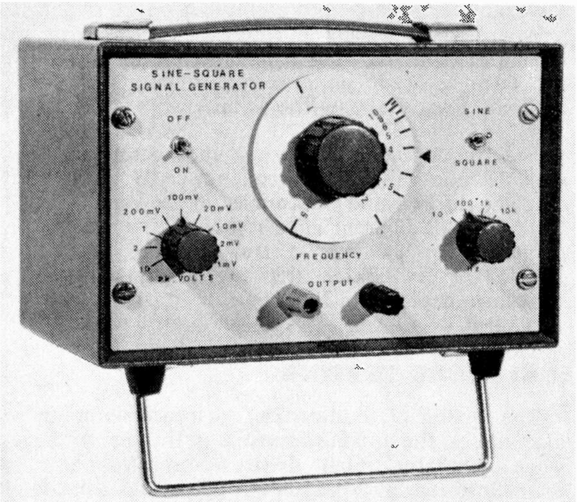


Fig. 9. Squarewave testing waveforms

CALIBRATION

The dial showing frequency settings may be a simple dial, knob and pointer, or an elaborate linear dial as used on a receiver. But whichever dial one uses, one must calibrate it. To allow for the various types of dial and potentiometer available, the calibration data is tabulated in Table 1. The best way of calibrating the instrument is to measure the frequency and to mark the dial accordingly; the next best method is to measure resistance.

However, if one does not have suitable measuring facilities one can still obtain quite good results by measuring dial positions with a protractor or ruler and using the data given in Table 1. Because the instrument has decade ranges, one needs only to plot one range of frequency.

If the instrument incorporates a linear dial, mark the two end stops to give 1·05kHz and 10·6kHz and use a rule to measure the distance between these two stops.

If it incorporates a rotary dial, mark the end stops to give 1·05kHZ and 10·6kHz and use a protractor to measure the angle (in degrees) between them.

Table 1 shows corresponding values of frequency measured directly with frequency measuring equipment, resistance measured with resistance measuring equipment, and the multiplying factor for determining the dial setting.

To calculate the dial setting corresponding to the required frequency, multiply the factor given in column 3 of Table 1 by the angle or distance measured between the two end stops. The result is the angle or distance from the 10·6kHz marker which one should mark on the dial. To illustrate how multiplying the total angle by the factor gives the calibration angle required, column 4 gives the angles calculated for the prototype instrument.

Because frequency is proportional to the reciprocal of resistance, the frequency scale marked on the dial will not be linear.

SQUARE WAVE TESTING

Using a square wave source for testing digital circuits such as counters and frequency meters is a fairly obvious application for these units. In contrast many enthusiasts are not aware of the value of square wave testing of high-fidelity amplifiers.

Gain frequency plots of amplifiers tell us a little about their characteristics, but such a plot does not indicate how the amplifier responds to transient signals. Plotting may miss small changes in level at different frequencies which can contribute to a reduced performance under transient conditions.

A good-shaped square wave signal consists of the fundamental frequency plus a large number of harmonics, which are necessary to form a precise square wave signal. Therefore, when one applies a square wave to an amplifier one is, in effect, sweeping a whole band of frequencies. This means that when one views the square wave signal output with an oscilloscope, one sees the effect of the overall response of the amplifier.

One can investigate the principal characteristics of square wave testing by connecting an audio amplifier to a resistive load and applying a low frequency, low amplitude square wave to the input. This gives rise to the three basic output waveforms shown in Fig. 9b, c and d. Fig. 9a represents the input square wave and also the output waveform which one might expect from a perfectly flat response amplifier.

The curve at b represents the output to be expected from a capacitively coupled amplifier. Here the pulse droops with an amount related to the low frequency characteristics of the amplifier.

Strictly speaking it is difficult to relate droop to the 3dB point in an amplifier, because the rate at which the amplifier falls towards cut-off influences the droop. However, many people assume that a single time constant operates (6dB per octave) and estimate the 3dB point from the droop which this single time constant causes. These estimates are quite accurate enough for most applications. Droop is also caused by the bass cut control of the amplifier, so we can use a square wave source for evaluating the operation of the tone circuits as well.

Table 1: Calibration

Frequency (kHz)	Potentio-meter Resistance kΩ	Multiplying Factor Angle or Distance	Typical Dial Angle 285°
1·05	20·1	1·0	285
1·5	13·40	0·652	190
2·0	9·50	0·475	135
2·5	7·16	0·358	102
3·0	5·60	0·28	78·8
3·5	4·49	0·224	64
4·0	3·65	0·182	52
4·5	3·00	0·15	43
5·0	2·48	0·124	35
5·5	2·05	0·10	28·5
6·0	1·70	0·085	24
6·5	1·40	0·07	20
7·0	1·14	0·057	16
7·5	0·92	0·046	12·8
8·0	0·72	0·036	10·2
8·5	0·55	0·028	7·9
9·0	0·40	0·02	5·7
9·5	0·26	0·013	3·7
10·0	0·14	0·007	1·9
10·6	0·01	0·00	0

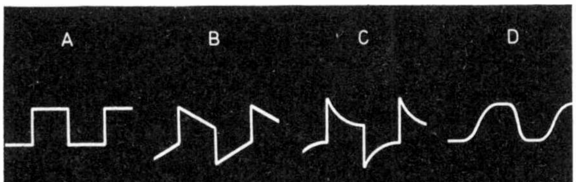


Fig. 9. Squarewave testing waveforms

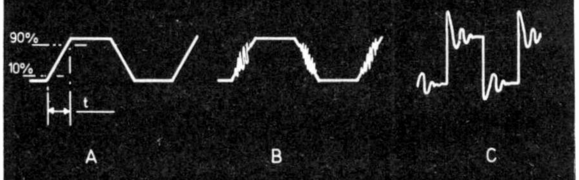


Fig. 10. High frequency waveforms

LOW FREQUENCY RESPONSE

Fig. 9c shows the characteristic effect of a rising high frequency response. The leading edge of a pulse contains the majority of the high frequencies, so when one increases the treble boost control, the pulse acquires leading-edge spikes. Adjusting the "treble cut" will remove high frequencies from the pulse as shown in Fig. 9d. These tests are normally carried out with square wave frequencies below 500Hz. The low frequency droop characteristics show up even better on lower frequencies, such as 50 to 100Hz, while the high frequency effects are more apparent at the higher frequencies.

HIGH FREQUENCY RESPONSE

At much higher frequencies square wave testing has several useful applications. Fig. 10 shows examples of high frequency waveforms. At 10a, the response of a good amplifier to a well-shaped square wave is shown. This waveform has sloping sides caused by the fall off in high frequency response of the amplifier.

Specifications often quote rise times for amplifiers, especially oscilloscope amplifiers. The rise time is the time the pulse takes to grow from 10 per cent of its final amplitude to 90 per cent of its final amplitude, hence the expression "the 10 to 90 per cent rise time *t*".

As with low frequency and droop, rise time may be related to the high frequency 3dB point in the amplifier, if one assumes a single time constant cut-off. Since one may measure the 3dB point directly using the sine generator, it is not worth making either of the latter calculations.

H.F. OSCILLATIONS

Waveform 10b represents a more important aspect of square wave testing in which the pulse causes some high frequency oscillation. Oscillations of this type are caused by stray capacity giving positive feedback and instability which shows up on transient signals. The source of such oscillations must be located and stopped.

The waveform of 10c shows a typical underdamped response which one would expect from many electro-mechanical systems. A transformer coupled circuit, for example, would often exhibit this type of characteristic. After finding a response of this type one would seek out the source of underdamped responses and in an effort to improve performance increase the damping to give a response as near as possible to Fig. 10a.

The frequency at which one should test amplifiers depends upon the high frequency 3dB point f3dB. One should examine frequencies in the range f3dB/10 to f3dB/2 as different effects show up at various frequencies, for example a frequency of f3dB/4 e.g. 25kHz for a 100kHz amplifier might produce the waveform depicted in Fig. 10a.

ENCLOSURE TESTING

The testing of loudspeaker enclosure damping will also interest the hi-fi enthusiast. In this test the square wave generator must drive a powerful amplifier coupled to the loudspeaker through a high impedance. An impedance some ten times that of the loudspeaker will be necessary using an amplifier which is capable of operating without the loudspeaker load. Few valve amplifiers can be used for this test. The amplifier must also be capable of amplifying at frequencies below that of the speaker resonance under test, and producing satisfactory square waves at 20Hz or less.

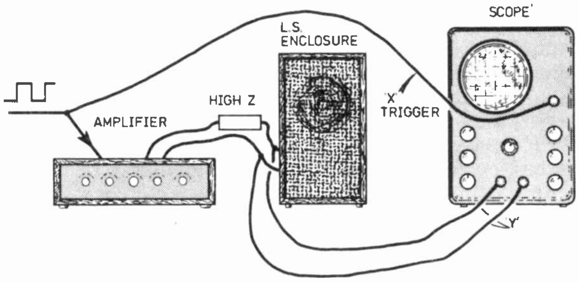


Fig. 11. Loudspeaker test rig arrangement

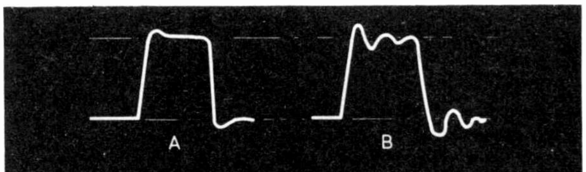
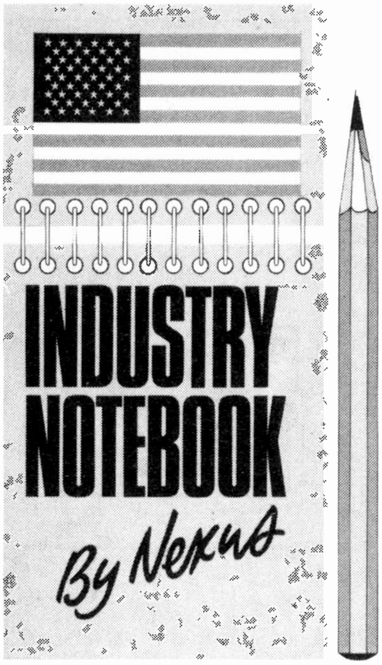


Fig. 12. Two possible outputs from the rig

Fig. 11 shows the test circuit arrangement. One needs a high gain oscilloscope to see the effects shown in Fig. 12a and b. Waveform 12a is the type of response one should try to achieve while 12b shows an underdamped system. This method provides a means of investigating the effect of various cavities and baffles using a variety of loudspeakers.

Square wave frequencies of the order 20 to 30Hz are necessary for these tests. Removing or omitting the high impedance will cause the amplifier to damp the loudspeaker system (a highly desirable characteristic in practice), but will mask out the effects of the acoustic damping system, which is being investigated.

In square wave testing one must be absolutely sure that the circuits are not being overdriven as this will remove any ringing or oscillatory responses one is investigating, so it is better to start off with a very small amplitude and increase it to the desired level. ★



THE US SCENE

Arriving in New York for the IEEE electronics show, one expected to find signs of recession and first impressions confirmed all expectations. Unemployment almost 9 per cent which meant 8 million workless citizens. Worse still, a survey showed that of these, over a million had given up all hope of finding a job and were not even bothering to try any more. The city itself is bankrupt—not enough income from rates and taxes to meet its bills.

In foreign affairs there was the added depression of the collapse of American policy in South East Asia and little comfort to be had from the Middle East where the Kissinger initiative had failed—at least for the time being.

Enough to give anyone the shivers and suddenly the European situation didn't look so bad after all. But strangely, when the show opened things seemed not nearly so desperate. True, Senator Barry Goldwater in the opening speech of the technical congress said the chips were down, the USA was running into bankruptcy, losing credibility in the world, but his was a political rather than a business speech.

At the New York Coliseum, where nearly 400 companies were exhibiting and attracting 22,000 visitors in three days, there was an optimistic outlook. Were these exhibitors and buyers just whistling in the dark to keep up their courage? This was not my impression. The consensus was that the recession was about to bottom out, perhaps had already done so. Another three months, perhaps, and things would be taking off. In twelve months the outlook would really be bright. Old hands in the game remembered being caught unprepared in former trade cycles. They had cut back in times of recession and missed out on market shares when the upturn came. This time they wouldn't be caught with their pants down.

This was the busiest show I had seen in years and among the least gloomy. It demonstrated that whatever the shortcomings of Government—the Americans are still in a state of shock from Watergate and have little confidence in the present administration—the hard core of the US electronics industry is showing resilience and enterprise.

The United States, recession or not, remains more than 50 per cent of the world's total electronics market and should not be neglected. In Europe, and especially in Britain, we are so mesmerised by the new affluence in the Arab states that all eyes are looking East. Those British companies who exhibited in New York were not disappointed.

Companies already established in the US market like Marconi Instruments, Plessey and Ferranti, widened their business base this year. Newcomers like Brandenberg, Mirvalle and the still tiny Linton Laboratories found new markets, new opportunities. And did you know that American semi-conductor manufacturers send wafers to Harwell for ion implantation? Well, Harwell Industrial Research, who offer this specialised service, also did good business.

Ten British companies exhibited. There should have been a hundred. British technology is highly respected in the USA and is in demand provided, of course, the price is right. Our problem is inflation, not technology.

HOT MARKETS

The two hottest and toughest markets in the United States are calculators and watches. The British Sinclair-made model designed for Gillette was test-marketed in San Francisco and St. Louis and, according to reports, exceeded all expectations. It was planned to sell the 4-function, 8-digit model at 30 dollars (£12·50) but the week before the test marketing started Novus came out with a competitive unit at 20 dollars so Gillette dropped the price to 25 dollars.

Although the operation was a success, Gillette has now pulled out of the business, blaming unstable pricing. Gillette was reported to have ordered 100,000 calculators for the test-marketing. It was good business for Sinclair because the British company is left with world marketing rights and those machines designed for Gillette have now appeared as the Sinclair Oxford range.

The 5-function 8-digit calculator from Texas Instruments had a retail price of 25 dollars (a little over £10) as I left for home, but even lower prices could be negotiated by individuals at the point of sale in many New York stores. One wag suggested to me that the way things are going the batteries will soon cost more than the calculators. He could be right!

Innovators are already working on getting some added value into calculators by making them part of a larger assembly. For example, by building a calculator into a notebook and daily diary. This model sells for 35 dollars and makes a nice present in a new market dubbed locally as "Gimmick Calculators".

PACESETTERS

Electronic watches are going the same way. If you are a watch manufacturer you can buy the complete l.e.d. electronics kit from Fairchild for a reported 10 dollars (just over £4) in 1,000 lots. This market is somewhat different because a lot of the value of a watch is not so much in the "movement" but in the case.

It is still not clear how many semiconductor manufacturers will go directly into the manufacture of complete watches but a number have already done so, two of them having already reached the low retail price level of 50 dollars (£21). It's hard to find any other product not going up in price but electronics goods still fall in price.—Amazing!

Nobody's yet done it but the next step, believe it or not, is the combined wristwatch and calculator in a single case. An enterprising plastics manufacturer has already produced a prototype case which can be plated to look like metal. There are 18 tiny dimpled calculator keys which can be depressed with the tip of a pen or pencil.

Expected to be a popular new line in the States is a calculator variant which caters for the individual (actually, nearly everybody) who runs his bank balance perilously near the red. It's called the CheckMaster. You enter in your bank balance and every time you pay by check (we spell it cheque) you key in the amount and it gives you your new balance statement. You also enter any deposits. Snapping the lid shut switches the CheckMaster off but the balance remains stored in the memory and shows up again next time you use the machine.

A curvilinear lens on the l.e.d. display gives a very narrow angle of view so that Peeping Toms can't see how hard up you are.

PATENTS REVIEW...

PAGING BY PHONE

BP 1 373 748

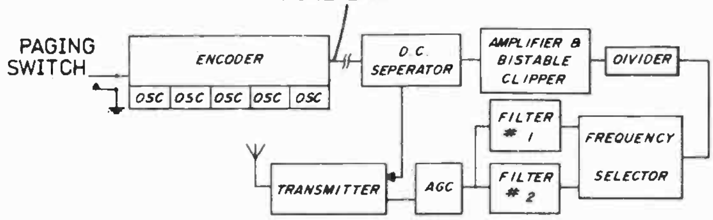


Fig. 1

Radio paging systems often use a radio frequency carrier, modulated by a sub-audio tone signal to alert the attention of someone carrying the necessary receiver. But usually the centre of paging operations is remote from the transmitter and connection must be via standard telephone lines and these attenuate all signals below 300Hz. Thus to transmit a sub-audio tone from a remote point involves the expense of hiring special phone line connections.

In BP 1 373 748, Motorola Inc. provide a simple answer which could have wider uses in the art of remote control over phone lines.

As shown in the block schematic diagram (Fig. 1) an encoder at the centre of operations incorporates a bank of oscillators which develop audio tone signals. These signals, in the range from 300–3,000Hz, can be transmitted without attenuation over the phone line to the transmitter station.

The audio tones produced are exact harmonics of the sub-audible tones which are needed to actuate a paging receiver. In the example given two sequentially received sub-audio tones are needed to actuate the paging receiver and the encoder sequentially develops two corresponding audible tones.

D.C. signals are also sent down the line for transmitter switching, and at the transmitter station the d.c. separator directs these to the transmitter and directs the audio tone signals to an amplifier and bistable clipper.

The square wave signal at the output of the amp and clipper have the same frequency as the tones sent down the phone line. A divider network separates these square wave signals by the requisite number, to produce a second spectrum of square wave signals of the required sub-audio frequencies.

For example, 1,800Hz square waves coupled to the divider will be divided by eight to develop 225Hz square wave signals. The latter are coupled to the frequency selector which routes all signals with a frequency in excess of 125Hz to filter 1 and all signals below 125Hz to filter 2.

Filter 1 has low pass characteristics to remove all harmonics above 250Hz and prevent intermodulation products. Filter 2 functions similarly on all frequencies above 125Hz.

An automatic gain control circuit (a.g.c.) compensates for filter variation, provides a constant amplitude output signal for all sub-audio tones in the range 65–225Hz and passes them to the transmitter for transmission and reception in conventional manner.

The patent contains detailed descriptions of suitable circuitry for realising the schematic.

WORLD PATENT INDEX

Patents reported here are almost exclusively British issues and represent only a few culled monthly, on a purely arbitrary basis, from the vast number (around 50,000) published every year by the British Patent Office. Even more daunting to anyone interested in keeping a close watch on patents for inventions in their own particular field, is the fact that comparable numbers of patents are continually being published in every other civilised country in the world.

The Derwent World Patents Index (WPI) is a weekly publication which seeks to give an early warning of important patents by listing 12,000 per week from 24 countries. The aim is to break through the language barrier and provide a summarised and indexed world-wide surveillance for researchers.

The Foreign Patents Section of the Science Reference Library, just over the road from the British Patent Office, in Southampton Buildings, Chancery Lane, has the WPI material available for the public's use free of charge.

Part of the Derwent scheme is to identify "basic" and "equivalent" patents as such. As the terms imply, basic patents are concerned with initial protection for new inventions, and equivalents relate to further protection elsewhere.

The WPI material, at least initially, is somewhat off putting. A researcher will need time and patience to accustom himself to the terminology and symbols used. American and British patents are logically listed as US and GB, but their normal seven-digit numbers are broken up with hyphens in a manner which may confuse workers used to dealing with conventional patent numbers.

The Foreign Patents Section enquiry desk has a guide handbook available to help readers who wish to use the index and need to familiarise themselves with the system. In fields such as electronics, where new developments are continually emerging and there is a real risk of laboratories wasting time by duplicating work already done by others, it could be of value for small or medium sized firms to form a consortium and use the WPI together.

Copies of Patents can be obtained from the Patent Office Sales, St. Mary Cray, Orpington, Kent. Price 33p each

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Stereo PCB (as published)	£2·20

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Power Supply PCB	55p
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Tone, Balance and Vol-control PCB (Oct. 73)	£1·50
Triffid I.C. Radio (P.E. Feb. 73)	60p

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Combined component set with PCBs, for alphaphone, cardiophone, frequency meter and visual feed-back lamp driver circuits	£4·96
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Type PC7	£5·50

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AC128	28p	BSY95A	22p	2N3823E	38p
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BC107	13p	MJE3055	75p	2N4871	36p
BC108	13p	NKT0033	112p	2N5245	51p
BC109	13p	OC28	60p	2N5777	45p
BC147	12p	OC71	14p		
BC148	12p	OC72	14p	**Diodes**	
BC149	12p	OC84	25p		
BC157	13p	ORP12	60p	1N914	4p
BC158	13p	ZTX107	12p	1N4001	6p
BC159	13p	ZTX503	15p	1N4002	7p
BC182L	12p	ZTX531	23p	1N4004	8p
BC184	12p	2N706	13p	1N4005	8p
BC204	14p	2N914	22p	1N4007	10p
BC209C	14p	2N1304	22p	OA91	7p
BC212L	15p	2N2219	27p	OA200	8p
BC213	15p	2N2905	27p	OA202	8p
BC478	28p	2N2907	22p	1GP7	12p
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748 14-pin DIL	83p
7400	20p
7402	20p
7410	20p
7420	20p
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5·6V 400mW	15p
5·6V 1·3W	20p
6·2V 400mW	15p
9·1V 400mW	15p
11V 1W	25p
12V 400mW	15p
12V 1·3W	30p
18V 400mW	15p
18V 1W	20p
20V 400mW	15p
20V 1·3W	23p
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0·47/63V	6p	47/63	7p	470/40	20p
1·0/63V	6p	100/4	6p	500/64	46p
1·5/63V	6p	100/10	6p	680/6·3	10p
2·2/63V	6p	100/25	6p	680/25	20p
4·7/63	6p	100/40	7p	680/40	25p
6·8/40	6p	100/63	13p	1000/10	14p
10/25	6p	150/16	6p	1000/16	25p
10/63	6p	150/63	13p	1000/25	30p
15/40	6p	220/10	6p	1000/40	54p
22/10	6p	220/16	7p	2200/25	45p
22/25	6p	220/25	11p	2200/40	71p
33/6·3	6p	220/40	14p	2600/100	300p
33/16	6p	220/63	21p	3300/63	133p
33/40	6p	330/10	6p	3300/100	300p
33/50	6p	470/6·3	6p	4700/16	66p
47/10	6p	470/10	12p	4700/25	75p
47/25	6p	470/25	16p	4700/40	93p
47/40	6p				

Polyester (μF)

0·01	3p
0·015	3p
0·022	3p
0·033	3½p
0·047	3½p
0·068	3½p
0·1	4p
0·15	5p
0·22	5½p
0·33	7p
0·47	8p
0·68	11p
1·0	14p
2·2	24p

Tantalum (μF/V)

0·1/35	12p
0·22/35	12p
0·47/35	12p
1·0/35	12p
1·5/35	16p
2·2/35	12p
4·7/35	12p
10/16	14p
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15/6·3	16p
22/16	16p
47/6·3	16p
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Readout—
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Readers requiring a reply to any letter must include a stamped addressed envelope. We regret that we cannot answer any technical queries on the telephone.

Voice control

Sir,—I recently built the "Voice Operated Fader" described in your December 1973 issue of Practical Electronics. The fader worked quite well apart from one disadvantage. This was that when the unit operated, the signal from the deck was attenuated too much causing an unacceptable interruption in the music.

What was needed was some form of control over the level to which the music was attenuated. My first attempt at providing this is shown in Fig. 1. Although this enabled the final voltage level to which C5 charged and thus the level of attenuation, to be set, the rate of attenuation was markedly reduced. This was due to the operating point being at the top of the charging curve to C5.

After some thought the circuit shown in Fig. 2 was evolved. This operates as follows: Suppose VR2 is set so that its slider is at 2V and TR4 is turned on. TR4 collector will be at 0·8V and diode D1 reversed biased. Hence, IC1 pin 2 will also be at approximately 0·8V. When TR4 turns off, capacitor C5 charges through R7. When the voltage across C5 reaches 0·6V greater than VR2 slider, D1 begins to conduct. Further increase of the voltage across C5 has little effect on VR2 slider voltage due to its relatively lower impedance than R7 and R10 and therefore IC1 pin 2 remains, substantially at 2·6V.

The circuit effectively clamps the rising voltage on IC1 pin 2 (attenuation control input) at any level 0·6V higher than that set by VR2 slider without effecting the rate of rise and hence the rate of attenuation.

Because of the increase in current due to R11 and VR2, R9 will need to be re-calculated to maintain the 9V supply rail.

J. H. Taylor,
Sunderland, Tyne & Wear.

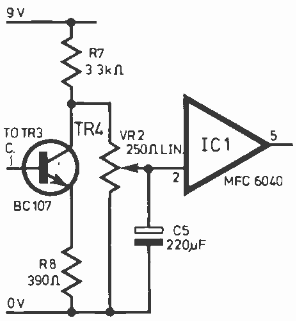

Fig. 1

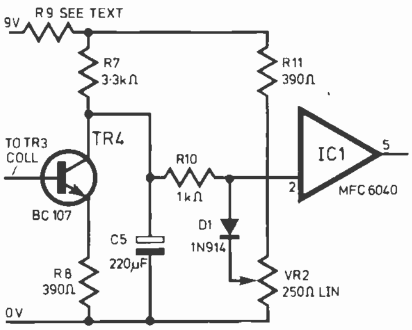

Fig. 2

So what!

Sir,—As a relative newcomer to P.E., I am amazed at some of the comments given with regard to electronically produced or synthesised music. I agree that some of the results are fairly hideous but I feel that some people allow their musical appreciation and technical ability to run away with common reasoning.

I speak as a fairly experienced D.J., also as a fairly experienced electrician dealing with radio/radar and so on in the aircraft industry. So what, if a machine is capable of producing over *n* thousand combinations of notes, etc. and only 100 of them are being used? So what, if a group chooses to use a simple application of £10,000 worth of electronic noise producing equipment? Surely, the general public have a say in the music that gets thrown at them. If they like a particular sound the record sales will reflect this; if it's not liked then it's tough luck on all concerned.

I suggest that if some of your readers are not satisfied with electronic music as it is now, they should make their own recordings, but I, as a D.J. do not relish the thought of playing "Handels Second Logical Computation" performed on an OC21! No sir, the proof of music is in its adaptation, not its rigid application.

M. D. Wells,
Hayling Island.

"Borus-calculatii"

Sir,—With reference to the article *Mild & Bitter*—"The Pocket Calculator Bore" by A.P.S. in your May issue, may I shine a ray of hope by offering a partial solution to the problem.

Recent research in the north-west shows that there exists a mutation of Borus-calculatii-simplex known as Borus-calculatii-simplex-erroneous, a particularly virulent strain of which appears to originate from the Oxbridge area. As far as can be ascertained, the mutation arose—through no fault of the Fish Fryer's Association—from the consumption of questionable chips.

The strain can be readily discerned. On being approached the challenge "0−3·5=K8+" is given. If the reply "−2·285714" is obtained, then the menace is of the normal strain. If however, the reply is "0.6530612" then the mutant strain has been identified and isolated.

Now for the annihilation of the pest. Leaving the constant of −3·5 still set, ask the menace to perform 8·0÷, 9÷ and 9·0÷ and closely observe his face. There should be some reddening accompanied by bulging of the eyes and general emission of steam. It is of the essence to move quickly at this stage before the blood pressure has a chance to subside.

The next step is to present the sequence "0−3 =K36998784" which will give "26972112" instead of "−8990704". Tension will be mounting at this point so step back two paces and ask that 10^{-12} should be added to, or subtracted from, 10^{+50}. This final operation will almost certainly cause the simultaneous bursting of several major blood vessels, which, according to my calculator, should leave the world one (or is it minus six) Borus-calculatii-simplex-erroneous fewer.

R. Lane,
Glossop, Derbyshire.

Moving speech

Sir,—In your article "Loudspeaker Breakthrough", published in the May edition, the author comments that C. W. Rice and E. W. Kellogg invented what is now known as the "moving-coil" or dynamic speaker "almost *forty* years ago".

It was in fact ten years earlier—nearly Half A Century ago—in the mid-twenties (not the thirties), when the R.K. was offered to the public.

The original production models were all energised from a low-voltage source (a car accumulator!), and in a 1929 wireless catalogue now in our archives, they are advertised side by side with balanced-armature cone units, and even horn-speakers!

Douglas Byrne, G3KPO,
The Wireless Museum,
Shanklin, I.o.W.

Sixth Sense, or Nonsense

Sir—Experiments with plants were reported by Mr Patrovsky (Readout, January 1975), in which he was able to speed germination and growth rate using either a magnetic field, hand movements or water acted upon by a magnetic field. He felt that the mechanism concerned was "polarisation" of water.

There have been many experiments of this nature around the world and some have yielded inexplicable results. A non-technical account of the whole subject can be found in "The Secret Life of Plants" by Peter Tomkins and Christopher Bird; a fascinating book.

One such experiment involved irradiating vermiculite using some kind of electronic apparatus. The vermiculite, which is an entirely inactive substance, was mixed with the earth in which plants were grown, and resulted in some 186 per cent increase in weight of those with irradiated vermiculite over the rest. The whole system was handed over to a commercial firm which tried it out and achieved no increased weight in their plants whatever. Later the original experimenters themselves (the De La Warrs) repeated the firm's trials at their nurseries and again showed increased growth. Finally, they supplied interested nurserymen with two lots of vermiculite. One was irradiated, and so labelled, and the other not. Again, increased growth was found in the plants grown with the irradiated vermiculite. The interesting part of this last experiment was that the De La Warrs in fact did nothing at all to either lot of vermiculite.

If Mr Patrovsky were to repeat his experiments by getting some other person to do them, and supplied him with two lots of water, one "polarised" and the other plain, and so labelled, the same increase in growth would most probably be observed even if nothing at all had been done to either supply of water.

The mechanism of this form of communication with plants is entirely unknown and it does the advancement of knowledge in this sphere a disservice by trying to tie it to magnetism, polarisation, radiation or any other well established physical process. Anyone doing so will be assumed by scientists to be either a charlatan or a fool.

That plants take heed of some as yet inexplicable message delivered to them can also be shown by a change in electrical resistance between two points, say, on a leaf, and lie detectors have been used to show it. This involves passing a current through the leaf and is therefore suspect. Similar results have been obtained, however, using an electrocardiograph, which is a recording millivoltmeter capable of showing changes of a millivolt or two. Mr Baily reported the same kind of result in "ESP" (April 1974) using a voltage controlled oscillator as an indicator.

When life first started on this planet there must have been a time when there was a little chunk of something different from every other little chunk because it was living. It absorbed energy and nourishment from its surroundings and became larger. A time came when its bulk, and therefore the ratio between mass and surface area, became too large, so it divided into two smaller chunks, to be able to absorb essential nourishment more easily. The two may well have remained in contact. The process must have repeated itself countless times with the formation later of separate chunks of living matter. It was obviously advantageous for each chunk to maintain some kind of communication with its neighbours, and it is reasonable to assume that such communication existed, and that every chunk of life in a group communicated with every other chunk. As the number of living organisms increased and different types started to appear, such universal communication would have become impossibly complex and no longer advantageous. So presumably links between separate organisms grew less generalised. Links between parts of the same organism became highly specialised and ultimately in animals, as distinct from vegetables, formed the nervous system.

If human imagination can accept the possibility of a perhaps fortuitous grouping of atoms into molecules of some primitive form of protein from which we all have developed, it should not stretch that imagination beyond its limit to accept as possible that the remnants of this primitive form of communication exist still between humans and plants, and that it can be demonstrated by those with green fingers and possibly by all of us to some extent. If between humans and plants, then it would seem even more likely that it still exists between human and human. Telephathists and ju-ju witch doctors at least, would agree.

Mr Baily (ESP, June 1974) has described experiments where efforts have been made by thought alone to influence an electronic device producing random readings. If the communication system, whatever its mechanism, depends upon there being living tissue at both the sending and receiving ends, then such experiments are doomed to failure. This may not be so, in which case there is presumably another system or sense and the astonishing feats of Uri Geller suggest that living tissue can have some kind of influence on inanimate material.

Any experiment to try to probe this almost entirely unexplained region should be as simple as possible. In Mr Russell's "Probability Anomaly Detector" (PE, Feb. 1975), supposing someone is found who can influence it, and that physical effects like hand capacity, static charge and so on can be eliminated, as well of course as chicanery, then one would still not be able to tell which part of it was being influenced.

A simpler system is needed. Such a system exists in the form of crystal growth, which some of us will remember from early chemistry days. A crystal of copper sulphate suspended by a strand of glass fibre in a saturated copper sulphate solution gradually grows larger as the water evaporates. It would be a simple matter to set up two equal crystals under identical conditions and try by will alone to influence the growth of one of them. Nothing could be more inanimate than copper sulphate. Perhaps something involved in animal metabolism would be more likely to be influenced. Glucose, urea or even common salt are possibilities.

This will not appeal to those who feel that electronics ought to be somehow involved. It may not perhaps be generally known that a neon lamp supplied with a voltage on the verge of its striking voltage can be triggered on by light, X-rays, cosmic rays and, who knows, Uri Geller and some of you, the readers—always assuming you have read this far. A possible device consists of a battery of about 180 volts with a 50 kilohm potentiometer across it. The voltage between the slider and one end is applied via a 0·25–0·5 megohm resistor to a 0·1 mf capacitor. The neon lamp, an Osram Osglim, is connected across the capacitor via a pair of headphones. The neon lamp is enclosed in a tin to avoid the effects of light and the potentiometer adjusted so that a few clicks are heard per minute in the headphones. These clicks are due to natural radiation.

A simple experiment might consist of setting the device to give an occasional click and at the start to press simultaneously a typewriter key and the start button of a stopwatch. At each click a letter would be typed and when the bell rang at the end of the line the watch would be stopped. If by willing the count rate to increase and decrease line by line alternately, a significant difference in time for alternate lines typed could be shown—then such a result would be utterly inexplicable but a basis for further experiment.

R. Parfitt,
Croydon.

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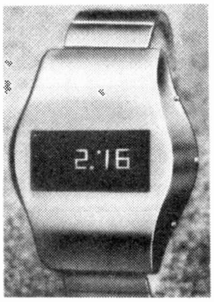

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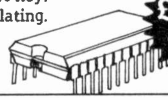

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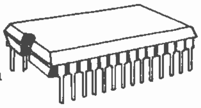

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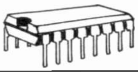

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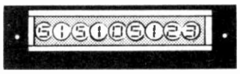

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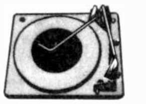

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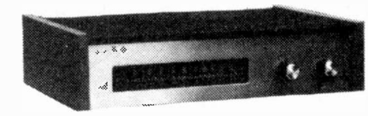

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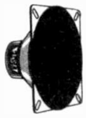

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R.C.S. 3 WAY CROSSOVER

Complete with 12 ft. twin lead fitted with din speaker plug. Ready assembled with leads for speakers, bass, mid and tweeter. Crossover frequencies—950 cps and 3,000 cps. **£2·25**

VALVE OUTPUT TRANSFORMER 50p.
MIKE TRANSFORMER MU metal 100-1 £1·25.
PUSH-PULL VALVE OUTPUT TRANSFORMERS.
50 watt .... £14·00 100 watt .... £20·00

ELECTRO MAGNETIC PENDULUM MECHANISM

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

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2 stage triode pentode valve. 3 watts output. Volume on/off and tone controls. Printed circuit A.C. mains complete and tested. Complete with speaker. **£4·50** Post 35p

COAXIAL PLUG 10p. PANEL SOCKETS 10p. LINE 18
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BALANCED TWIN RIBBON FEEDER 300 ohms, 7p yd.
JACK SOCKET Std. open-circuit 20p. closed circuit 30p; Chrome Lead Socket 45p. Phono Plugs 7p. Phono Socket 7p
JACK PLUGS Std. Chrome 30p; 3·5mm Chrome 20p DIN SOCKETS Chassis 3-pin 10p; 5-pin 10p DIN SOCKETS Lead 3-pin 25p; 5-pin 25p. DIN PLUGS 3-pin 25p; 5-pin 25p.
VALVE HOLDERS 5p; CERAMIC 10p; CANS 5p.

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E.M.I. WOOFER AND TWEETER KIT

£6·75 THE PAIR, Post 45p. (Available separately. Woofer £4·25; Tweeter £1·90)

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

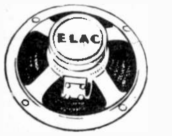
Impedance Standard 8 ohms
Maximum power 12 watts
Useful Response 35 to 18,000 cps
Bass Resonance 45 cps

SUITABLE ENCLOSURE 20 × 13 × 12in. MODERN DESIGN. TEAK WOOD FINISH. **£14** Post 75p

ANOTHER R.C.S. BARGAIN !

ELAC 9 × 5in. HI-FI SPEAKER TYPE 59RM
This famous unit now available, 10 watts, 8 ohm.
Price **£3·45** Post 30p

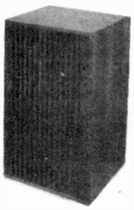
8" or 10" x 6" ELAC HI-FI SPEAKER



Dual cone plasticised roll surround. Large ceramic magnet. 50-16,000 cps. Bass resonance 55 cps. 8 ohm impedance. 10 watts. **£4·35**

10in round £5.

TEAK VENEER HI-FI SPEAKER CABINETS
Fluted Wood Fronts



MODEL "A". 20 × 13 × 12in For 12 in. dia. or 10in speaker. **£14** Post 75p

MODEL "B". 16 × 10 × 7in For 13 × 8in. or 8 in. speaker **£7·60** Post 45p

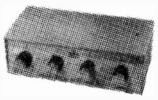
MODEL "4C". 30 × 20 × 12in. Reflex cabinet will accept 1-12in. bass unit, 1-5in. mid range, 1-3in. tweeter. Teak finish. Grooved front **£21·50** Carr. £2

LOUDSPEAKER CABINET WADDING 18in wide, 20p ft.

GOODMANS CONE TWEETER

3¾in. diam. 18,000 C.P.S. 25 WATTS 8 Ω **£3·60**

BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt battery operated. **£5·20**



STEREO VERSION OF ABOVE £6·85.
BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built with volume, treble and bass controls. 18 volt battery operated. Mains Supply £3·45. **£4·50**

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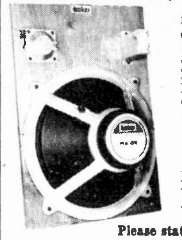
OFFERING 1001 USES for every type of heating and drying applications in the home, garage, greenhouse factory (available in manufacturing quantities) Approx size 10¾ × 8¾ × 1/16in. Operating voltage 200/250V. a.c. 250 watts approx. Printed circuit element enclosed in asbestos fitted with connecting wires. Completely flexible providing safe Black heat. British-made for use in photo-copiers and print drying equipment.
Ideal for home handymen and experimenters. Suitable for Heating Pads, Food Warmers, Convector Heaters, etc. Must be clamped between two sheets of metal or asbestos, etc., to make efficient clothes dryers, towel rails—ideal for airing cupboards. Ideal for anti-frost device for the garage—preventing frozen radiators or acting as oil sump heater. Use in greenhouse for seed raising and plant protection. Invaluable aid for bird houses, incubators, etc., etc. Can be used in series for lower heat. Or in parallel for higher heat applications.

ONLY **40p** EACH (FOUR FOR £1·50)
ALL POST PAID—Discounts for quantity.

BAKER MAJOR 12" £11·50



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

Module kit, 30-17,000 c/s with tweeter, crossover, baffle and instructions. **£14·50**

Please state 3 or 8 or 15 ohms.

BAKER SPEAKERS "BIG SOUND"

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

GROUP "25" 12in 25 watt 3, 8 or 15 ohms. **£9·50** Post 40p

GROUP "35" 12in 35 watt 3, 8 or 15 ohms. **£11·50** Post 40p

GROUP "50" 15in. 50 watt 8 or 15 ohms. **£22** Post 50p

GROUP "50/12" 12in 50 watt professional model. 8 ohms or 15 ohms **£16**

MAJOR 100 WATT ALL PURPOSE TRANSISTOR AMPLIFIER

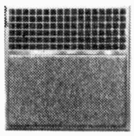
All purpose transistorised.
Ideal for Groups, Disco and P.A.
4 inputs speech and music. 4 way mixing. Output 8/15 ohm a.c. Mains. Separate treble and bass controls.
Guaranteed. Details S.A.E. **£59** Carr. £1·00

DE-LUXE MODEL IN WOOD CABINET. BLACK. £69.

NEW MODEL MAJOR 50 WATT

4 inputs, 2 way mixing, £49·95. Carr. £1. Ideal disco amp.

QUALITY LOUDSPEAKER ENCLOSURE



Teak veneered ½in thick wood cabinet. Size 18½in × 18½in × 8½in. Weight 23lb. This cabinet features a wide mesh Silver Grill covering a separate compartment for mounting Tweeters or Mid-Range Horn. The fully sealed bass compartment is cut out for 6½in Woofer. £8·50. Carr. 85p. Rosewood Version £9·50. Carr. 85p. Baffle could be cut for larger speaker.

SPECIAL OFFER 95p. Post 25p.
100 Ohm 20 watt Rheostat 2½in dia. Ceramic Former. Screw Terminals ¼in. dia. spindle.

R.C.S. STEREO DECODER

British made. Ready aligned and tested. Complete with instructions. Size 3in × 2in. **£4·95**

WEYRAD COILS

P50/2CC	40p	RA2W	85p
P50/1AC	60p	OPT1	65p
P50/3CC	40p	LFDT4	65p
PCA1	85p	Twin gang	£1·20

DELUXE 4 POLE MOTOR

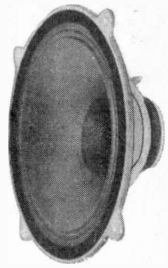
1,400 r.p.m. reversible 42 Watt, spindle 1¼in × 7/32in, size 3¼in × 3in. As illustrated. 240V a.c. mains. **£2·60** Post 25p

E.M.I. GRAM MOTOR

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

BAKER HI-FI SPEAKERS
HIGH QUALITY—BRITISH MADE

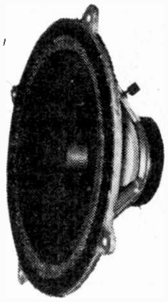
REGENT
12in. 15 watts



An inexpensive unit for the beginner in high fidelity and for general purposes. May be used to improve any Radio, Amplifier, Hi-Fi or Television receiver.
Bass Resonance 45cps
Flux Density 12,000 gauss
Useful response 45-13,000cps
3 or 8 or 15 ohm models.

£9·50 Post 40p

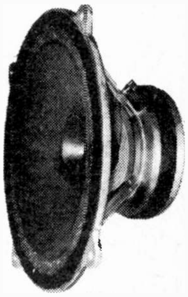
DE-LUXE Mk II
12in. 15 watts



Especially designed to provide full range reproduction at an economical cost. Suitable for use with any high fidelity system. Built-in concentric tweeter cone.
Bass Resonance 30cps
Flux Density 14,000 gauss
Useful response 25-16,000cps
8 or 15 ohms models.

£12·50 Post 40p

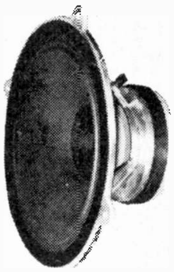
SUPERB
12in. 20 watts



A high quality loudspeaker, its remarkable low cone resonance ensures clear reproduction of the deepest bass. Fitted with a special copper drive and concentric tweeter cone resulting in full range reproduction with remarkable efficiency in the upper register.
Bass Resonance 25cps
Flux Density 16,500 gauss
Useful response 20-17,000cps
8 or 15 ohms models.

£17 Post 50p

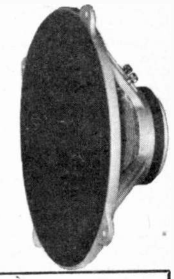
AUDITORIUM
12in. 25 watts



A full range reproducer for high power, Electric Guitars, public address, multi-speaker systems, electric organs, Ideal for Hi-Fi and Discotheques.
Bass Resonance 35cps
Flux Density 15,000 gauss
Useful response 25-16,000cps
8 or 15 ohms models.

£16 Post 50p

AUDITORIUM
15in 35 watts



A high wattage loudspeaker of exceptional quality with a level response to above 8,000 cps. Ideal for Public Address, Discotheques, Electronic instruments and the home Hi-Fi.
Bass Resonance 35cps
Flux Density 15,000 gauss
Useful response 20-14,000cps
8 or 15 ohms models.

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Hi-Fi Enclosure Manual containing plans, designs, crossover data and cubic tables. 68p.

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Col. (1) Coil ohms / Col. (2) Working d.c. volts / Col. 3 Contacts / Col. (4) Price / HD = Heavy duty	1	2	3	4
	52	4–8	2 c/o	70p*
	58	5–9	6 c/o	80p
	185	8–12	6M	60p*
	230	9–18	2 c/o	70p*
	430	15–24	4 c/o	80p*
	700	12–24	2 c/o	60p*
	700	16–24	4M 2B	60p*
	700	16–24	4 c/o	80p*
	1,250	18–36	2 c/o	60p*
	2,500	31–43	2 c/o HD	60p*
	2,500	36–45	6M	60p
	9,000	40–70	2 c/o	60p*
	15k	85–110	6M	60p*

*Incl. Base. All prices incl. P. & P.

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Miniature relay. 675 ohm coil. 24 Volt D.C. 2 c/o. **70p** post paid.
110V. 2 c/o. 20 amp contacts. **£1·25.** Post 10p.
Many others from stock—phone for details.

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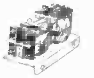
Honeywell Type N100
10A changeover micro switch. 10 for **£2·50.** Post 25p.

PUSH BUTTON MICRO SWITCH. 5 amp. c/o contacts. NEW. 20 for **£2.** Post 15p. (Min. order 20). Ditto press to break, 20 for **£1·50.** Post 15p.

SUB-MINIATURE REED RELAY 3-9V d.c. 250 ohm Coil
Single make, size 1¼ × ⅜ × ⅜in. **Outstanding Value only £1** for six, **£1·50** for ten. Post 15p. (Min. order six.)

LATCHING RELAY



Twin latching relay, "flip-flop" 2 c/o each relay. Mains contacts. 115V A.C. or 50V D.C. operation. 240V A.C. with 2·5K resistor. **85p.** Post 15p.

TRIAC

Raytheon Tag symmetrical Triac. Type TAG. 250/500V, 10 amp, 500 p.i.v. Glass passivated plastic triac. Swiss precision product for long term reliability **£1·00.** Post 10p. (Inclusive of Data and application sheet.) Suitable Diac **18p.**

230/250 VOLT A.C. SOLENOID

Approximately 1½lb pull. Size of feet 1¾" × 1⅜". Price **£1·00.** Post 15p.

24 VOLT DC SOLENOIDS

UNIT containing 1 heavy duty solenoid approx. 25lb pull 1 inch travel. Two × approx. 1lb pull ½ inch travel. 6 × approx. 4oz. pull ¼ inch travel. One 24 volt d.c., 1 heavy duty single make relay. Price **£2·50.** Post 75p. **ABSOLUTE BARGAIN.**

COIN MECHANISM (Ex London Transport)
Unit containing, selector mechanism for 1p, 2p and 5p coins. Micro switches, relays, solenoid operated hopper. 24 volt D.C. Precision built to high standard. Incredible VALUE at only **£2·50.** Post 70p.

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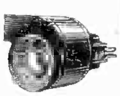

Mfg. Airflow Developments Ltd. Precision continuously rated, smooth running, 230/240V a.c. motor 80 c.f.m. As illustration but with round aperture. **£6·50.** Post 50p.

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OPEN TYPE 1 amp (panel mount) **£10·00**

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Step up step down
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REVERSIBLE MOTOR

A.E.I. $\frac{1}{70}$ h.p. reversible motor 100/120 volt A.C. 50/60 cycle 1400/1680 r.p.m. Flange fixing. Dia. 4", length 6⅛", shaft 1" × $\frac{5}{16}$". Brand New. Price **£2·50.** Post 50p. Suitable 110/240v. 150 watt Auto Transformer **£3·50.** Post 50p. (Post for both items together 75p.)

230/240 VOLT A.C. MINIATURE MOTOR. 20 R.P.M. Price **£1.** Post 15p.

BODINE TYPE N.C.I. GEARED MOTOR

(Type J) 71 r.p.m. torque 10 lb. in. **Reversible** 1/70th h.p. cycle 0·38 amp. **(Type 2) 28 r.p.m.** torque 20 lb. in **Reversible** 1/80th h.p. 50 cycle 0·28 amp. The above two precision made U.S.A. motors are offered in 'as new' condition. Input voltage of motor 115V A.C. Supplied complete with transformer for **230/240V A.C. input.**
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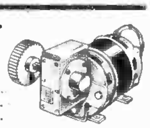
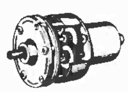
'FRACMO' 240 VOLT A.C. 50 cycle SINGLE PHASE GEARED MOTOR



33 r.p.m. 30 lb. ins. Reversible. Fitted with mounting feet. Brand New. **£14.** Post £1·00. (Total price incl. VAT £16·20).

9-12 VOLT D.C. GOVERNED REVERSIBLE MOTOR



Machine cut gear train, giving final speed of 2 r.p.m. with cam driving 3 sub-miniature micro-switches (removable). Spindle 12mm long 6mm dia. Built to PO spec., in heavy metal hinged case. **£3·75.** Post 40p.

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230/240V A.C., smooth, powerful, continuously rated. Two types: 32 r.p.m. or 110 r.p.m. Either type **£4·50.** Post 50p.

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Superior Quality Precision Made NEW POWER RHEOSTATS

New ceramic construction, vitreous enamel embedded winding, heavy duty brush assembly, continuously rated.
25 WATT 10/25/50/100/150/250/500/1k/1·5k/2·5k ohm. **£1·70.** Post 15p.
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VAT AT THE APPROPRIATE RATE MUST BE ADDED TO ALL ORDERS FOR THE TOTAL VALUE OF GOODS INCLUDING POSTAGE.

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Build a Strobe Unit, using the latest type Xenon white light flash tube. Solid state timing and triggering circuit. 230/250V a.c. operation. **RANGE OF FOUR STROBE KITS FROM STOCK. PRICES FROM £6·30 to £22.** S.A.E. for details.

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400 Watt. Mercury vapour ultra violet lamp. Powerful source of u.v. P.F. ballast is essential. Price of matched ballast and bulb **£21.** Post £1. Spare bulb **£8.** Post 40p.

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4ft 40 watt, £5·50 (callers only). **2ft 20 watt, £4·25.** Post 40p. (For use in standard bi-pin. MINI. **12in 8 watt, £1·60.** Post 25p. **9in 6 watt, £1·30.** Post 25p. Complete ballast unit and holders for 9in and 12in tube, **£1·70.** Post 25p. (9in and 12in measures approx.)

METERS NEW

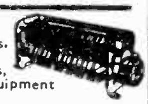
90mm diameter
Type 65C5. 2A D.C. M/C; 5A D.C. M/C 10A D.C. M/C; 20A D.C. M/C; 50A D.C. M/C.
Type 62T2. 1A A.C. M/I; 20A A.C. M/I; 300V A.C. M/I; **ALL ABOVE £2·50. Post 20p.**
Type 65L5. 300V A.C. R/M/C; **£2·75. Post 20p.**

64mm × 56mm RECTANGULAR
Type 85C1. 5A D.C. M/C; 20A D.C. M/C.
Type 85L1. 5A A.C. R/M/C; 10A A.C. R/M/C; 300V A.C. R/M/C: **All at £3. Post 20p.**

ROTARY VACUUM AIR PUMP AND COMPRESSOR

Carbon vane, oilless, 100/115V a.c., $\frac{1}{12}$h.p. motor, 50/60 cycle, 2875/3450 r.p.m., 20 in vacuum, comp. 1·25 c.f.m., 10 p.s.i. (approx. figures). New unused surplus stock. Supplied with electrical connection data. FRACTION OF MAKERS' PRICE **£12.** Post 50p. Suitable 110/240V, 150 watt auto transformer **£3·50.** Post 50p. (Both items together Post 75p.)

PROGRAMME TIMERS



230/240V a.c. 15 r.p.m. Motors. Each cam operates a c/o micro switch, Ideal for lighting effects, animated displays, etc. Ex equipment tested.
2 cam model. **£2·00** post 35p.
4 cam model. **£2·50** post 35p.
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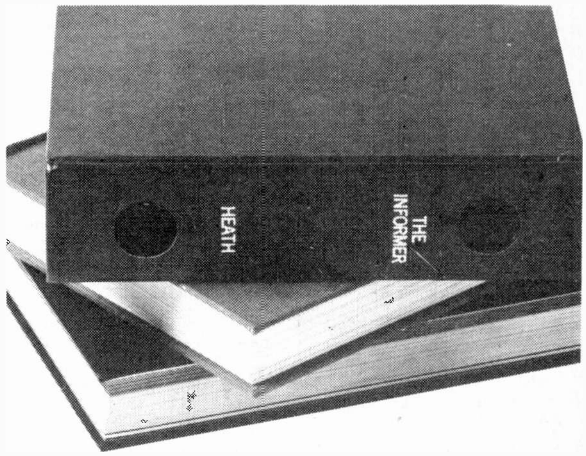

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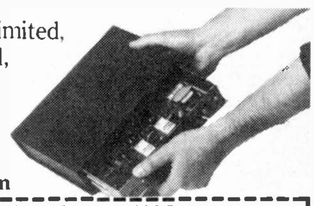

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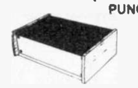

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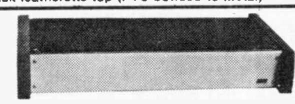

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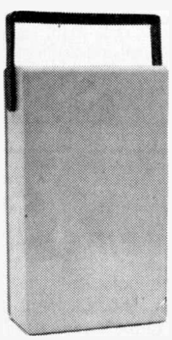

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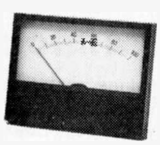

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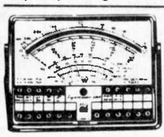

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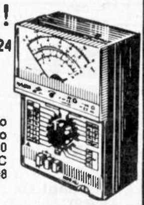

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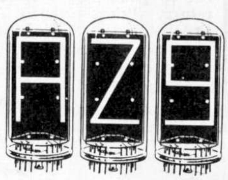

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£14 plus 25% VAT

Decade Resistance Box 0–111kΩ in 0·1 ohm steps.
£38 plus 8% VAT

**All prices include postage and packing.
All goods supplied are new and guaranteed**

TUAC
Important Announcement

Prices quoted in our June advertisement included 25% V.A.T. V.A.T. should be 8%. When ordering, the following prices apply: Disco Mix £31·50; 3 Channel Light Modulator £15·50, Single Channel version £7·25; Power Modules—TP125 £19·50, TL30 £7·90, TL60 £12·50, TL100 £15·00; Preamplifiers—VAO8 £5·75, VAO6 £5·00, SVAO1 £10·00; PS125 £12·25, PS100 £11·25, PS60 £10·00, PS30 £5·90, PSU2 £4·75.

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