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PRACTICAL

ELECTRONICS

VOLUME 12 No. 1 JANUARY 1976

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GENERAL FEATURES

NEWS AND COMMENT

Our February issue will be published on Friday, January 9, 1976
(for details of contents see page 49)

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CD4020	0·92	CD4038	0·88	CD4056	1·08	CD4081	0·18	MC14585	1·45

RCA 1975 CMOS Databook: Pin-Outs, 400 pages of data, 200 pages of circuits, applications and use, £2·87 (no VAT or P. & P.).

ADD VAT at 8% (higher rate does not apply to any of above). 15p P. & P. on orders under £3 (despatch is 1st class post). Price List sent FREE with any order, or on request (a S.A.E. helps). Official orders welcomed (written or phoned)—Universities, Polytechnics, Government, Companies, etc. Export orders (no VAT): add 35p (Europe), £1 (overseas) for air mail P. & P.

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BI-PAK SEMICONDUCTORS

COMPONENTS

CARBON RESISTOR PAKS

These Paks contain a range of Carbon Resistors, assorted into the following groups:

R1	50	Mixed	100 ohms–820 ohms 1/8th W	0·60
R2	50	Mixed	1K ohms–8·2K ohms 1/8th W.	0·60
R3	50	Mixed	10K ohms–82K ohms 1/8th W	0·60
R4	50	Mixed	100K ohms–820K ohms 1/8th W	0·60
R5	30	Mixed	100 ohms–820 ohms ½ W	0·60
R6	30	Mixed	1K ohms–8·2K ohms ½ W	0·60
R7	30	Mixed	10K ohms–82K ohms ½ W	0·60
R8	30	Mixed	100K ohms–820K ohms ½ W	0·60

THESE ARE UNREPEATABLE PRICES

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500	µF	50V Elect	0·09 each
0·01	µF	400V	0·03 each

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	CH3	7·5mH	0·29
	CH5	1·5mH	0·26
	CH2	5·0mH	0·28
	CH4	10mH	0·31

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CARBON POTENTIOMETERS

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4·7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M.

VC 1	Single Less Switch	0·14
VC 2	Single D.P. Switch	0·26
VC 3	Tandem Less Switch	0·43
VC 4	1K Less Switch	0·14
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0·1W 0·06 each
100, 220, 470, 1K, 2·2K, 4·7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M, 4·7M.

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NORMAN ¼" Cores & Formers 0·07p
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CABLES			Per Metre
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CP	4	Four Core Common Screen	★0·21
CP	5	Four Core individually screened	★0·28
CP	6	Microphone Fully Braided Cable	★0·11
CP	7	Three Core Mains Cable	★0·11
CP	8	Twin Oval Mains Cable	★0·08
CP	9	Speaker Cable	★0·06
CP	10	Low Loss Co-Axial	★0·14

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BV2	11"	× 6"	× 3"	★£1·62
BV3	6"	× 4¾"	× 1¾"	0·92
BV4	9"	× 5¼"	× 2½"	£1·39

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BA2	4"	× 4"	× 1½"	★0·45
BA3	4"	× 2¼"	× 1½"	★0·45
BA4	5¼"	× 4"	× 1½"	★0·54
BA5	4"	× 2½"	× 2"	★0·45
BA6	3"	× 2"	× 1"	★0·39
BA7	7"	× 5"	× 2½"	★0·79
BA8	8"	× 6"	× 3"	★£1·02
BA9	6"	× 4"	× 2"	★0·65

(Each complete with ½" deep lid & screws)
PLEASE ADD 20p POSTAGE AND PACKING FOR EACH BOX.

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Pak No.	Qty.	Description	Price
C1	200	Resistors mixed values approx. count by weight	0·60
C2	150	Capacitors mixed values approx. count by weight	0·60
C3	50	Precision Resistors mixed values	0·60
C4	75	1/8th width Resistors mixed preferred values	0·60
C5	5	Pieces assorted Ferrite Rods	0·60
C6	2	Tuning Gangs, MW/LW VHF	0·60
C7	1	Pak Wire 50 metres assorted colours	★0·60
C8	10	Reed Switches	0·60
C9	3	Micro Switches	0·60
C10	15	Assorted Pots & Pre-Sets	0·60
C11	5	Jack Sockets 3 × 3·5m, 2 × standard Switch Type	0·60
C12	30	Paper Condensers preferred types mixed values	0·60
C12	20	Electrolytics Trans. types	0·60
C14	1	Pack assorted Hardware—Nuts/Bolts, Grommets, etc.	★0·60
C15	5	Mains Slide Switches, 2 Amp.	0·60
C16	20	Assorted Tag Strips & Panels	0·60
C17	10	Assorted Control Knobs	0·60
C18	4	Rotssy Wave Change Switches	0·60
C19	2	Relays 6-24V Operating	0·60
C20		Sheets Copper Laminate approx. 200 sq.ins.	★0·60

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Ref.		Price
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J	Tape head cleaning kit	★68p
P	Hi-Fi cleaner	★30p
9	Wire stripper/Cutter	★94p
31	Cassette head cleaner	★58p
32	Tape editing kit	★£1·64
32A	Stylus balance	★£1·24
66A	Record stylus cleaning kit	★32p
42	De Luxe Groov-Kleen	★£1·84
43	Record care kit	★£2·68
45	Auto changer groove cleaner	★98p
46	Spirit level	★68p
58	Hi-Fi stereo hints & tips	★38p
60	Chrome finish as above	★£1·72

ANTEX EQUIPMENT ★

SOLDERING IRONS

X25, 21W	★£2·45
Model G, 18W	★£2·70
CCN 240, 15W	★£2·90
SK2, Soldering Kit	★£3·90

BITS AND ELEMENTS

Bit No.	
102 for model CN240 3/32"	★42p
104 for model CN240 3/16"	★42p
1100 for model CCN240 3/32"	★42p
1101 for model CCN240 3/8"	★42p
1102 for model CCN240 ¼"	★42p
1020 for model G240 3/32"	★42p
1021 for model G240 1/8"	★42p
1022 for model G240 3/16"	★42p
50 for model X25 3/32"	★44p
51 for model X25 1/8"	★44p
52 for model X25 3/16"	★44p

ELEMENTS

Model EX25	★£1·20
Model ECN240	★£1·10
Model EG240	£1·35★
Model ECCN240	£1·55★

SOLDERING IRON STAND

ST3 Suitable for all models ★£1·10
Antex heat shunt ★10p

PLUGS

			Price
PS	1	DIN 2 pin (Speaker)	0·10
PS	2	DIN 3 pin	0·11
PS	3	DIN 4 Pin	0·14
PS	4	DIN 5 Pin 180°	0·15
PS	5	DIN 5 Pin 240°	0·15
PS	6	DIN 6 Pin	0·16
PS	7	DIN 7 Pin	0·17
PS	8	Jack 2·5mm Screened	0·17
PS	9	Jack 3·5mm Plastic	0·11
PS	10	Jack 3·5mm Screened	0·17
PS	11	Jack ¼" Plastic	0·14
PS	12	Jack ¼" Screened	0·20
PS	13	Jack Stereo Screened	0·33
PS	14	Phono	0·09
PS	15	Car Aerial	0·14
PS	16	Co-Axial	0·14

INLINE SOCKETS

PS 21	DIN 2 Pin (Speaker)	0·18
PS 22	DIN 3 Pin	0·19
PS 23	DIN 5 Pin 180°	0·19
PS 24	DIN 5 Pin 240°	0·19
PS 25	Jack 2·5mm Plastic	0·15
PS 26	Jack 3·5mm Plastic	0·15
PS 27	Jack ¼" Plastic	0·28
PS 28	Jack ¼" Screened	0·32
PS 29	Jack Stereo Plastic	0·28
PS 30	Jack Stereo Screened	0·35
PS 31	Phono Screened	0·17
PS 32	Car Aerial	0·20
PS 33	Co-Axial	0·20

SOCKETS

PS 35	DIN 2 Pin (Speaker)	0·07
PS 36	DIN 3 Pin	0·09
PS 37	DIN 5 Pin 180°	0·90
PS 38	DIN 5 Pin 240°	0·10
PS 39	Jack 2·5mm Switched	0·11
PS 40	Jack 3·5mm Switched	0·11
PS 41	Jack ¼" Switched	0·19
PS 42	Jack Stereo Switched	0·28
PS 43	Phono Single	0·07
PS 44	Phono Double	0·09
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Containing 6 sheets of 6" × 4" single sided laminate, a generous supply of etchant powder, etching dish, etchant measure, tweezers, etch resistant marking pen, high quality pump drill with spares, cutting knife with spare blades, 6" metal ruler, plus full easy to follow instructions.
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S237	5 pin DIN plug to 5 pin DIN plug mirror image length 1·5m	£1·20
S238	2 pin DIN plug to 2 pin DIN socket length 5m	68p
S268	5 pin DIN plug to 3 pin DIN plug 1 & 4 and 3 & 5 length 1·5m	£1·00
S270	2 pin DIN plug to 2 pin DIN socket length 10m	80p
S271	5 pin DIN plug to 2 phono plugs connected to pins 3 & 5 length 1·5m	70p
S275	5 pin DIN plug to 2 phono sockets connected to pins 3 & 5 length 23cm	68p
S318	5 pin DIN socket to 2 phono plugs connected to pin 3 & 5 length 23cm	68p
S404	Coiled stereo headphones extension cord extends to 7m	£1·40
S217	3 pin DIN plug to 3 pin DIN plug length 1·5m	80p
S219	5 pin DIN plug to 5 pin DIN plug length 1·5m	80p
S474	3·5mm Jack to 3·5mm Jack length 1·5m	68p
S600	5 pin DIN plug to 3·5mm Jack connected to pins 3 & 5 length 1·5m	80p
S700	5 pin DIN plug to 3·5 jack connected to pins 1 & 4 length 1·5m	80p

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K4007 (2-way) I/P Impedance 8 ohms. Insertion Loss 3dB. Crossover Frequency 3 KHz. PRICE £1·12

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4-6 digit, 12-24 hr, alarm, timer & date circuits with data £4-00

TTL

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7401	11	7450	12	74151	60
7402	11	7451	13	74153	71
7403	11	7453	13	74154	1·05
7404	13	7454	14	74155	95
7405	13	7460	11	74156	71
7406	22	7464	21	74157	71
7407	22	7465	21	74161	95
7408	14	7472	22	74163	1·05
7409	14	7473	26	74164	1·25
7410	11	7474	26	74165	1·25
7411	16	7475	41	74166	1·15
7413	35	7476	26	74173	95
7415	22	7483	70	74175	95
7416	22	7485	80	74176	95
7417	22	7486	24	74177	85
7420	11	7489	1·50	74180	80
7422	22	7490	45	74181	2·50
7423	22	7491	71	74182	80
7425	22	7492	44	74184	1·55
7426	23	7493	44	74185	1·45
7427	22	7494	49	74190	95
7430	12	7495	49	74191	95
7432	22	7496	55	74192	90
7437	25	74100	1·25	74193	85
7438	21	74105	60	74194	95
7440	11	74107	27	74195	80
7441	60	74121	32	74196	1·00
7422	55	74122	50	74197	75
7443	55	74123	55	74198	1·70
7444	60	74125	50	74199	1·70
7445	75	74126	50	74200	3·90
7446	85	74141	68		
7447	80	74145	75		

LOW POWER

74L00	£0·16	74L51	£0·16	74L90	£0·93
74L02	16	74L55	18	74L91	80
74L03	16	74L71	18	74L93	89
74L04	18	74L72	27	74L95	89
74L06	18	74L73	38	74L98	1·53
74L10	16	74L74	38	74L164	1·53
74L20	16	74L78	44	74L165	1·53
74L30	16	74L85	85		
74L42	89	74L86	38		

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74H00	£0·16	74H21	£0·16	74H55	£0·20
74H01	16	74H22	18	74H60	21
74H04	16	74H30	18	74H61	21
74H08	16	74H40	16	74H62	20
74H10	16	74H50	16	74H74	32
74H11	15	74H52	18		
74H20	16	74H53	20		

8000 SERIES

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8092	33	8220	93	8812	60
8095	76	8230	1·42	8822	1·42
8121	49	8520	71	8830	1·42
8123	88	8551	91	8831	1·42
8130	1·20	8552	1·37	8836	27
8200	1·42	8554	1·37	8880	73
8210	1·92	8810	44		

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9002	£0·21	9309	£0·49	9601	£0·54
9301	63	9312	49	9602	49

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1101	256 bit RAM MOS	£0·96
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5203	2048 bit erasable PROM	13·68
5260	1024 bit RAM Low Power	2·16
7489	64 bit RAM TTL	1·50
8223	Programmable ROM	2·72

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MM5739	9 DIG 4 funct (btry sur)	2·92
MM5311	28 pin BCD 6 dig mux	2·42
MM5312	24 pin 1 pps BCD 4 dig mux	1·94
MM5313	28 pin 1 pps BCD 6 dig mux	2·42
MM5314	24 pin 6 dig mux	2·42
MM5316	40 pin alarm 4 dig	2·42

LED'S

MV10B	Red TO 18	£0·14
MV50	Axial leads	8
MV5020	Jumbo Vis. Red (Red Dome)	18
	Jumbo Vis. Red (Clear Dome)	18
ME4	Infra red diff. dome	18
MAN 1	Red 7 seg .270"	1·38
MAN 2	Red alpha num .32"	2·72
MAN 4	Red 7 seg. .190"	1·18
MAN 5	Green 7 seg. .270"	1·62
MAN 6	.6" high solid seg.	3·81
MAN 7	Red 7 seg. .270"	74
MAN 8	Yellow 7 seg. .270"	2·17
MAN 64	.4" high solid seg.	2·45
MAN 66	.6" high spaced seg	2·55
MCT2	Opto iso transistor	38

MULTIPLE DISPLAYS

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HP5082 7405	3 digit .11 led magn. lens com. cath	1-80
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FNA37	9 digit 7 seg led RH dec clr. magn. lens	2-75
SP-425-09	9 digit .25" neon direct interface with MOS/LSI, 180 VDC, 7 seg	98

DTL

930	10	937	10	949	10
932	10	944	10	962	10
936	10	946	10	963	10

LINEAR CIRCUITS

300	Pos V Reg (super 723)	TO-5	£0·43
301	Hi Perf Op Amp	mDIP TO-5	18
302	Volt follower	TO-5	43
304	Neg V Reg	TO-5	49
305	Pos V Reg	TO-5	52
307	Op AMP (super 741)	mDIP TO-5	38
308	Micro Pwr Op Amp	mDIP TO-5	60
309K	5V 1A regulator	TO-3	91
310	V Follower Op Amp	TO-5 mDIP	65
311	Hi perf V Comp	mDIP TO-5	58
319	Hi Speed Dual Comp	DIP	71
320	Neg Reg 5.2, 12, 15	TO-3	74
322	Precision Timer	DIP	60
324	Quad Op Amp	DIP	1·07
339	Quad Comparator	DIP	92
340K	Pos. V reg (5, 6, 8, 12, 15, 18, 24)	TO-3	1·20
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372	AF-IF Strip detector	DIP	44
376	Pos. V Reg	mDIP	33
377	2w Stereo amp	DIP	1·47
380	2w Audio Amp	DIP	81
380-8	.6w Audio amp	mDIP	69
381	Lo Noise Dual preamp	DIP	98
382	Lo Noise Dual preamp	DIP	98
550	Prec V Reg	DIP	54
555	Timer	mDIP	44
556A	Dual 555 Timer	DIP	89
560	Phase Locked Loop	DIP	1·94
562	Phase Locked Loop	DIP	1·94
565	Phase Locked Loop	DIP	1·20
566	Function Gen	mDIP	1·20
567	Tone Decoder	mDIP	1·20
709	Operational AMPL	DIP	27
710	Hi Speed Volt Comp	DIP	21
711	Dual Difference Compar	DIP	44
723	V Reg	DIP	38
739	Dual Hi Perf Op Amp	DIP	65
741	Comp Op AMP	mDIP TO-5	27
747	Dual 741 Op Amp	DIP or TO-5	44
748	Freq Adj 741	mDIP	27
1304	FM Mulpx Stereo Demod	DIP	65
1307	FM Mulpx Stereo Demod	DIP	45
1458	Dual Comp Op Amp	mDIP	38
LH2111	Dual LM 211 V Comp	DIP	1·07
	Audio preamp	DIP	44
3900	Quad Amplifier	DIP	33
7524	Core Mem Sense AMPL	DIP	1·04
7534	Core Mem Sense Amp	DIP	1·42
8864	9 DIG Led Cath Drvr	DIP	1·37
75451	Dual Perepheral Driver	mDIP	21
75452	Dual Peripheral Driver	mDIP	21
75453	(351) Dual Periph. Driver	mDIP	21
75491	Quad Seg Driver for LED	DIP	50
75492	Hex Digit Driver	DIP	55

CMOS

74C00	£0-21	74C74	£0-63	74C162	£1-78
74C02	30	74C76	93	74C163	1-78
74C04	41	74C107	82	74C164	1-92
74C08	41	74C151	1-59	74C173	1-59
74C10	36	74C154	1-92	74C195	1-65
74C20	36	74C157	1-20	80C95	82
74C42	1-18	74C160	1-78	80C97	82
74C73	.85	74C161	1-78		

4000A	£18	4013A	£32	4025A	£18	4069A	£31
4001A	18	4014A	1-06	4027A	42	4071A	19
4002A	18	4015A	1-06	4028A	70	4072A	25
4006A	96	4016A	40	4030A	32	4073A	28
4007A	19	4017A	85	4035A	90	4075A	28
4008A	1-27	4020A	1-06	4042A	1-05	4078A	28
4009A	41	4021A	98	4049A	42	4081A	19
4010A	38	4022A	78	4050A	42	4082A	25
4011A	21	4023A	18	4066A	63	4528A	1-14
4012A	18	4024A	63	4068A	31	4585A	1-49

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CLEAR PLASTIC MODEL SD640
Size: 85 x 64mm

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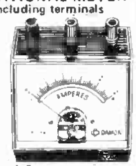
100uA	£4.15		
200uA	£4.10		
500uA	£4.05		
50-0-50uA	£4.15		
100-0-100uA	£4.10		
1mA	£4.05		
5mA	£4.05		
10mA	£4.05	10V DC	£4.05
50mA	£4.05	20V DC	£4.05
100mA	£4.05	25V DC	£4.05
500mA	£4.05	50V DC	£4.05
1A DC	£4.05	300V DC	£4.05
5A DC	£4.05	15V AC	£4.15
10A DC	£4.05	300V AC	£4.15
5V DC	£4.05	VU Meter	£4.95

CLEAR PLASTIC MODEL SW100
Size: 100 x 80mm

50uA	£5.05		
100uA	£4.95		
500uA	£4.75		
50-0-50uA	£4.95		
100-0-100uA	£4.90		
1mA	£4.75		
1A DC	£4.75		
5A DC	£4.75		
20V DC	£4.75	150V AC	£4.90
50V DC	£4.75	300V AC	£4.90
300V DC	£4.75	VU Meter	£6.25

MODEL ED107 EDUCATIONAL METER
Size: 100 x 90 x 150mm including terminals

A range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The meter movement is easily accessible to demonstrate internal working.



50uA	£9.35		
100uA	£8.70		
50-0-50uA	£8.70		
1mA	£8.40	20V DC	£8.40
1-0-1mA	£8.40	50V DC	£8.40
1A DC	£8.40	300V DC	£8.40
5A DC	£8.40	500mA 5A DC	£9.50
5V DC	£8.40	5V 50V DC	£9.50
10V DC	£8.40	5V 15V DC	£9.50
15V DC	£8.40	1A 15A DC	£9.50

CLEAR PLASTIC MODEL SD460
Size: 59 x 46mm

50uA	£3.85		
100uA	£3.80		
200uA	£3.75		
500uA	£3.70		
50-0-50uA	£3.80		
100-0-100uA	£3.75		
1mA	£3.65		
5mA	£3.65	5V DC	£3.65
10mA	£3.65	10V DC	£3.65
50mA	£3.65	20V DC	£3.65
100mA	£3.65	50V DC	£3.65
500mA	£3.65	300V DC	£3.65
1A DC	£3.65	15V AC	£3.80
5A DC	£3.65	300V AC	£3.80
10A DC	£3.65	VU Meter	£4.65

*Items with asterisk are Moving Iron type, all others are Moving Coil

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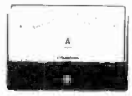
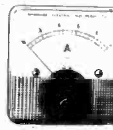
CLEAR PLASTIC MODEL SD830
Size: 110 x 83mm



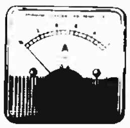
50uA	£4.75		
100uA	£4.65		
200uA	£4.60		
500uA	£4.55		
50-0-50uA	£4.65		
100-0-100μA	£4.60		
1mA	£4.50		
5mA	£4.50		
10mA	£4.60		
50mA	£4.50	10V DC	£4.50
100mA	£4.50	20V DC	£4.50
500mA	£4.50	50V DC	£4.50
1A DC	£4.50	300V DC	£4.50
5A DC	£4.50	15V DC	£4.60
10A DC	£4.50	300V AC	£4.60
5V DC	£4.50	VU Meter	£5.60

CLEAR PLASTIC MODEL MR 45P
Size: 50 x 50mm



50uA	£3.55		
100uA	£3.50		
200uA	£3.45		
500uA	£3.30		
50-0-50uA	£3.50		
100-0-100uA	£3.45		
500-0-500uA	£3.25		
1mA	£3.25		
5mA	£3.25		
10mA	£3.25		
50mA	£3.25	15V AC	£3.40
100mA	£3.25	300V AC	£3.40
500mA	£3.25	5 Meter 1mA	£3.75
1A DC	£3.25	VU Meter	£4.30
5A DC	£3.25	1A AC	£3.25*
10V DC	£3.25	5A AC	£3.25*
20V DC	£3.25	10A AC	£3.25*
50V DC	£3.25	20A AC	£3.25*
300V DC	£3.25	30A AC	£3.25*

CLEAR PLASTIC MODEL MR 38P
Size: 42 x 42mm

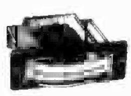


50uA	£3.45		
100uA	£3.40		
200uA	£3.30		
500uA	£3.10		
50-0-50uA	£3.40		
100-0-100uA	£3.30		
500-0-500uA	£3.05		
1mA	£3.05		
1-0-1mA	£3.05		
2mA	£3.05		
5mA	£3.05	10V DC	£3.05
10mA	£3.05	15V DC	£3.05
20mA	£3.05	20V DC	£3.05
50mA	£3.05	50V DC	£3.05
100mA	£3.05	100V DC	£3.05
150mA	£3.05	150V DC	£3.10
200mA	£3.05	300V DC	£3.10
300mA	£3.05	500V DC	£3.15
500mA	£3.05	750V DC	£3.15
750mA	£3.05	15V AC	£3.15
1A DC	£3.05	50V AC	£3.15
2A DC	£3.05	150V AC	£3.15
5A DC	£3.05	300V AC	£3.15
10A DC	£3.05	500V AC	£3.30
3V DC	£3.05	5 Meter 1mA	£3.50
		VU Meter	£4.10

CLEAR PLASTIC MODEL MR 85P
Size: 120 x 110mm

50uA	£6.00		
100uA	£5.95		
200uA	£5.90		
500uA	£5.80		
50-0-50uA	£5.95		
100-0-100uA	£5.90		
500-0-500uA	£6.65		
1mA	£5.75		
1-0-1mA	£5.75	50V DC	£5.75
5mA	£5.75	150V DC	£5.75
10mA	£5.75	300V DC	£5.75
50mA	£5.75	15V AC	£5.85
100mA	£5.75	300V AC	£5.85
500mA	£5.75	5 Meter 1mA	£6.65
1A DC	£5.75	VU Meter	£7.10
5A DC	£5.75	1A AC	£5.75*
15A DC	£5.75	5A AC	£5.75*
30A DC	£5.95	10A AC	£5.75*
10V DC	£5.75	20A AC	£5.75*
20V DC	£5.75	30A AC	£5.75*

EDGWISE MODEL PE70
Size: 90 x 34mm



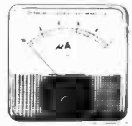
50uA	£4.55
100uA	£4.50
200uA	£4.45
500uA	£4.30
50-0-50uA	£4.50
100-0-100uA	£4.45
1mA	£4.25
10V DC	£4.25
300V DC	£4.35
VU Meter	£5.50

BAKELITE MODEL S80 Enlarged Window
Size: 80 x 80mm

50uA	£4.95
100uA	£4.90
500uA	£4.60
50-0-50uA	£4.80
100-0-100uA	£4.85
1mA	£4.60
1A DC	£4.60
5A DC	£4.60
20V DC	£4.60
50V DC	£4.60
300V DC	£4.60
300V AC	£4.75
VU Meter	£5.95

POSTAGE/PACKING & INSURANCE 15p

CLEAR PLASTIC MODEL MR 52P
Size: 60 x 60mm

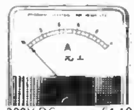


50uA	£4.10		
100uA	£3.85		
500uA	£3.70		
50-0-50uA	£3.85		
100-0-100uA	£3.70		
1mA	£3.65		
5mA	£3.65		
10mA	£3.65		
50mA	£3.65		
100mA	£3.65		
500mA	£3.65		
1A DC	£3.65		
5A DC	£3.65	5 Meter 1mA	£4.20
10V DC	£3.65	VU Meter	£4.85
20V DC	£3.65	1A AC	£3.65*
50V DC	£3.65	5A AC	£3.65*
300V DC	£3.65	10A AC	£3.65*
15V AC	£3.75	20A AC	£3.65*
300V AC	£3.75	30A AC	£3.65*

BAKELITE MODEL MR 65 Size: 80 x 80mm

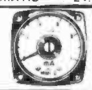
25uA	£5.80		
50uA	£4.40		
100uA	£4.35		
500uA	£4.05		
50-0-50uA	£4.35		
100-0-100uA	£4.30		
500-0-500uA	£3.95		
1mA	£3.95		
1-0-1mA	£3.95		
5mA	£3.95		
10mA	£3.95		
50mA	£3.95	300V DC	£3.95
100mA	£3.95	30V AC	£3.95*
500mA	£3.95	50V AC	£3.95*
1A DC	£3.95	150V AC	£3.95*
2A DC	£3.95	300V AC	£3.95*
5A DC	£3.95	500V AC	£3.95*
10A DC	£3.95	VU Meter	£5.20
15A DC	£3.95	1A AC	£3.95*
30A DC	£3.95	5A AC	£3.95*
50A DC	£4.20	10A AC	£3.95*
5V DC	£3.95	20A AC	£3.95*
10V DC	£3.95	30A AC	£3.95*
15V DC	£3.95	50A AC	£3.95*
20V DC	£3.95	500mA AC	£3.95
50V DC	£3.95	50mV DC	£4.15
150V DC	£3.95	100mV DC	£4.15

CLEAR PLASTIC MODEL MR 65P
Size: 86 x 78mm



50uA	£4.35		
100uA	£4.25		
200uA	£4.20		
500uA	£4.15		
50-0-50uA	£4.25		
100-0-100uA	£4.20		
500-0-500uA	£4.10		
1mA	£4.10		
1-0-1mA	£4.10		
5mA	£4.10	300V DC	£4.10
10mA	£4.10	15V DC	£4.20
50mA	£4.10	50V AC	£4.20
100mA	£4.10	150V AC	£4.20
500mA	£4.10	300V AC	£4.20
1A DC	£4.10	500V AC	£4.30
5A DC	£4.10	5 Meter 1mA	£4.85
10A DC	£4.10	VU Meter	£5.20
15A DC	£4.10	1A AC	£4.10*
20A DC	£4.20	5A AC	£4.10*
30A DC	£4.25	10A AC	£4.10*
50A DC	£4.10	20A AC	£4.10*
5V DC	£4.10	30A AC	£4.10*
10V DC	£4.10	50A AC	£4.10
15V DC	£4.10	50mA AC	£4.10*
20V DC	£4.10	100mA AC	£4.10*
50V DC	£4.10	200mA AC	£4.10*
150V DC	£4.10	500mA AC	£4.10*

240° Wide Angle 1mA METERS
MW1-8, 80 x 80mm
£7.45 P & P Ins 15p



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YAMABISHI VARIABLE VOLTAGE TRANSFORMERS

Excellent quality at low cost. Input: 230V 50/60Hz. Output 0–260V.
MODEL S260 BENCH MOUNTING

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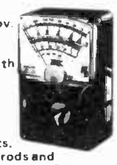
12A	£25.90	£1.50
20A	£60.45	£1.50
25A	£64.75	£1.50

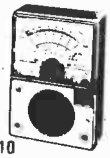
TMK 200 MULTIMETER KIT



Build yourself a quality 20000 opv multimeter and save money. Complete kit with meter scale, movement and rotary range selector ready mounted in cabinet. All parts, batteries, test prods and instructions. Ranges: 0/0.6/6/30/120/600/1200V D.C. 0/6/30/120/600/1200V A.C. Current: 0/0.6/6/60/600mA. Resistance: 0/10/100K/1/10 Meg ohms. Decibels: −20 to +63db. Size: 90 x 150 x 35mm

OUR PRICE £9.65 P/P & Ins 30p

HIOKI 730X



30,000 opv. Overload protection. 6/30/60/300/600/1200V DC. 12/60/120/600/1200V AC. 60/μA/30mA/300mA. 2K/200K/2 Meg Ohm. 10 to 63dB.

OUR PRICE £8.10
P/P & Ins 30p

U4323 MULTIMETER

20,000opv. Simple unit with audio/IF oscillator. Suitable for general receiver tuning. Ranges: 0.5/2.5/10/50/250/500/1000V DC. 0.5/5/50/500mA DC. Resistance: x 10, x 100, x 1,000, x 10,000 (50Ω, 500Ω, 5kΩ, 50kΩ centre scale) Battery operated. Size: 160 x 97 x 40mm. Supplied in carrying case complete with test leads.

OUR PRICE £8.60 P/P & Ins 60p

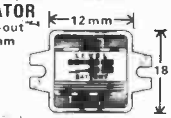
MODEL C7208FM

30,000 opv DC. 15,000 opv AC. 6/3/15/60/300/600/1200V. DC. 6/30/120/600/1200V. AC. DC Resistance x 1, x 10, x 100, x 1000 (50Ω centre scale) DC Current 30uA/3/30/600mA. −20 to +63dB.

OUR PRICE £9.65 P/P & Ins 30p

BATTERY/LEVEL PANEL INDICATOR

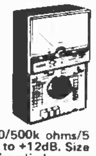
Dial cut-out 18×12 mm approx.



OUR PRICE 95p P/P & Ins 15p

Discounts for quantity.

U4324 MULTIMETER
High sensitivity.



20,000opv. Ranges: 0.6/1.2/3/12/30/60/120/600/1200V DC. 3/6/15/60/150/300/600/900V AC. Current: 0.06/0.6/6/60/600mA/3A DC. 0.3/3/30/300mA/3A AC. Resistence: 25/500 ohms/0.5/5/50/500k ohms/5 Mohms. Decibels: −10 to +12dB. Size 167 x 98 x 63mm. Supplied complete with test leads, spare diode and instructions.

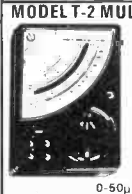
OUR PRICE £10.60 P/P & Ins 60p

U4315 MULTIMETER

Sturdy 43-range multimeter for current and voltage in DC AC circuits with freq. 45–20kHz and DC resistance, capacitance, etc. Ranges: DC 50 μA/100μA/0.5μA/1/5/25/100/500/2500; DC 75mV/1V/2.5/5/10/25/100/250/500/1000; AC 0.5 mA/1/5/25/100/500/2500; AC 1V/2.5/5/10/25/100/250/500/1000; DC 300Ω, DC 5kΩ/50/500/5000; −15db +2dB. Complete with steel carrying case and leads, manual.

OUR PRICE £10.80 p/p & Ins. 60p

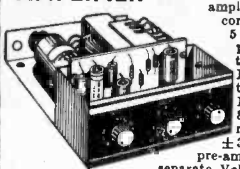
MODEL T-2 MULTITESTER



RANGES:
DC Voltage: 5-25-50-250-500-IK-2.5K (20,000 Ohms per Volt)
AC Voltage: 10-50-100-500-1000 Volts (10,000 Ohms per Volt)
DC Current: 0-50μA, 0-2.5MA, 0-250MA
Resistance: 0-6K, 0-6mg (300 ohm and 30K at center scale)
Capacitance: 10μμF to .001μF to 001μF. to .1μF Decibels: −20 to 22DB. Includes leads, batteries, and soft carrying case!

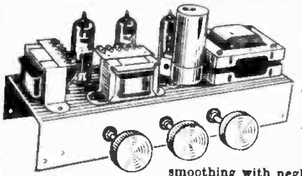
OUR PRICE £9.95
P/P & Ins. 60p

SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 Silicon transistors plus 2 power out-put transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz. 30KHz ±3db. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high × 6" wide × 7½" deep. AC 200/250V. PRICE £15·00. P. & P. 85p.

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. 95p.

ALL PURPOSE POWER SUPPLY UNIT 200/240v. A.C. input. Four switched fully smoothed D.C. outputs giving 6v. and 7½v. and 9v. and 12v. at 1 amp on load. Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" × 3½" × 2½". Ready built and tested. Price £6·35. P. & P. 85p.

VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. Our price £1·30 yd. length. P. & P. 35p per yd. (min. 1 yd.). S.A.E. for samples.

HARVERSON'S SUPER MONO AMPLIFIER

A super quality gram amplifier using a double wound fully isolated mains transformer, rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3·5 watts. Volume and tone controls. Chassis size only 7in. wide × 3in. deep × 6in. high overall. AC mains 200/240v. Supplied absolutely Brand New completely wired and tested with good quality output transformer. P. & P. 85p. BARGAIN PRICE £5·00

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0-210-240v. Secondary combinations 0-5-10-15-20-25-30-35-40-60v. half wave at 1 amp. or 10-0-10, 20-0-20, 30-0-30v. at 2 amps full wave. Size 3in. long × 3½in. wide × 3in. deep. Price £2·75. P. & P. 75p.

MAINS TRANSFORMER. For power supplies.
Pri. 200/240v. Sec. 9-0-9 at 500 mA. £1·35. P. & P. 35p.
Pri. 200/240v. Sec. 12-0-12 at 1 amp. £1·50. P. & P. 55p.
Pri. 200/240v. Sec. 10-0-10 at 2 amp. £2·20. P. & P. 70p.

GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER

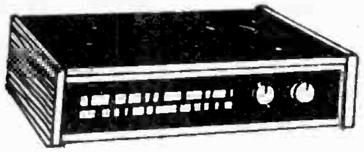
For P.U. Tape, Mike, Guitar, etc. and suitable for use with valve or transistor equipment. 9-18v. battery or from H.T line 200/300v. Frequency response 15Hz—25KHz. Gain 26dB. Solid encapsulation size 1½" × 1½" × ½". Brand new complete with instructions. Price £1·50 P. & P. 15p.

STEREO-DECODER SIZE 2"×3"×½"

Ready built. Pre-aligned and tested. Sens. 20-560mV for 9-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions (inclusive of hints and tips) supplied. £6·25 plus 20p P. & P. Stereo beacon light if required 45p extra.

QUALITY RECORD PLAYER AMPLIFIER MK. II A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in wide × 3in deep × 6in high. Ready built and tested. PRICE £6·50. P. & P. 90p. ALSO AVAILABLE mounted on board with output transformer and speaker. PRICE £7·75. P. & P. £1·00.

HARVERSONIC MAINS OPERATED SOLID STATE STEREO FM TUNER



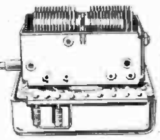
Enjoy Fabulous Stereo Radio at this Low Introductory Price!

Designed and styled to match our 10 + 10 amplifier but will suit any other standard stereo amplifier. The design incorporates the very latest circuitry techniques with high-grain, low noise IF stages. Automatic frequency control to "lock on" station and prevent drift. IC stereo decoder for maximum stereo separation. L.E.D. for stereo beacon indicator. Nominal output of tuner 100mV. Approximate size 12½in wide × 8in deep by 2½in high. Supplied ready built, fully tested and fully guaranteed (not available in kit form).
Price £27·50. Post and Packing £1·20.

LATEST ACOS GP91/1SC mono compatible cartridge with t/o stylus for LP/EP/78. Universal mounting bracket. £1·75. P. & P. 18p.
CERAMIC STEREO CARTRIDGE. Universal mounting brackets and turnover stylus. 70mV per channel output. ONLY £2·06. P. & P. 18p.
SONOTONE 9TAHC COMPATIBLE STEREO CARTRIDGE T/O stylus Diamond Stereo LP and Sapphire 78. ONLY £2·62. P. & P. 10p. Also available fitted with twin Diamond T/O stylus for Stereo LP. £3·18. P. & P. 18p.
LATEST CRYSTAL T/O STEREO/COMPATIBLE CARTRIDGE for EP/LP/Stereo 78. £1·98. P. & P. 18p.
LATEST T/O MONO COMPATIBLE CARTRIDGE for playing EP/LP/78 mono or stereo records on mono equipment. Only £1·75. P. & P. 18p.

SPECIAL OFFERS

Mullard LP1159 RF-IF Double Tuned Amplifier Module for nominal 470kHz. Size approx. 2⅜" × 1¼" × ½" 7·6V + earth. Brand new pre-aligned. Full specification and connection details supplied. £2·50 + P. & P. 12p.



Pye VHF/FM Tuner Head covering 88-108M/Hz. 10·7M/Hz IF output 7-8V + earth. Supplied pre-aligned, with (illus.) full circuit diagram and connection details supplied. Beautifully made with precision-geared FM and 323 Pf + 323 Pf AM Tuning Gauge only £3·50 + P. & P. 35p.

PRECISION MADE
Push Button Switch bank. 8 Buttons giving 16 S/P C/O interlocked switches plus 1 Cancel Button Plus 3 d/p c/o. Overall size 5" × 2½" × 1". Supplied complete with chrome finished switch buttons £1·50 ea. + 10 P. & P.

HI-FI LOUDSPEAKER SYSTEM MkII

Beautifully made simulated teak finish enclosure now with most attractive slatted front. Size 16½" high × 10½" wide × 9" deep (approx.). Fitted with E.M.I. Ceramic Magnet 13" × 8" bass unit, H.F. tweeter unit and crossover. AVAILABLE IN NOMINAL 4 ohm, 8 ohm or 16 ohm impedance (state which).
OUR PRICE £12·50 each. Carr. £1·60
Cabinet Available Separately £7·50. Carr. £1·20.
Also available in 8 ohms with EMI 13" × 8" bass speaker with parasitic tweeter £11·00. Carr. £1·60

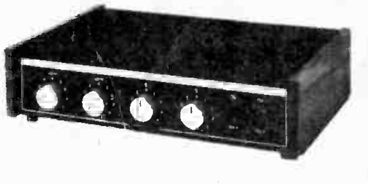
LOUDSPEAKER BARGAINS

5in. 3 ohm £1·45, P. & P. 35p. 7 × 4in. 3 ohm £1·69, P. & P. 48p. 10 × 6in. 3 or 15 ohm £2·50, P. & P. 75p. E.M.I. 8 × 5in. 3 ohm with high flux magnet £2·06, P. & P. 50p. E.M.I. 13½ × 8in. with high flux ceramic magnet with parasitic tweeter 3, 8 or 15 ohm £4·12, P. & P. 85p. E.M.I. 13 × 8in 3, 8 or 15 ohm with inbuilt tweeter and crossover network £5·50, P. & P. 95p. E.M.I. tweeter. Approx. 3½". Available 3 or 8 or 15 ohms, £2·00 + 25p, P. & P.

"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER
Size 11½" × 14⅜" × 1³⁄₁₆" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz-20kHz. Can be mounted on ceilings, walls. Send S.A.E. for details. Only £7·68 each. P. & P. 70p.

Now also available 8", 10 watts r.m.s. 20 watt peak 40 Hz-20,000 Hz. Overall depth 1". Ideal for Hi-Fi or for use in cars. £5·18 + 40p P. & P.

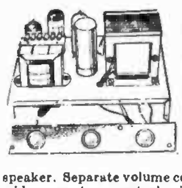
HARVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT



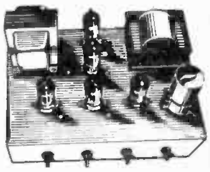
A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metal work, high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specifications: Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response ±3dB 12–30,000 Hz Sensitivity: better than 80mV into 1MΩ. Full power bandwidth: ±3dB 12–15,000 Hz. Bass, boost approx. to ±12dB. Treble cut approx. to —16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1·0 amp.
Overall Size 12"w. × 8"d. × 2½"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. 55p
(Magnetic input components 33p extra)		
POWER PACK KIT	£5·35	P. & P. 85p
CABINET	£5·35	P. & P. 75p

P. & P. only £1 if all units purchased at same time.
Full after sales service
Also available ready built and tested £32·50. P. & P. £1·00.
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 7½"w. × 4"d. × 4½"h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only £7·75. P. & P. 85p.
HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. £6·50. P. & P. 85p.



10/14 WATT HI-FI AMPLIFIER KIT A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3–15 Ω 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. £1·25. Also available ready built and tested £16·50. P. & P. £1·20.

SPECIAL OFFER

Limited number of the latest BSR C141R1 Auto/Manual changer de-luxe. Lightweight tubular arm cue-ing lever bias compensator £14·00 + £1·10 P. & P.

OUR PRICES INCLUDE VAT AT CURRENT RATES

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SEND STAMPED ADDRESSED ENVELOPE WITH ALL ENQUIRIES

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BSR HI-FI NEW CHANGER
STEREO & MONO

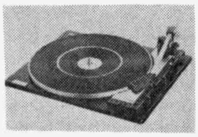
Plays 12", 10" or 7" records. Auto or Manual. A high quality unit backed by BSR reliability RCS 12 months' guarantee. AC 200/250V. Size 13¼ × 11¼in.
Above motor board 3¼in. Below motor board 2½in.

with STEREO and MONO XTAL **£10·95** Post 50p.

PORTABLE PLAYER CABINET

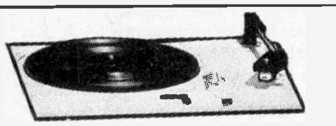
Modern design. Rexine covered. Large front grille. Lift-up Lid. Chrome fittings. Approx. size 17in × 15in × 7in. Few only in red and black rexine. Motor board cut for Garrard deck **£5·25** Post 50p

B.S.R. SINGLE PLAYER



NEW MODEL. IDEAL AS DISCO PLAYER. 3 SPEEDS. BALANCED ARM. CUEING DEVICE STEREO CERAMIC CARTRIDGE. BARGAIN. SIMILAR TO MP60

£17·50 PLUS POST 75p



R.C.S. DISCO DECK
SINGLE RECORD PLAYER

Fitted with auto stop. Compatible cartridge. Baseplate. Size 11in × 8¾in. Turntable. Size 7in diameter. A/C mains. 200/250V motor has a separate winding 14 volt to power a small amplifier. Three speeds. Plays all records.

£6·95 Post 45p

TWO FOR £12·95. Post 75p

HEAVY METAL PLINTH

Post 75p

With P.V.C. Cover. Cut out for most B.S.R. or Garrard decks. Size 12¾ × 14¾ × 7¼in. **£5·95**

R.C.S. STEREO BARGAIN

Two full size loudspeakers 13¾ × 10 × 3¾in. Player unit clips to loudspeakers making it extremely compact, overall size only 13¾ × 10 × 8¼in., 3 watts per channel, plays all records 33 r.p.m., 45 r.p.m. Separate volume and tone controls. 240V AC Mains.

FEW ONLY

Attractive Teak finish Weight 13 lb.

Bargain Price **£25** 85p Carriage

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

OUR PRICE **£2·50** Post 45p

ALUMINIUM BOXES. 3 × 3 × 3in 75p; 4 × 4 × 4in 90p; 6 × 4 × 4in £1·10; 9 × 4 × 4in £1·30; 12 × 4 × 4in £1·50.

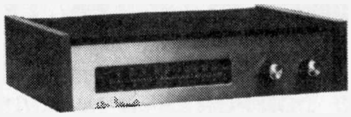
BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2½in sides 6 × 4in 55p; 8 × 6in 68p; 10 × 7in 80p; 12 × 8in £1; 14 × 9in £1·20; 16 × 6in £1·20; 12 × 3in 60p; 16 × 10in £1·40.
ALUMINIUM PANELS 18 s.w.g. 6 × 4in 15p; 8 × 6 in 25p; 14 × 3in 25p; 10 × 7in 30p; 12 × 5in 30p; 12 × 8in 40p; 16 × 6in 45p; 14 × 9in 50p: 12 × 12in55p; 16 × 10in 75p.
1½ inch DIAMETER WAVECHANGE SWITCHES, 45p ea.
2 p. 2-way, or 2 p. 6-way, or 3 p. 4-way.
1 p.1. 2-way, or 4 p. 2-way, or 4 p. 3-way.
TOGGLE SWITCHES, sp. 20p; dp. 25p; dp. dt. 30p.

BRITISH FM/VHF TUNING HEART

88 to 108 Mc/s British made. 2 Transistors ready aligned —requires 10·7 Mc/s I.F. Complete with tuning gang. Connections supplied but some technical experience essential. **Our price £1·95** Post 20p

TESTED I.F. STRIP £4·95. TESTED DECODER £4·95

R.C.S. STEREO FM TUNER BRITISH MADE



This completely cased mains powered Hi-Fi Tuner with brushed aluminium facia is British made using the latest circuitry. Few Only. **£30** Post 75p.

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

Ideal for Mike, Tape, P.U., Guitar, etc. Can be used with Battery 9-12V or H.T. line 200-300V d.c. operation. Size: 1¾ x 1¼ x ¾ in. Response 25 c/s to 25 kc/s. 26 dB gain. For use with valve or transistor equipment. Full instructions supplied. Details S.A.E. **£1·45**

R.C.S. POWER PACK KIT

12 VOLT, 750mA. Complete with printed circuit board and assembly instructions. **£3·25** Post 45p
12 VOLT 300mA KIT, £3 9 VOLT 1 AMP KIT, £3·25.

4MFD 800V DC PAPER CAPACITOR

Block Capacitor. Ideal as Filter Unit in 100 watt Loudspeaker Systems. 95p each, post 30p.

NEW ELECTROLYTICS				CAN TYPES	
2/350V	20p	250/25V	18p	50+50/300V	50p
4/350V	20p	500/25V	20p	32+32/350V	45p
8/350V	22p	100+100/275V	65p	32+32/450V	75p
16/350V	30p	150+200/275V	70p	350+50/325V	55p
32/500V	50p	8+8/350V	50p	16+16+16/275V	45p
25/25V	10p	8+16/350V	50p	32+32+32/350V	75p
50/50V	10p	16+16/350V	50p	900/350V	95p
100/25V	10p	32+32/350V	50p	4700/63V	95p

LOW VOLTAGE ELECTROLYTICS.
1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF 15V 10p.
500mF 12V 15p; 25V 20p; 50V 30p.
1000mF 12V 20p; 25V 35p; 50V 47p; 100V 70p.
2000mF 6V 25p; 25V 42p; 50V 57p.
2500mF 50V 62p; 3000mF 25V 47p; 50V 65p.
5000mF 6V 25p; 12V 42p; 25V 75p; 35V 85p; 50V 95p.
CERAMIC 1pF to 0·01mF, 4p. Silver Mica 2 to 5000pF, 4p.
PAPER 350V-0·1 7p; 0·5 13p; 1mF 15p; 2mF 150V 15p.
500V-0·001 to 0·05 4p; 0·1 10p; 0·25 8p; 0·47 25p.
TWIN GANG. "0-0" 208pF+176pF, £1.20p.
Slow motion drive 365pF+365pF with 25pF+25pF, 50p;
Twin 500pF 75p. Twin 410pF 50p. Twin 120pF 50p.
SHORT WAVE SINGLE. GANGABLE 50pF, 65p.
NEON PANEL INDICATORS 250V AC/DC. Amber 30p.
RESISTORS. ¼W, ½W, 1W, 20% 2p; 2W, 10p. 10Ω to 10M.
HIGH STABILITY. ½W 2% 10 ohms to 6 meg., 10p.
Ditto 5%. Preferred values 10 ohms to 10 meg., 4p.
WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt, 10 ohms to 100K 12p each.
TAPE OSCILLATOR COIL Valve type 35p.
FERRITE ROD 8 × ⅜in 20p; 6 × ⅜in 20p; 3 × ⅜in 10p

MAINS TRANSFORMERS

ALL POST Small 45p each Large 75p each

250-0-250 80mA. 6·3V 2 amp .... £2·90
250-0-250 80 mA. 6·3V 3·5A 6·3V 1A or 5V 2A .... £4·60
350-0-350 80 mA 6·3V 3·5A, 6·3V 1A or 5V 2A .... £5·80
300-0-300V 120mA, 6·3V 4A C.T.; 6·3V 2A ...... £7·00
SMALL 220V 45mA, 6·3V 2A 2¾ × 2¼ × 2in ...... £1·25
HEATER TRANS. 6·3V ½ amp 85p, 3 amp £1.40p
GENERAL PURPOSE LOW VOLTAGE. Tapped outputs at 2 amp. 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30V £4·60
1 amp, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £4·60
2 amp, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £7·00
5 amp, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £11·25
10, 30, 40V 2 amp. £3; 20V 3 amp. £2·30. 5, 8, 13V, 5 amp. £1·50; 6-0-6V 500mA £1; 9V 1 amp. £1; 12V 300mA £1; 12V 500mA £1; 12V 750mA £1; 40V 2 amp. £2·75; 22-0-22V 4 amp. D.C. £3·45; 16V ½ amp. 95p; 16V 2 A. £2; 5V, 8V, 10V, 16V ½ A. £1·90. 20V 1A. £2.
AUTO TRANSFORMERS. 115V to 230V or 230V to 115V 150W £5; 250W £6; 400W £7; 500W £8.
CHARGER TRANSFORMERS. 1½A £2·75 4 amp £4·60.
FULL WAVE BRIDGE CHARGER RECTIFIERS:
6 or 12V outputs. 1½ amp 40p; 2 amp 55p; 4 amp 85p.

MAINS ISOLATING TRANSFORMER

Primary 0-110-240V. Secondary 0-240V 3 amps 720 watts. Insulated terminals. Varnish impregnated. Fully enclosed in steel case with fixing feet. Famous make (Value £19) OUR PRICE **£13·50** Carr. 95p
Can be used as 800 watt auto transformers 240-110V.

VOLUME CONTROLS

Long spindles. Midget Size 5 K. ohms to 2 Meg. LOG or LIN. L/S 25p. D.P. 40p. STEREO L/S 55p. D.P. 75p. Edge 5K. S.P.Transistor 25p.

80 Ohm Coax 5p yd.

BRITISH AERIALITE AERAXIAL-AIR SPACED 40 yd £2·00: 60 yd £3·00.
FRINGE LOW LOSS Ideal 625 and colour. **10p** per yd

Wire Wound controls 1½in diam. 3 Watts. 10 ohms to 100K British Made with long spindles ¼in dia. 85p each.
DUAL CONCENTRIC POT 500K LOG AND 500K LIN D.P. switch. Inner spindle 3½in; outer spindle 2½in 75p.

E.M.I. 13½ × 8in. SPEAKER SALE!

With tweeter and crossover. 10 watt. State 3 or 8 ohm. As illustrated. **£5·25** Post 45p

With flared tweeter cone and ceramic magnet. 10 watt. Bass res. 45-60 c/s. Flux 10,000 gauss. State 3 or 8 or 15 ohm. **£3·45** Post45p
13 × 8in Bass unit 20 watt 8 or 15 ohm £6·60.

LOUDSPEAKER FRONT GRILLES

Teakwood strips mounted on cloth backing, easily glued on to baffle to modernise cabinets.
Size 18½ in × 10½in. **75p** Or size 10½in × 7½in. **45p**

GOODMANS 6½in. HI-FI SPEAKER

8 ohm. 10W. Large ceramic magnet. Special Rubber cone surround. Frequency response. Twin cone. 30-12,000 c/s. Ideal P.A. Columns. Hi-Fi Enclosure Systems, etc. **£4·60**

ELAC CONE TWEETER

The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 c/s to 18,000 c/s. Size 3½ × 3½ × 2in deep. Rating 10W, 3 ohm.
Crossover £1·85 **£2·20** Post 30p.

GOODMANS 8 in. WOOFER

8 ohm 15 watt. Rubber surround. Heavy ceramic magnet. Bass resonance 35 cps. Frequency response 30-8,000 cps. Ideal bass unit for Hi-Fi system. **£6·75**
Post 50p

SPECIAL OFFER LOUDSPEAKERS

3 ohm, 2½in; 2¾in; 3½in; 5in; 7 × 4in; 8 × 5in.
8 ohm, 2½in; 2¾in; 5in × 3in; 3in; 4in; 5in; 6 × 4in.
15 ohm, 3½in; 5in; 6 × 4in; 5 × 3in; 7 × 4in.
25 ohm, 2½in; 5 × 3in; 5in; 6 × 4in; 7 × 4in.
35 ohm, 3in; 5in. 64 ohm 2½in.
80 ohm, 2½in; 2¾in. 120 ohm 3in. **£1·25** EACH

RICHARD ALLAN TWIN CONE LOUDSPEAKERS. 8in diameter 4W £2·50, 10 in diameter 5W £2·95; Post 25p 12in diameter, 6W, £3·50; 3 or 8 or 15 ohm models.
SPEAKER COVERING MATERIALS. Samples Large S.A.E
Horn Tweeters 2-16Kc/s. 8W 8 ohm or 15 ohm £2·50
De Luxe Horn Tweeters 2-18Kc/s, 15W, 15 ohm £4·50
TWO-WAY 3,000 c.p.s. CROSSOVERS 3. 8 or 15 ohm £1·85

CASSETTE. MACHINE MOTOR. 6 Volt. Will replace many types £1·25.

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. For systems up to 25 watts. **£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 30p

R.C.S. "MINOR" 10 watt AMPLIFIER KIT

This kit is suitable for record players, guitars, tape playback, electronic instruments or small P.A. systems. Two versions available: Mono, £12·50; Stereo, £20. Post 45p. Specification 10W per channel; input 100mV; size 9½ × 3 × 2in. approx. S.A.E. details. Full instructions supplied.

COAXIAL PLUG 10p. PANEL SOCKETS 10p. LINE 18 OUTLET BOXES. SURFACE MOUNTING 50p.
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.

CASH PRICES INCLUDE VAT ● 30p MINIMUM POST AND PACKING ● CALLERS WELCOME ●

RADIO COMPONENT

Illustrated Brochure, Radio Books & Component Lists 10p Written guarantee.

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JUST RELEASED

R.C.S. 100 watt VALVE AMPLIFIER

Four inputs. Four way mixing, master volume, treble and bass controls. Suits all speakers. This professional quality amplifier chassis is suitable for all groups, disco, P.A., where high quality power is required. 5 speaker outputs. A/C mains operated. Slave output. Produced by demand for a quality valve amplifier.
Suitable carrying cabinet £14. Price **£85**, carr. £2·50

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 40p

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.
10in round £5. **£4·35**

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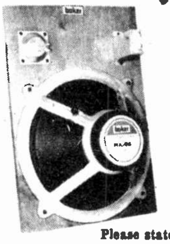

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30-14,500 c/s, 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c/s Rated 25 watts. NOTE: 3 or 8 or 15 ohms must be stated.

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

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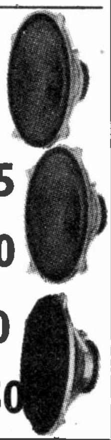

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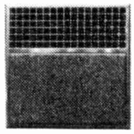

Teak veneered ½in thick wood cabinet. Size 18½in × 13½in × 8½in. Weight 23lb. This cabinet features a wide mesh Silver Grill covering a separate compartment for mounting Tweeters or Mid-Range Horn. The fully sealed bass compartment is cut out for 6½in Woofer. £7·50. Carr. 85p. Rosewood Version £8·50. Carr. 85p. Baffle could be cut for larger speaker.

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

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4 pole, 240 v. 135 mA. Size 3¼ × 2¾ × 2¼in. 1200 rpm. Spindle 3/16in. diameter. 20v version £1. **£1·85** Post 45p

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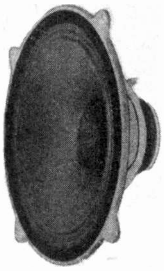
HIGH QUALITY—BRITISH MADE

REGENT

12in. 20 watts

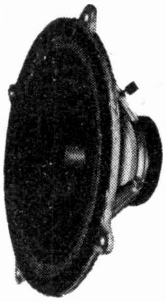


An inexpensive unit for the beginner in high fidelity and for general purposes. May be used to improve any Radio, Amplifier, Hi-Fi or Television receiver.
Bass Resonance 45cps
Flux Density 12,000 gauss
Useful response 45-13,000cps
3 or 8 or 15 ohm models.

£10·50 Post 50p

DE-LUXE Mk II

12in. 15 watts

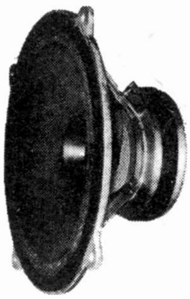


Especially designed to provide full range reproduction at an economical cost. Suitable for use with any high fidelity system. Built-in concentric tweeter cone.
Bass Resonance 30cps
Flux Density 14,000 gauss
Useful response 25-16,000cps
8 or 15 ohms models.

£13·50 Post 50p

SUPERB

12in. 25 watts

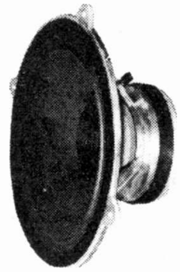


A high quality loudspeaker, its remarkable low cone resonance ensures clear reproduction of the deepest bass. Fitted with a special copper drive and concentric tweeter cone resulting in full range reproduction with remarkable efficiency in the upper register.
Bass Resonance 25cps
Flux Density 16,500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

£17 Post 80p

AUDITORIUM

12in. 35 watts



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Bass Resonance 35cps
Flux Density 15,000 gauss
Useful response 25-16,000cps
8 or 15 ohms models.

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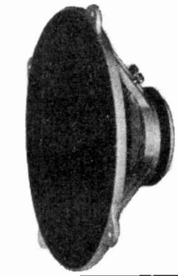
AUDITORIUM

15in 45 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.
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PE

SMALL MERCIES

ALL in all it has been a pretty grim year, with the pound in the pocket shrinking month by month. And the economists and financial experts predict there's worse to come before things bottom-out and the slow upward haul to more prosperous and cheerful times begins. So there is every reason to be thankful for any small mercies, like the downward trend in semiconductor prices that has taken place during the last twelve months.

Digital i.c.s have shown a spectacular fall, and CMOS devices the most notable of all. Keen rivalry between device manufacturers competing for a stake in the large and growing computer field has stimulated the development of new monolithic technologies, and CMOS is now established as a possible alternative to TTL. The battle is likely to continue with the bipolar protagonists fighting back with more recently developed techniques such as emitter coupled logic and integrated injection logic, to say nothing of charge coupled devices and CDI. All these different families of i.c.s have promising futures for each has some unique advantages to offer which will be important in specific applications.

The lively competition augers well for the future of the electronics industry because the constant aim is the worthy one of more circuit functions per chip for a lower cost with, wherever possible, enhanced operational performance. A commercial philosophy which could well be emulated by other industries, since all too often it seems some sacrifice of quality or quantity is the only way a price reduction can be realised.

It is fortunate that the chief building blocks of electronics are extremely viable in present day terms, with continuing downward tendencies in cost rather than the reverse. Fortunate for *everyone* in the long term—because electronics has a most vital part to play, directly or indirectly, in improving the economic wellbeing of the country and the standard of living of the individual.

The private designer and constructor already enjoys some of these benefits. Active devices are likely to account for the smaller portion of the total material cost in a modern design. Not unexpectedly there is sometimes a temptation to extravagance in the use of i.c. devices, simply because they are modestly priced. At least, this might be considered to be the case by those brought up with a more frugal outlook during the pre-semiconductor era. Yet however cheap and versatile the components, the project designer owes it to himself and to those who may imitate his work to observe sound design principles throughout and to strive for elegance in circuit arrangement and economy in component count, no less than in price. Small is beautiful, it is said. Good housekeeping is laudable in good and bad times alike. That goes without question.

F.E.B.

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ICE will begin to form on roads when air temperature is between 36°F and 32°F (2·2°C–0°C) in our damp winter conditions. This device monitors the air temperature by means of a thermistor and gives warning of impending icy road conditions by variable flash duration of a light-emitting diode. The completed unit is so small that the entire assembly may be housed in a small metal cannister and fixed through the dash of a car by a single ⅜in bush.

CIRCUIT FUNCTION

This circuit depends upon the ratios of currents flowing and is therefore insensitive to fluctuations in the car's battery potential and most interference derived from the vehicle's electrics. Power-line regulation is therefore unnecessary, but a 0·1–1microfarad capacitor across the power input to the unit may be needed in extreme circumstances. (C2 in Fig. 1.)

Section IC1a of the quad op-amp package (MC 3401) forms a comparator looking at the current through the thermistor compared with that flowing in the "CAL" network, and R3 defines the output gradient of the amplifier according to the required response to temperature. For 36°F (2·2°C), the output is approximately 7·2V and at 32°F, 3·6V.

The multivibrator IC1b is similarly designed so that the upper and lower voltages across C1 are of the same order, determined by R4, 5, 6. The oscillator has a period of approximately 1 second.

The third section of the op-amp is used as a comparator looking at the charge on C1 and comparing this to the output of IC1a. When the charge on C1 is lower than the output of IC1a, the output of IC1c goes positive and current flows through the l.e.d. whose maximum drain is limited by R7 to about 22–25mA.

As IC1b produces a rough sawtooth waveform across C1 the on-time of the l.e.d. varies, as only the peaks lower than IC1a's output will cause IC1c to turn on. Thus we obtain flashes from the l.e.d., starting as very short ones, at about 36°F, and gradually becoming longer as IC1c's trigger-level is shifted by the action of the thermistor through IC1a passing less current as it gets cooler. Finally the l.e.d. will be on continuously at about 32°F as IC1c will never be cut off.

SENSOR PROBE

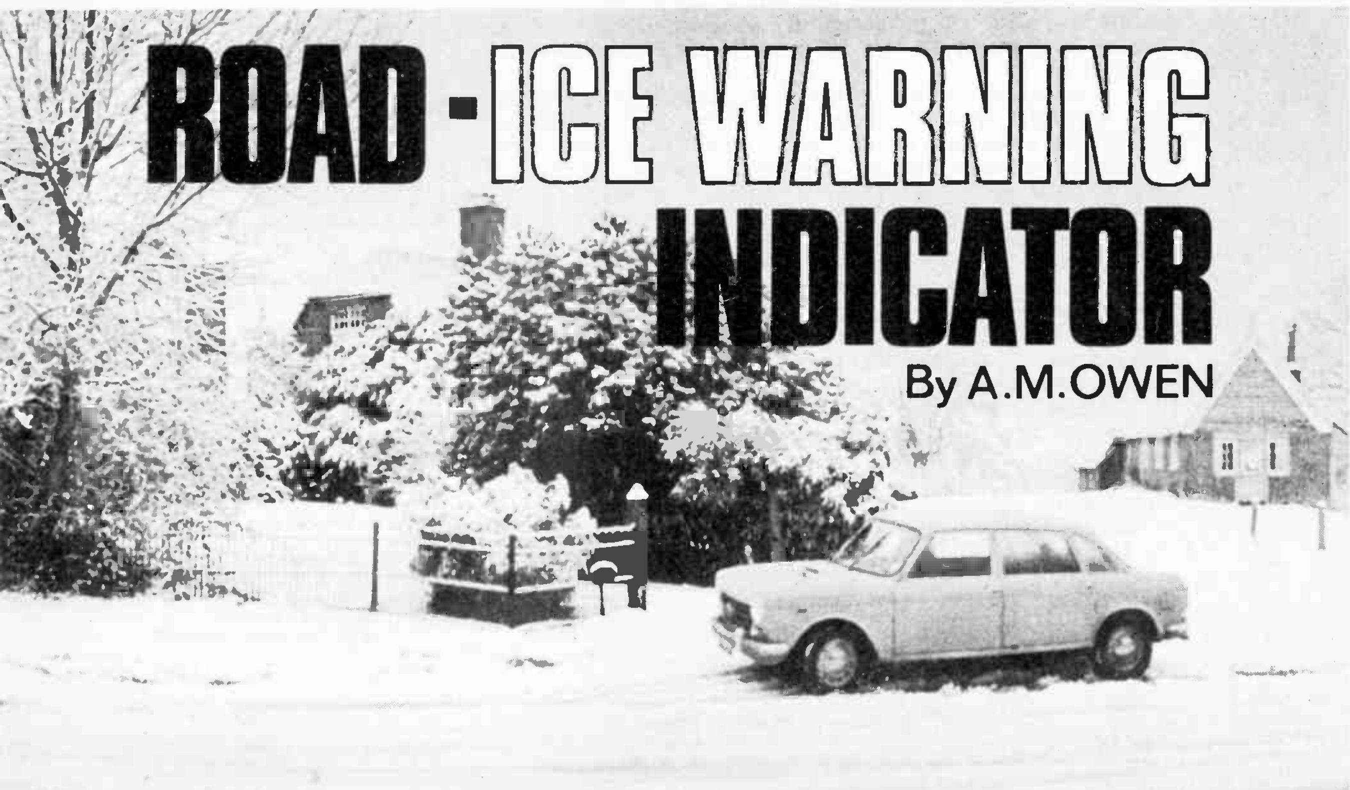
The sensor probe consists simply of a thermistor of 15 kilohms resistance (at 25°C) mounted in an enclosure to baffle it from moving air as this could cause false indication. The whole assembly should be mounted as close to the ground as is practical, perhaps the best place being below the front apron or scuttle of the vehicle. It is important to keep the probe unit well away from any hot engine or radiator parts.

It is suggested that the thermistor element be mounted in an old cigar tube to act as a baffle, and suspended therein by small annular pieces of thick polyethylene sheet. No filler should be used, as this increases the conductivity to the thermistor and the baffle effect of the tube will be degraded.

No short-circuits should occur when the printed circuit assembly is inserted into the tube/baffle. The thermistor and the printed circuit board must be protected from the ingress of moisture and/or condensation.

ROAD-ICE WARNING INDICATOR

By A.M.OWEN



ROAD-ICE WARNING INDICATOR

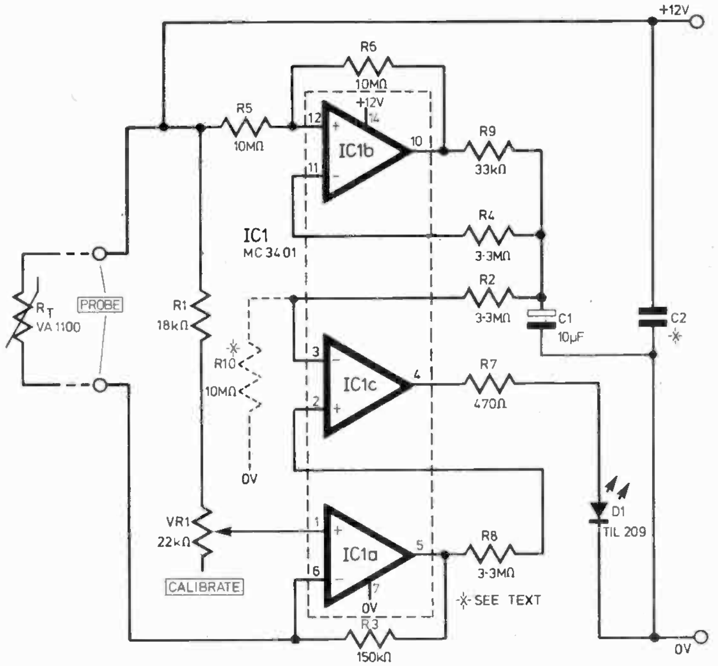


Fig. 1. Circuit diagram for the ice warning indicator

COMPONENTS . . .

Resistors

R1	18kΩ	R4	3·3MΩ	R7	470Ω
R2	3·3MΩ	R5	10MΩ	R8	3·3MΩ
R3	150kΩ	R6	10MΩ	R9	33kΩ

All 10% $\frac{1}{4}$W carbon

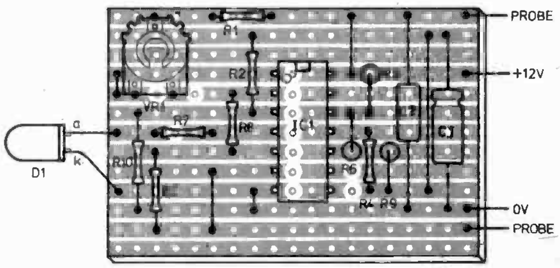
Capacitors
C1 10μF elect. 10V
C2* 0·1–1μF as required

Semiconductors
IC1 MC3401 (Motorola)
D1 TIL209 or similar

Potentiometer
VR1 22kΩ linear (RS)

Thermistor
RT—VA1100 *or* VA1055S (Mullard)

Miscellaneous
Small screw top canister (such as a film can)



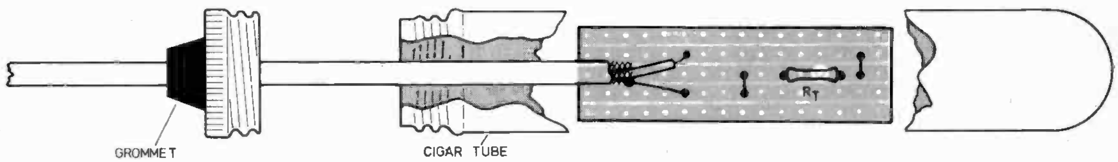
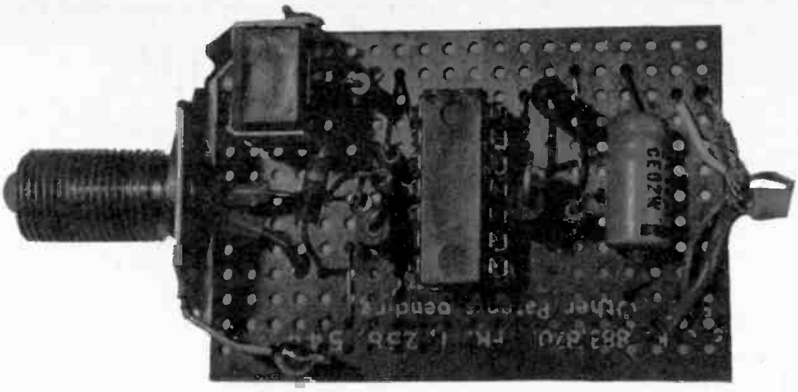


Fig. 3. Constructional details and wiring for the probe



Completed prototype circuit board. Note that the l.e.d. is mounted inside the $\frac{3}{8}$in dashboard mounting bush

Ensure good isolation between the terminations of the thermistor by removing the copper from the track as shown in Fig. 3.

Coat the whole of the p.c. board with a thin layer of 5-minute epoxy-resin to prevent moisture affecting the resistance of the assembly.

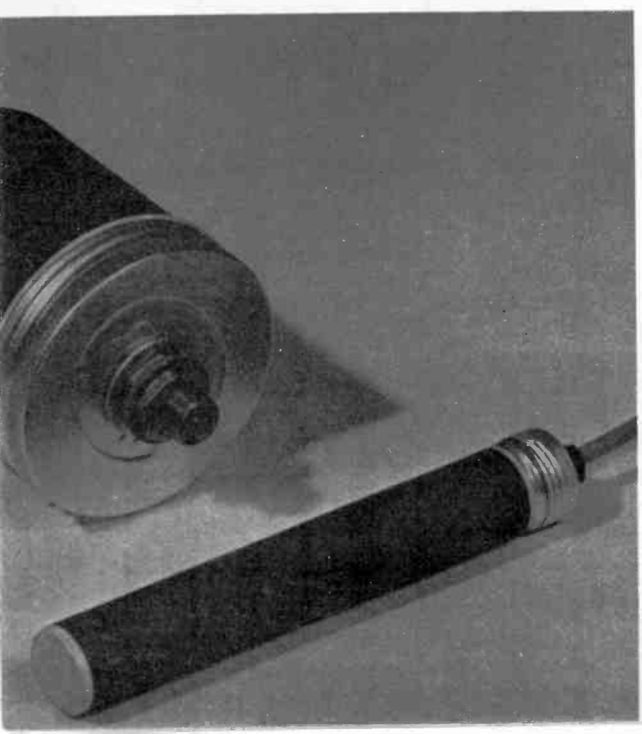
Faster response to temperature might be achieved by filling the bottom of the tube, prior to insertion of the thermistor assembly, with silicone grease, although this has not been tried in practice.

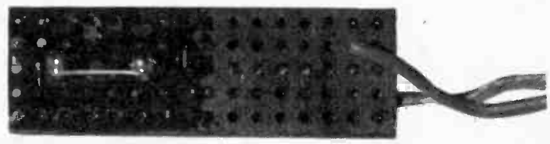
Size of printed circuit board used and shown in the diagram is only arbitrary and will of course vary depending on the size of mounting tube available.

CONSTRUCTION

The unit has been designed to be as small as possible and is non-critical in its layout. However, in order to ensure that the unit works properly after construction and remains a reliable device, it is well to be sure that no dry-joints or track-bridging or shorts between components have occurred during the course of construction. The upper leads of R1, 6, 9 should be sleeved.

Typical housings for the probe and circuit board





Thermistor mounted on the probe board and covered with an epoxy-resin

CALIBRATION

This is very simply accomplished by wrapping the thermistor, before mounting in the baffle-tube, in a polyethylene bag, to keep away the ice and water mixture in which it is to be immersed. The assembly is then plunged into the well stirred saturated solution of ice and water.

After about a minute, and with the unit fully wired and connected to a 12V source, adjust VR1 to the point where the l.e.d. just comes on steady. A very slight "wink" may be noticed due to a slight imbalance between the outputs of IC1a, IC1b because of resistor tolerances.

If it is not possible to obtain a steady illumination of the l.e.d. when the thermistor is at 32°F, it may be necessary to add a 10MΩ (R10) at the —ve input (Pin 3) and connect the other end to chassis.

OTHER APPLICATIONS

If the unit is provided with a suitable 12V battery supply there is no reason why this instrument may not be used as a portable monitor to check for the possibility of ice forming on outdoor swimming pools or fish ponds so that precautionary measures may be taken.

The unit may also be made to operate on other temperature ranges by changing the values of R1, 2, 3.

In view of the low current drain it was not considered necesary to incorporate an on/off switch for the in-car device. ★

IC50

By B.W. TERRELL & C.F. TERRELL

GUITAR AMPLIFIER

LAST month we discussed the power supplies, pre-amplifier and power amplifier circuits of the guitar amplifier; this month we conclude with the wiring, construction and testing procedures.

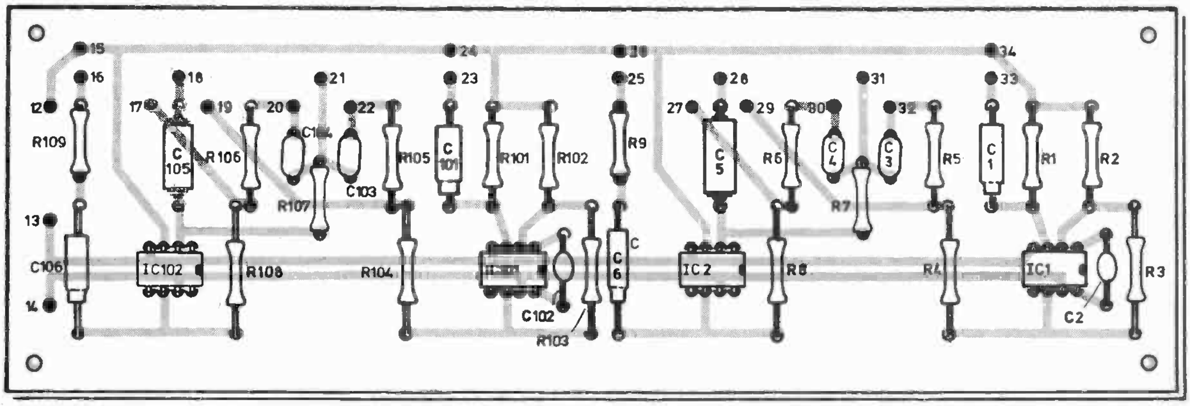
PREAMPLIFIER BOARD

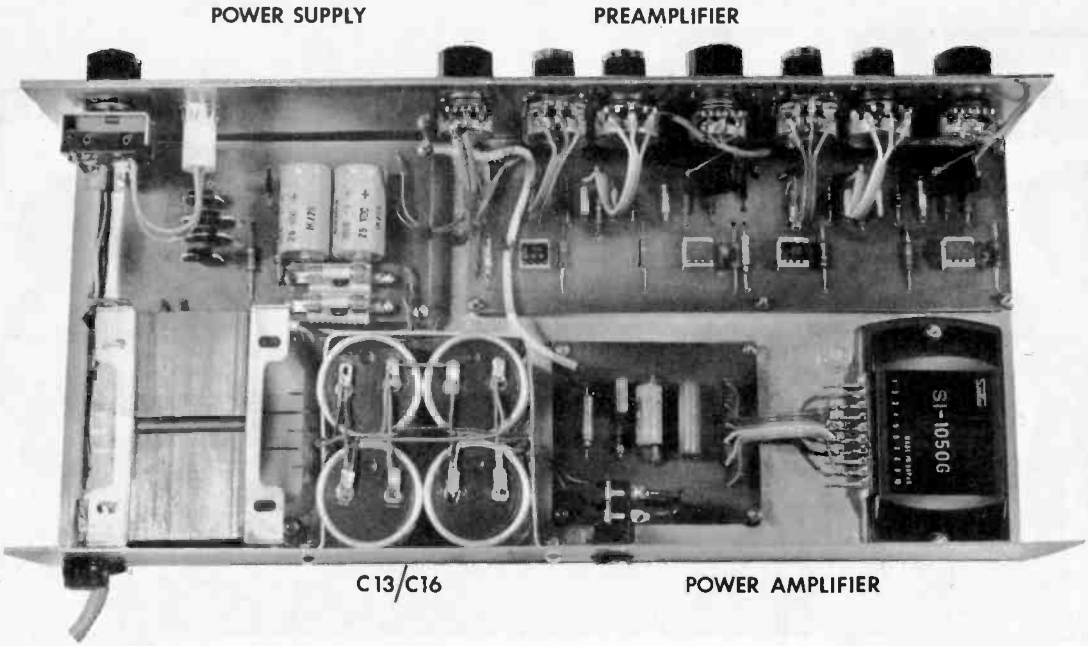
A full-size drawing of the preamplifier printed circuit board is shown in Fig. 8. The layout of the components on the topside is shown in Fig. 5.

Ensure that the fixing holes at each corner are drilled before commencing assembly, and begin by inserting and soldering in the p.c.b. pins.

Although the integrated circuits used in the preamplifier are tough devices, it is strongly recommended that integrated circuit sockets be used and that the latter be soldered in position with the i.c. removed, thus avoiding possible damage from the heat of the soldering iron. In the event of the i.c.s needing replacement, it will then be an easy matter not requiring the removal of the board and not involving desoldering, which can be tricky. The layout of the board has been designed so that all the i.c.s "face" the same way. Do likewise with the i.c. sockets to avoid confusion at a later stage.

Fig. 5. Component layout for the pre-amplifier board. A full size p.c.b. master is given in Fig. 8





The finished guitar amplifier showing positioning of all the boards

Special note should be taken to observe correct polarity when soldering in the electrolytic capacitors. Do not attach any flying leads at this stage.

POWER AMPLIFIER BOARD

The printed circuit board to accommodate the components associated with IC3 is shown full-size in Fig. 8. The layout of the components on the top-side of the board is shown in Fig. 6. Before embarking on component assembly, ensure that the four fixing holes have been drilled and that all the printed circuit pins have been inserted and soldered in place. Construction is straightforward, but pay attention to capacitor polarities. Do not attach any flying leads yet.

POWER SUPPLY BOARD

The smaller components of the power supply section are mounted on a printed circuit board; the layout of the components on this board can be seen in Fig. 7. The full-size drawing of the copper clad side are shown in Fig. 8.

When positioning and soldering these components in place, special attention should be paid to the diodes and capacitor polarities, as a mistake in this section could have disastrous (and expensive) effects. Do not solder in any lead-out wires at this stage.

CHASSIS DETAILS

The prototype chassis was made from two L-shaped pieces of 1·5mm thick aluminium sheet and

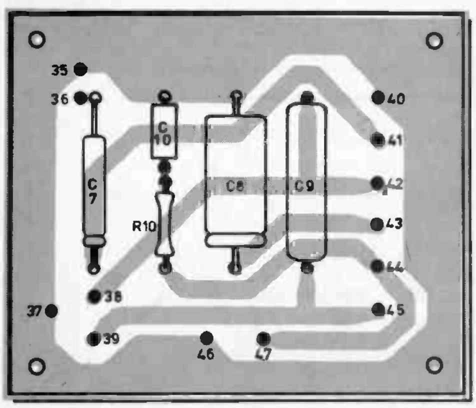


Fig. 6. Component layout for the power amplifier board

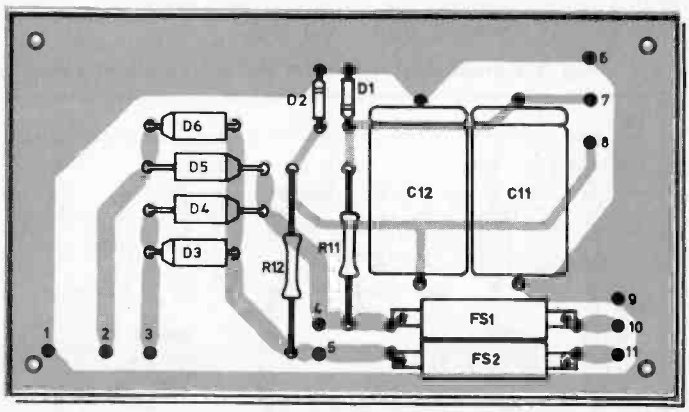


Fig. 7. Component layout for the power supply board. The p.c.b. master is shown opposite full size

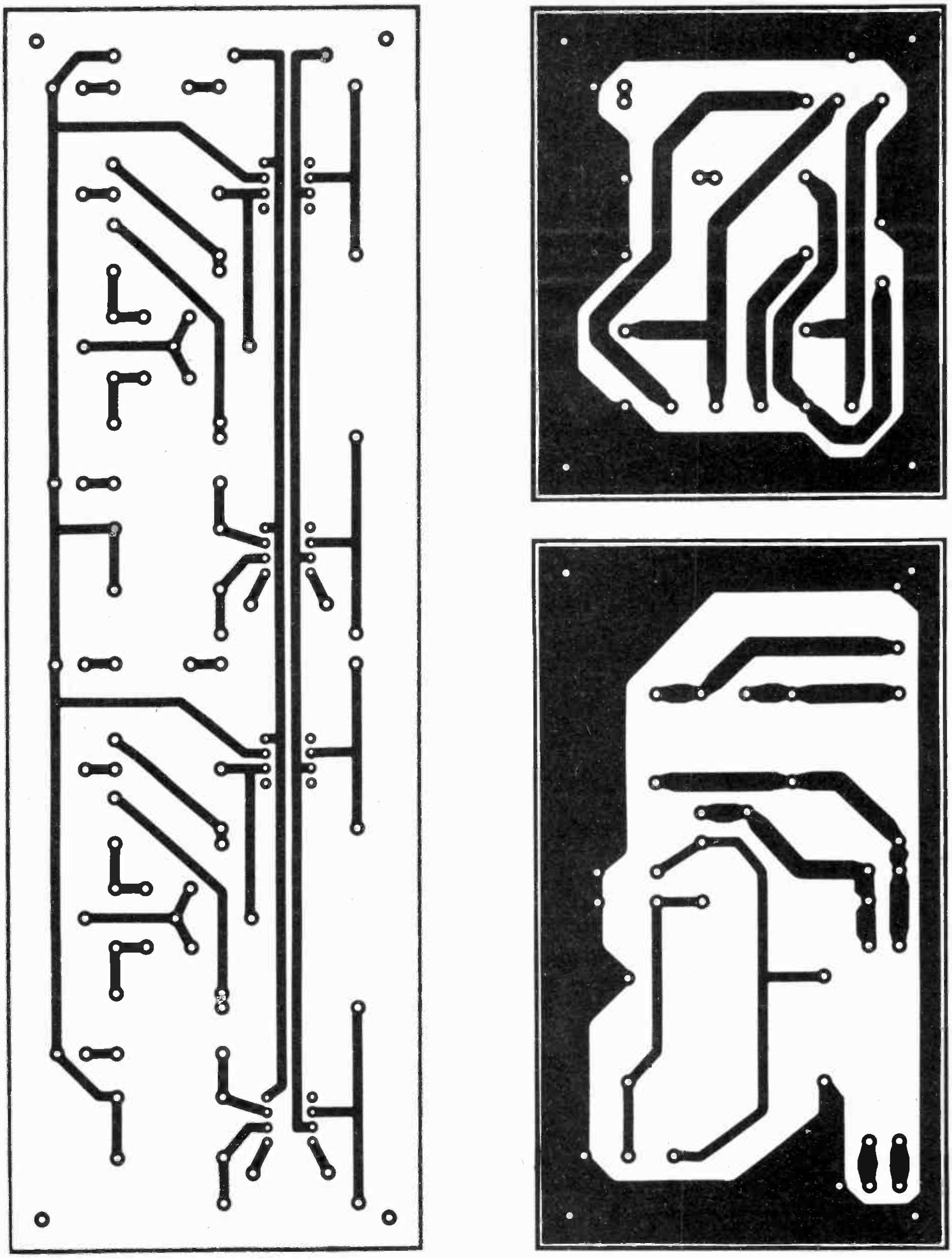


Fig. 8. Full size printed circuit masters for the IC50 Guitar Amplifier

CHASSIS DRILLING

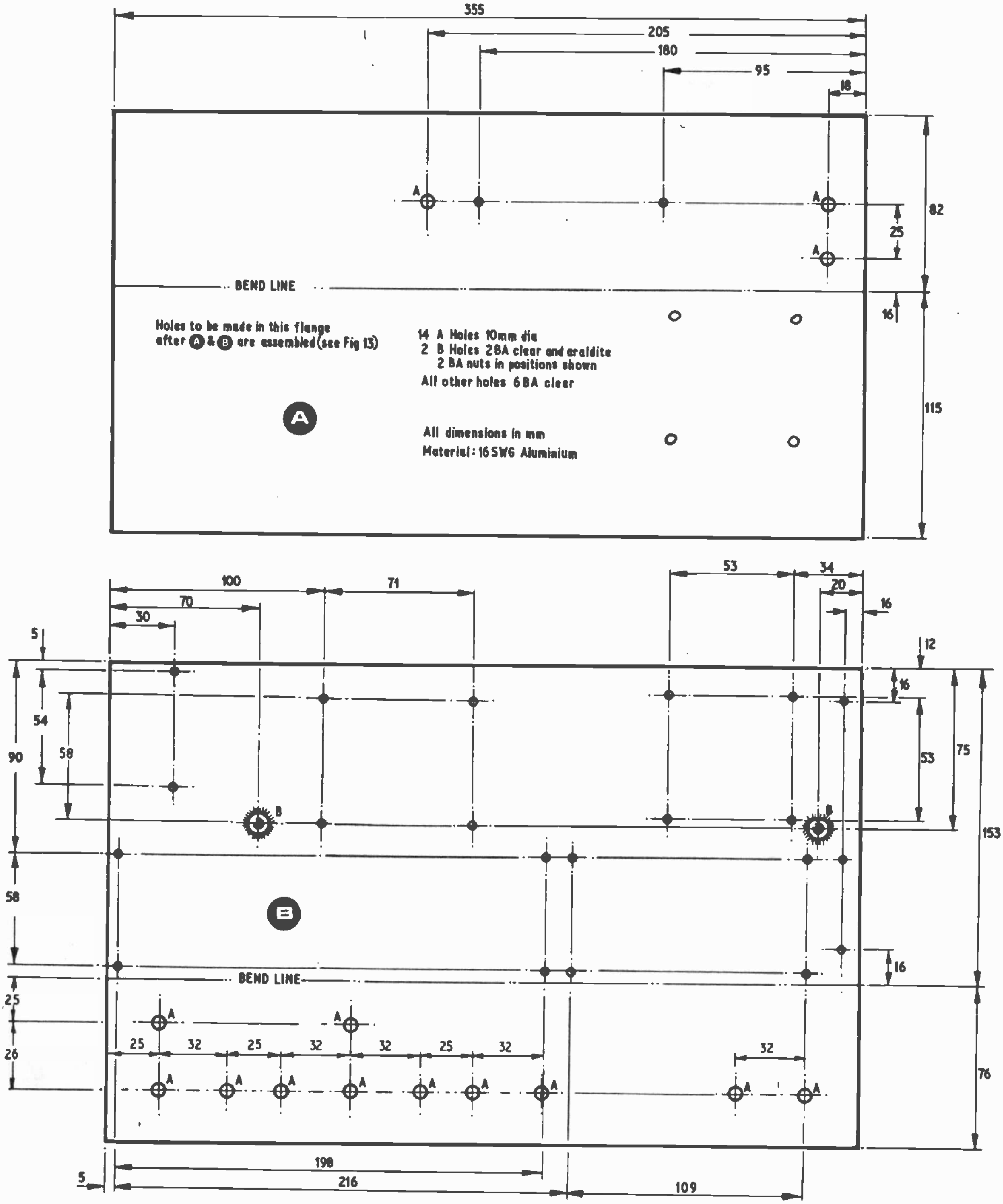


Fig. 9. Complete drilling details for the amplifier chassis. The front panel drilling can be marked from panel B

bolted together, using the component and component board fixing bolts to form a U-shaped chassis. Complete drilling and marking out details are given in Fig. 9. Both sheets should be marked out and drilled according to the details, and all the holes drilled before bending. Drilling details for the base of sheet A are incomplete (intentional), only the transformer fixing holes are shown. It is recommended that sheet A base section and sheet B base section be drilled (as shown) and then bolted together, and then sheet B used as a template. This method ensures that the holes in each sheet will be correctly aligned, whereas separate drilling may cause problems.

Once all the holes are drilled the right-angled bends should be made as indicated. A bracket is necessary for holding the power supply smoothing capacitors. Details are given in Fig. 11.

The front panel drilling details are taken from Fig. 9. It has the same dimensions as the chassis front and is commercially available guillotined to this size. The holes on the front panel were punched out using Q-max cutters which give a clean finish. The choice of decoration and finish on the front panel is left to the individual requirements of the constructor. In the prototype coloured adhesive film was used, the lettering and borders done with Letraset, and was then sprayed with Letragloss for protection.

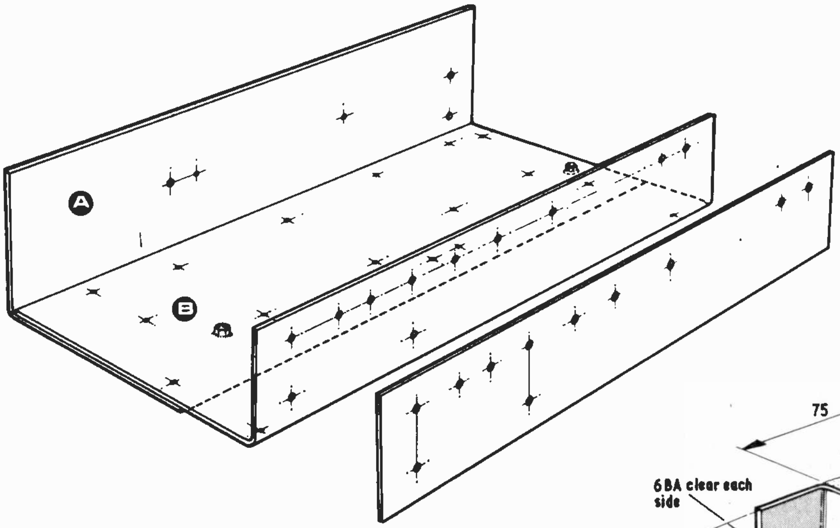


Fig. 10. Showing how the various chassis parts are positioned to form the final chassis

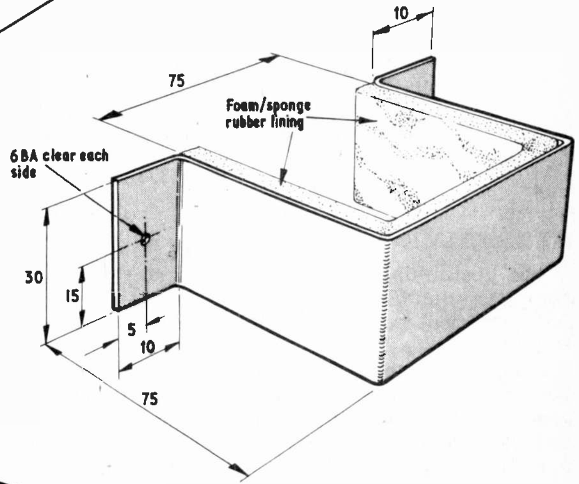


Fig. 11. Drilling and bending details for the capacitor clamp

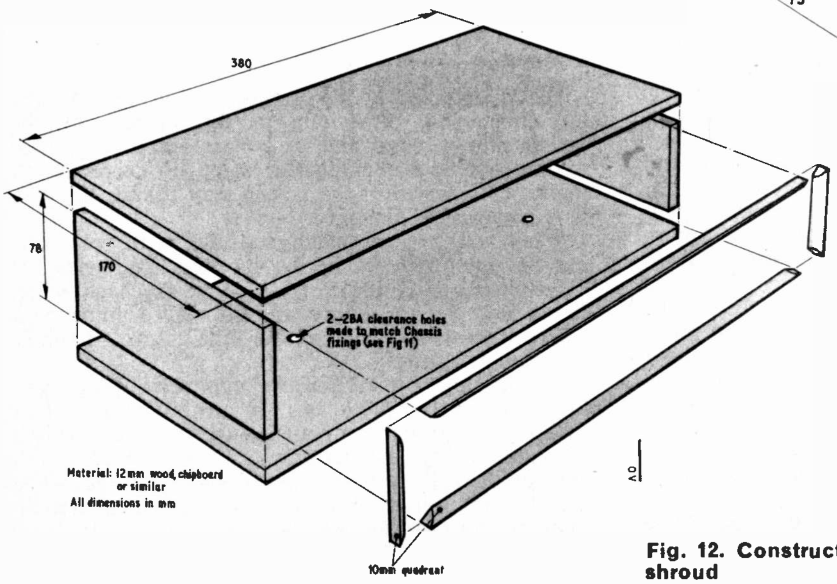


Fig. 12. Constructional details for the wooden case shroud

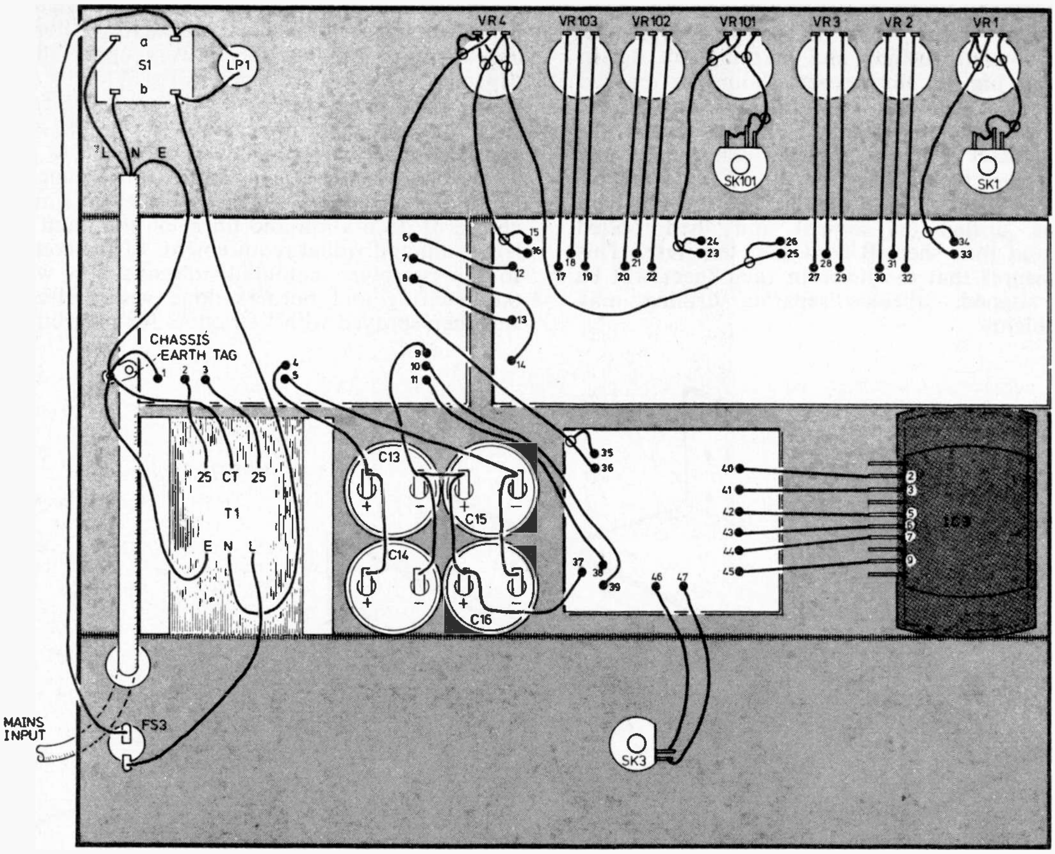


Fig. 13. Interwiring details for the guitar amplifier

ASSEMBLY

The positioning of components, circuit boards and complete interwiring details are shown in Fig. 13. Assembly will be found easiest if carried out in the following order.

Begin by securing the transformer in place on the two chassis sections using 4BA nuts, bolts and shakeproof washers, thereby forming a single U-shaped chassis. Next fix all the completed component boards to the chassis using 6BA nuts, bolts, shakeproof washers and 5mm long spacers such that the undersides of the boards stand clear of the chassis base. The use of a lock-nut is recommended.

The control potentiometers, jack sockets, neon and rotary on/off switch should next be secured to the front panel through the chassis front. All the potentiometers should have their connecting tags uppermost. Now fix IC3 in position using some silicon grease on the area of contact between IC3 and chassis to ensure good thermal contact. Screw the output jack socket SK3 in position and fix the panel mounting fuse to the rear panel. Insert a rubber grommet in the mains feedthrough hole immediately below the fuseholder. Bolt the chassis earth tag in place and then the cable clips to hold the mains lead.

It is now necessary to interconnect the four smoothing capacitors C13 to C16. To hold these together during wiring up, a wrapping of Sellotape will be found useful. Take special care that capacitor polarities are obeyed. When they are satisfactorily wired up, place them in position in the chassis and bolt on the capacitor bracket. Now wire up according to Fig. 13. It will be found useful to tick off the connections as you make them and also to use different colours of connecting wire. Try and use brown wire for positive supply rails, blue for the negative rails and green for all earth connections. This way wire tracing will be more simple.

TESTING

When completed, the wiring should be checked out thoroughly, especially in the vicinity of the power supply board and the power output board. In particular, check that SK3 is wired up correctly. If the latter is wired in the wrong way round, IC3 can be permanently damaged.

When you are completely satisfied with your wiring up, the fuses should be inserted, 2A types for the supply board and a 1A type in the back panel fuseholder. Fit the knobs and turn all volume controls anti-clockwise and set the tone controls to their midway positions.

First of all, with no speaker connected, plug in to the mains and switch on. If any fuses blow, or smoke or burning components are observed, switch off immediately and investigate. If all appears well the supply rail voltages should be measured. The preamplifier rails should be ± 15 volts and the main amplifier rails approximately ± 35 volts.

continued on page 47

JODRELL BANK

A grant of nearly £2 million has been made by the Science Research Council, for the purpose of setting up a multi-unit interferometer.

Three of the telescopes that will make up the new group are already in existence, the Mark 1 and the Mark 2 at Jodrell Bank together with the 80ft dish at Malvern. The addition of the fourth unit will considerably assist the work controlled from Jodrell Bank.

The extension of facilities will enable a much greater resolution to be obtained and Jodrell bank are hoping to achieve an accuracy of 0·03 seconds of arc. The manner of the disposition of the units will reduce the data to some extent, but it is considered that the increased resolution will more than compensate.

In order to make the best use of the grant it has been decided that the fourth unit shall be an "off the line" dish from America. A regular production line dish 25m in diameter and fitted on an altazimuth mounting is available from E Systems Inc of Dallas, Texas. It will be installed at Knockin, near Oswestry, and be linked by landline and a reserve back-up microwave system.

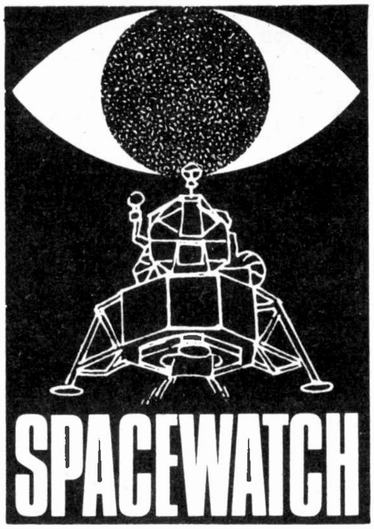
The work involved in the future observations will be a continuing story and will include the study of the detailed structure of novae, pulsars, quasars and the areas where star formation is active.

BLACK HOLES

Until recently the writer and a small number of people were of the opinion, "that the rotating black hole was possibly the gateway to an alternative space time". This seems not to be true after all and according to an advertisement the Bacon Foundation is offering a prize of £300 for the solution to the problem of a space ship to make the journey.

The problem as stated is, according to current theory, that rotating black holes are the actual gateways to an alternative spacetime. How, therefore, could a space vehicle pass through a rotating black hole into another region of spacetime, without being crushed by the gravitational field of a singularity?

This is so near to the ideas found in space fiction that perhaps here begins the new thinking, making further progress in the inevitable revolution in physics. The outcome of this challenge will be eagerly awaited.



BY FRANK W. HYDE

WHITE HOLES

While white holes are not often in the news their claims are now being seriously advanced. There has been activity in this field for a number of years now and it is not surprising that the same sort of people as those concerned with black holes are involved.

However, in the past white holes have not been taken too seriously. This attitude is not really justified and some new light is thrown on this subject by Professors J. V. Narlikar and K. M. V. Apparao.

The name of Narlikar is closely associated with the continuous creation theory advocated by Fred Hoyle. Narlikar was in fact a protégé of Fred Hoyle and many papers were issued under their joint names.

At the Tata Institute and among cosmologists, Narlikar is known for his extreme views. The creation of matter in the universe is an idea not much removed from the possibility of singularities which are projecting their energy out into the universe and so interacting with the matter around.

To this end Narlikar and Apparao have been looking more closely at the kind of spectrum which should appear from a white hole. The term white hole is not really apt but since it implies the opposite of black it will no doubt continue to be used. They are suggesting that the Seyfert galaxies could be a white hole effect. They are able to offer an explanation for all the facts observed including the particle production.

There is another possibility and that is that if a black hole is the entrance to another region of space time, could not the white hole be the emergence of the other side of a black hole?

The idea of a white hole of necessity involves blue shift. The name of Kapp comes to mind in connection with blue shift. Several years ago when his book appeared it caused a stir, for the claim made was that matter was being concentrated in certain areas, and that it was moving towards the observer, thus the blue shift.

CO-OPERATION

For the first time a United States series of experiments will be flown in a Soviet Spacecraft. The scheme was discussed during the joint working group meetings on space biology and space medicine.

Four NASA developed life science experiments will be taken on board the spacecraft in special containers manufactured in the Soviet Union. The maximum weight of the containers including the experiments will be less than 2·5 kilogrammes each.

A unique feature of the spacecraft is the onboard centrifuge. The U.S. experiments will be divided with some on the centrifuge platform and some on the stationary platform.

The four experiments are concerned with the investigation of sensitive plant systems. The effect of weightlessness on embryonic plant systems. A heavy particle radiation experiment, small lexan plastic nuclear track detectors will be inside the containers on the centrifuge and in the stationary biological containers. And finally, an experiment with minnows to discover the effect of weightlessness on the vestibular system of developing embryos.

WIND ON THE MOON

When making an analysis of the lunar soil samples delivered to earth by *Luna 16* and *Luna 20*, Soviet scientists found that the *Luna 20* material contained four times as much mercury as *Luna 16*.

The unevenness is thought to come about by the emanation of mercury vapour during the Lunar day, at a temperature of 150°C, toward the colder areas by the lunar wind. As it cools it would be deposited on the rocks in the cold areas.

BOOK REVIEWS

AUDIO ON WHEELS
By Vivian Capel
Published by Newnes-Butterworths
199 pages, 142mm × 222mm. Price £6.00 (Hardback)

With the seemingly ever increasing interest in "in-car entertainment" it is surprising that, until now, very little information on installing audio equipment in the car has been published. Of course, this does not include manufacturers' literature, which invariably only give part of the story anyway.

This book is divided into two parts, Basic Principles and Practical Applications, and sets out, fairly successfully in my opinion, to cater for the radio engineer, motor mechanic and the amateur. It covers all aspects of in-car entertainment from basic principles of radio and tape recording to the installation of complete systems.

The different types of radio, cassette and cartridge equipment, including stereo and quad systems are discussed and assessed. The chapters on power supplies, aerials, loudspeakers and interference suppression on a.m. and f.m. is covered in some depth and are probably the most useful sections in the book.

The chapter on setting-up a workshop is interesting and the final chapter on "Repair and Maintenance" contains some very good pointers on fault diagnosis and basic test procedures, together with the necessary test equipment needed.

The only criticism I can find (apart from price) is that it's a pity that the interference suppression section could not have been expanded to cater for solid state or CDI (Capacitor Discharge Ignition) systems. This could easily have been accomplished by deleting the references to the ancient valve vibrator power supply circuits.

D.G.B.

BASIC DIGITAL ELECTRONICS
By Ray Ryan
Published by Tab Books (No. 728)
210 pages, 130mm × 210mm. Price $7.97 Hardback, $4.95 Paperback

ADVANCED APPLICATIONS FOR POCKET CALCULATORS
By Jack Gilbert
Published by Tab Books (No. 824)
304 pages, 130mm × 120mm. Price $8.95 Hardback, $5.95 Paperback

Although these two books are of American origin, they offer a good basic grounding in their relevant subjects. For the student or person who wants to realise the full potential of his calculator this book should prove a reasonable acquisition.

The main emphasis in the digital electronics book is on presenting the various types of digital circuits and describing the features pertinent to these circuits. Today, discrete circuits are seldom used and almost all logic is performed with integrated circuits. For this reason, there is a slight bias throughout towards the assumption that a given logic function is just that—a function.

The logic symbols used throughout are not to British Standards, but several chapters explain the basics of logic and introduce the logic diagram and truth table. Because a system of *one's* and *zero's* probably seems strange to the uninitiated, the early chapters describe the binary number system and the different codes digital systems use in some depth. There is even a chapter on CMOS logic.

The pocket calculator book covers 4-function, scientific, programmable, electronic slide rules, metric converters and business units.

This book shows how the ability of the calculator to multiply and divide can be used to calculate square roots, cube roots, powers of numbers, logarithms and all the trigonometric functions to five or seven places. As an example the author shows how to perform the scientific computations above using an elementary 4-function unit.

The book also shows how to solve such problems as quadratic equations, right angles, compound interest mortgage problems and even determine satellite orbits.

D.G.B.

GUNN-EFFECT ELECTRONICS
By B. G. Bosch and R. W. H. Engelmann
Published by Pitman Publishing Ltd.
434 pages, 240mm × 160mm. Price £16.00

With microwave technology very much on the increase, this book looks at one of the effects often used in microwave devices, that of the "transferred electron" or better known "Gunn" effect. The book is clearly aimed at those directly concerned with microwave device development or post-graduate students, and gives an authoritative account of the whole device technology.

Also the book serves to collate the great deal of work which has been done on the subject over the last few years not only through its own text, but also through the vast number of references that appear after each chapter.

The book commences by looking into the Gunn Effect in the strict sense (space-charge dipole domains) and then moves on to dipole-domain free operation. Mode classification, frequency limitations, efficiency, power and noise performance are then covered, followed by a detailed look at the actual manufacturing processes involved in producing Gunn devices.

The final few chapters deal with some application considerations and the book finishes by detailing the use of Gunn technology in logic circuits.

R.W.L.

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Copies of Practical Electronics can no longer be supplied on direct subscription. The publishers have found it necessary to close the subscription service chiefly on account of escalating costs on packing and postage.

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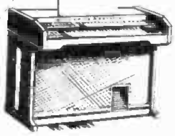

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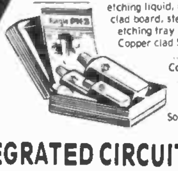

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1.5	63	3	68	6.3	3	330	63	03
2.2	63	3	68	16	4	470	6.3	6
3.3	63	3	68	63	00	470	10	00
4.7	63	3	100	4	3	470	25	01
6.8	40	2	100	10	4	470	40	02
6.8	63	3	100	25	5	680	6.3	00
10	25	2	100	40	6	680	16	01
10	63	4	100	63	01	680	25	02
15	16	2	150	6.3	4	680	40	03
15	40	3	150	16	5	1000	4	00
15	63	4	150	25	6	1000	10	01
22	10	2	150	40	00	1000	16	02
22	25	3	150	63	01	1000	25	03
22	63	5	220	4	4	1500	6.3	01
33	6.3	2	220	10	5	1500	10	02
33	16	3	220	16	6	1500	16	03
33	40	4	220	25	00	2200	6.3	02
47	4	2	220	40	01	2200	10	03
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BC107	12p	BCY71	24p	MCR102	36p	2N3053	19½p
BC108	11p	BD131	49p	MJ2955	92p	2N3054	72½p
BC109	14p	BC132	57p	MJE2955	£1.21	2N3055	53p
BC142	25p	BD131 2MP	£1.20	MJE3055	73p	2N3702	16p
BC143	28p	BD135	45p	MPF102	45p	2N3703	15p
BC147	12½p	BD139	61p	OC71	25p	2N3704	17½p
BC148	12½p	BD140	86p	SC146D	95p	2N3705	16p
BC149	15p	BF258	38p	ST2	35½p	2N3706	15p
BC168C	15p	BF259	27p	TIS43	35p	2N3707	17½p
BC169C	15p	BFX29	32½p	WOO5	32½p	2N3708	10p
BC178	18½p	BFX30	35p	W04	35½p	2N3819	27½p
BC179	19½p	BFX84	32½p	ZIJ	94p	2N3866	68p
BC182L	12½p	BFX85	35p	ZTX108	11p	2N3903	25p
BC183L	15p	BFX87	32½p	IN914	5p	2N3904	27½p
BC184L	15p	BFX88	34½p	IN4148	5p	2N5245	56p
BC212L	17½p	BFY50	21½p	2A 50PIV Bridge	48½p	2N5459	64p

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?

SKIN RESISTANCE INDICATOR

THERE is a relationship between the electrical resistance of a person's skin and and state of relaxation. A device to make people aware of changes in their skin resistance can tell them how relaxed they are (bio-feedback) and thus help them relax. The skin resistance indicator, Fig. 1, provides an audible tone which falls as the state of relaxation increases (skin resistance rises).

The circuit is shown in Fig. 1. Potentiometer VR1 and the skin resistance between the electrodes forms a potential divider, whose output voltage depends on skin resistance. Transistor TR1 compares the voltage with a reference and feeds a current proportional to the difference between the voltage and the reference to a multivibrator TR2 and TR3. The frequency of the multivibrator depends upon the current from TR1. A crystal microphone insert acts as a speaker. Simple electrodes may be made from a pair of thimbles to which wires have been soldered.

In operation the two thimbles would be put on two fingers of one hand, and VR1 rotated to give an intermediate tone pitch. Upon relaxing the tone pitch should fall slowly.

A. Russell,
Whinmoor.

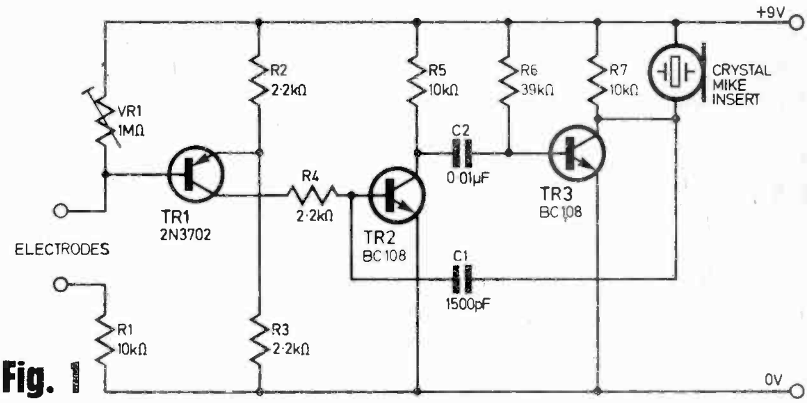

Fig. 1

SIMPLE SAWTOOTH GENERATOR

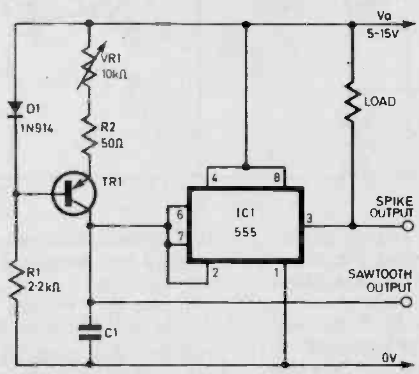

Fig. 1

A SIMPLE sawtooth generator may be constructed with the 555 timer and a germanium transistor. The circuit is shown in Fig. 1. TR1, D1 and R1 form a constant current source. C1 thus charges at a constant rate until the 555 internal comparator triggers. C1 is then discharged quickly, and the cycle repeats itself. Variation of VR1 alters the charging current of C1 and thus the output freqency. A sawtooth output may be taken from C1 through a high impedance buffer, and a spike output of the same frequency is available from pin 3. Output frequency may be varied by about 50 : 1, and the sawtooth linearity is about 5%.

A linear voltage versus period characteristic can be achieved by applying a modulating voltage to pin 5, which sets the comparator threshold.

J. N. Paine,
Oxford.

A GATED OUTPUT RANDOM GENERATOR

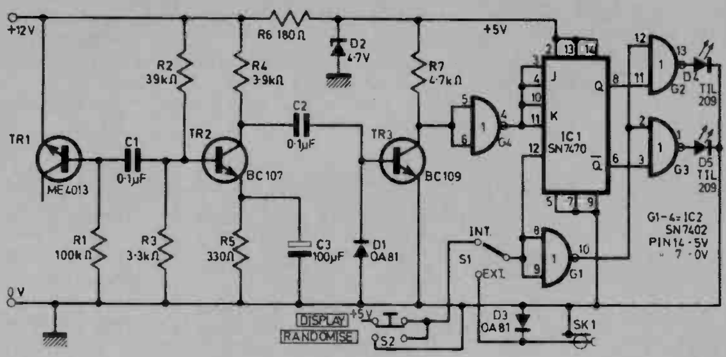

Fig. 1

THE following circuit (Fig. 1) was devised to act as a random generator of similar type to those used in parapsychology or ESP experiments. That is to say, it has an "off" period when neither of the light emitting diodes is illuminated followed by an "on" period when one or other, but not both of the l.e.d.'s is lit. Which l.e.d. is lit during this period is unpredictable, and this is the random aspect of the circuit.

The circuit consists of two sections: the random generator, and the gating circuitry. The random generator consists of a noise source (TR1) whose output is amplified and shaped by the following stages and fed to NOR gate G4 which acts as a buffer.

The gating circuitry functions as follows. While the clock input (pin 12) of the 7470 J.K. flip-flop is at "0", its output is allowed to follow its input signal, i.e. it is changing state for every input pulse. This output is not seen on the l.e.d. display however, as the clock signal is inverted by gate G1 and used to disable l.e.d. driver NOR gates G2 and G3. When the clock signal goes to logic "1", the output circuits of the SN7470 are isolated from its input gates and are held, one at logic "1", the other at logic "0". The clock signal is again inverted by gate G1, and enables the appropriate NOR gate G2 or G3, depending which is fed from the "0" output of the SN7470. Thus the appropriate l.e.d. is illuminated.

The clock input is shown as a simple push button switch in the diagram, but provision is made for an external clock. This should be a positive going square wave not exceeding five volts. The mark-space ratio of this square wave will give the "randomise" to "display" times of the unit.

C. Cartlidge,
Stafford.

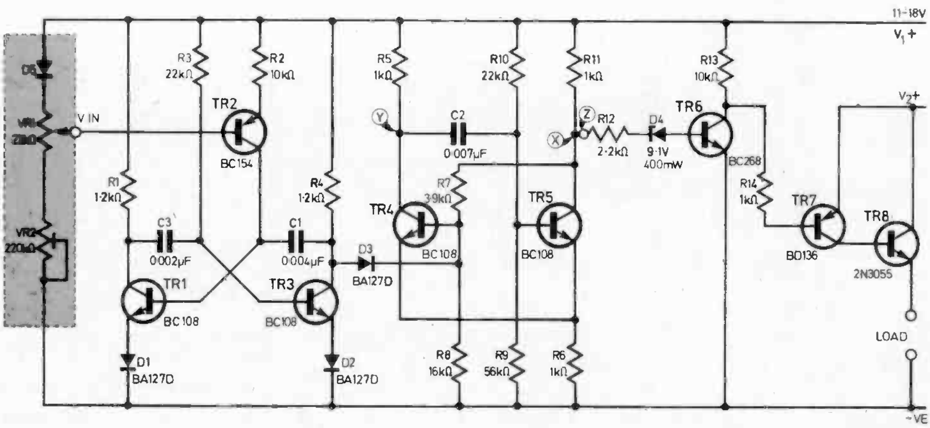

Fig. 1

HEADLIGHT DIMMER

THIS idea was suggested by an article in a motoring magazine concerning sidelight visibility. The circuit is capable of reducing the current to the headlamps (or to any other resistive load). Their output is thus reduced to sidelight level, whilst superior visibility is retained.

The limited space behind the dashboard made remote voltage control a necessity. The circuit generates a square wave with a variable mark-space ratio, thus the lamps are either on or off and no power is dissipated by the circuit.

The circuit consists of a voltage controlled multivibrator driving a monostable which in turn drives the headlamps. This arrangement does not permit full control of the headlamps, but with a 12V supply and Z on the diagram connected to point X 0–10V was obtained, or 4–12V with Z connected to Y. A little experimentation with C1 and C2 may be necessary for optimum performance.

A supply voltage between 11-18V is satisfactory, but V_2 (which provides the current) must not be higher than V_1, or more than 5V lower. The maximum safe current is 10 amps. A suitable source of Vin is shown in the shaded portion.

J. A. Heathcote
Newport.

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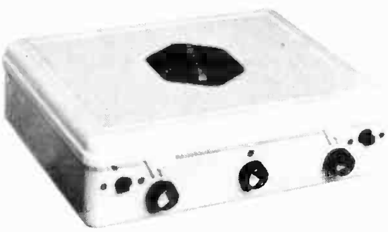

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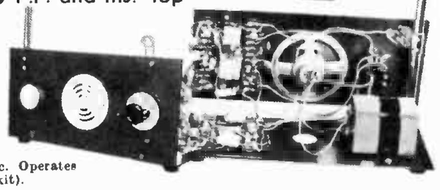

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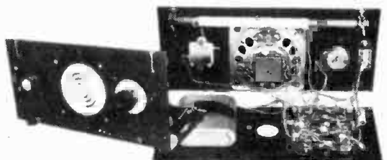

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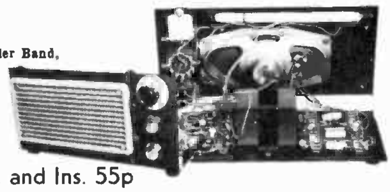

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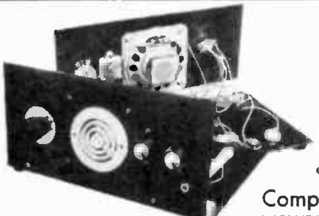

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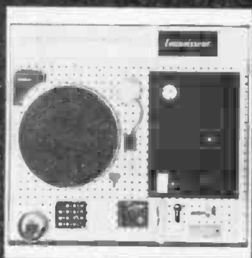

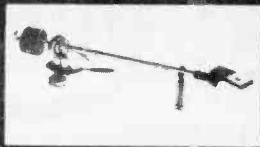

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Top left: The BD1 Turntable Kit.
Top: The SAU2 pick up arm.
Top right: The BD2 Turntable Assembly.
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BFY50	14p*	2N3706/7/8/9	9p
BFY51	14p*	2N3710 & 11	10p
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LIGHTS-ON REMINDER

This circuit (Fig. 1) can be used to remind one to switch on sidelights when darkness falls. During the day the l.d.r. is in a low resistance state, TR1 is turned on and the relay RLA energised. Contacts RLA1 are thus open (RLA is a normally closed type).

When the ambient light drops to a level preset by VR1, TR1 turns off, contacts RLA1 close and RLB (normally open) is energised via the side and tail filaments causing the buzzer to sound. When the sidelights are switched on RLB drops off and the buzzer is thus silenced.

D. Doughton,
Merseyside.

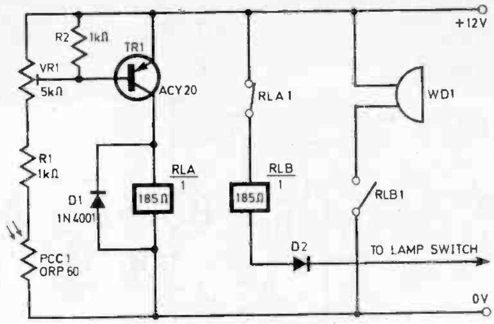


Fig. 1

SIMPLE TIME SWITCH

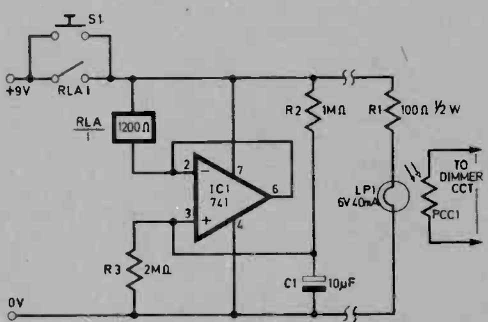


Fig. 1

A time switch to save wasteful use of lighting on a staircase is shown in Fig. 1. The circuit operates a lamp for several seconds and consumes no power when not in use.

When S1 is momentarily depressed it becomes bypassed by the relay switch. After several seconds the relay loses holding current, and the supply to both timer and lamp is broken. The timing network consists of R2, R3 and C1. Charge build-up on the capacitor is prevented by R3.

The addition of a light dependent resistor to a conventional lamp dimmer will allow control of mains lighting—the lamp being optically coupled to the l.d.r.

S. L. Thompson,
Stafford.

SEQUENCING OSCILLATOR

This circuit (Fig. 1) uses a 7413 and a 7490 to produce a repeating series of ten notes. R1, C1, G1 (IC1a) form a low frequency oscillator which drives the decade counter. G2 (IC1b), R2, C2, R3, R4, C4, R5, C5 form another oscillator. Sections of this oscillator can be disabled by holding the input terminals of the decade counter at V_{ce}.

The outputs of the decade counter (A, B, C and D) are connected to the input terminals of the oscillator (1, 2, 3 and 4). Any combination of inputs and outputs can be used (one input to one output). As the decade counter counts, different parts of the oscillator are disabled, resulting in a series of ten notes.

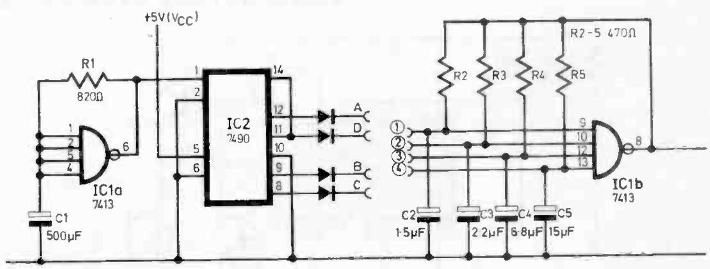
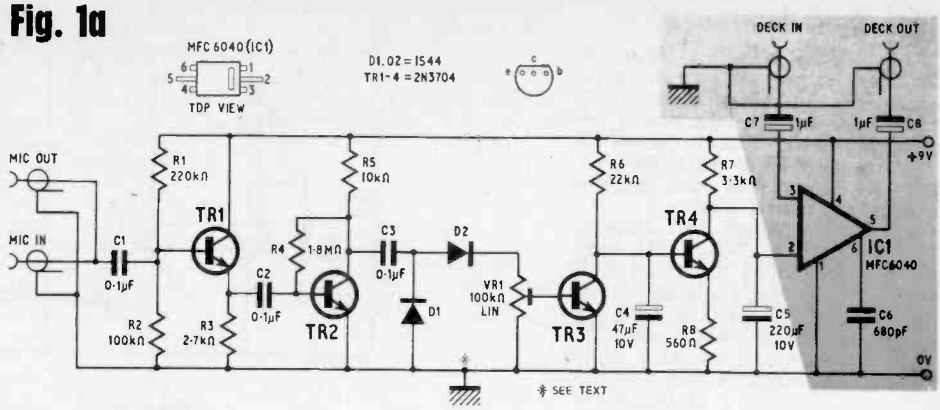


Fig. 1

The frequency can be changed by altering the value of the capacitors.

W. H. Montgomery, Lorne.

Fig. 1a



VOICE OPERATED FADER MODIFICATIONS

WITH a little modification the Voice Operated Fader (P.E. December 1973) can be made to drive f.e.t.'s instead of the more expensive (and harder to get) MFC 6040. The original circuit is shown in Fig. 1a. The shaded section should be deleted and the circuitry in Fig. 1b inserted.

The control voltage at the collector of TR4 is fed to the gates of the f.e.t.'s TR5 and TR6 via the presets VR2 and VR3. The presets are incorporated to prevent image shift problems arising due to the f.e.t.'s pinch-off voltages being different.

The circuit uses the f.e.t.'s property of being a voltage controlled resistor; in this case the f.e.t.'s are off with no "voice" input (TR4 on) and are driven on when there is a "voice" input. This results in attenuation of the left and right channels when a "voice" signal is present.

Since this is a shunt attenuator it would not be suitable for direct connection to a ceramic cartridge as in the original arrangement. *Note*

OUTPUT METER

THE record level meter in less expensive tape-recorders is not used in the replay mode. Where the drive to the meter is a rectified, smoothed version of the record amplifier output, a simple switch and circuit can be used to display the audio output.

Fig. 1 shows the arrangement for the modified meter. S1 is operated where possible by the record button such that the meter is only driven by the existing circuitry when in the record mode. When in playback the speaker drive signal is rectified by D1 (any germanium signal diode) and the response of the meter is damped by capacitor C1.

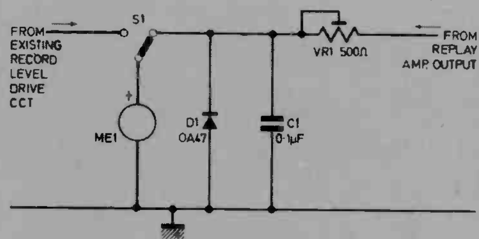


Fig. 1

Since the meter is less than 1mA f.s.d. the series potentiometer VR1 limits the current to a safe value. The indication on the meter is therefore the positive peaks of the audio with the attack/decay time set by C1 and the deflection for a given signal by VR1.

J. C. Sadler,
Altrincham.

TEMPERATURE SENSING DEVICE

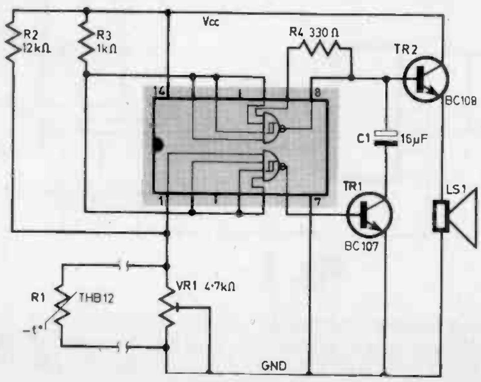


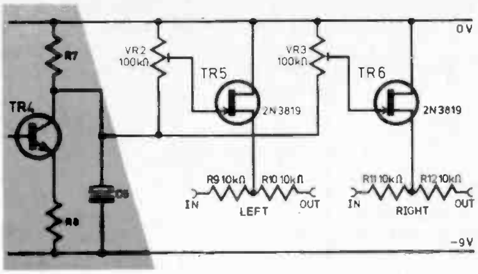
Fig. 1

THIS circuit (Fig. 1) uses the Schmitt properties of the dual 4 input NAND gate 7413. A potential divider is formed with the thermistor R1 in parallel with VR1, and R2. When the voltage from the potential divider exceeds the Schmitt threshold, an oscillator formed around the remaining components is activated. Potentiometer VR1 allows adjustment of the threshold temperature.

The whole circuit may be built on a piece of Veroboard 5cm by 5cm.

P. R. G. Reynolds,
Benfleet.

Fig. 1b



that the earth should be changed from the lower (negative) rail to the upper (positive), since the f.e.t.'s are working around the positive rail.

N. Valentine,
Angus.

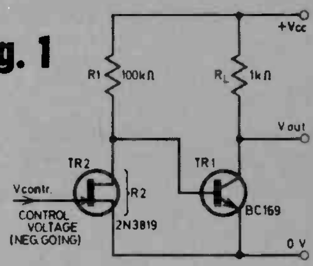
VOLTAGE CONTROLLED ZENER

THE circuit shown in Fig. 1 can be used as a voltage controlled Zener diode. If the f.e.t. is replaced with a resistor R2 the standard "amplified diode" configuration is obtained.

The addition of a f.e.t. merely provides a voltage control of one of the resistors and thus a control over the voltage at which the transistor turns on.

I. D. Evans,
Cambridge.

Fig. 1



DWELL METER MODIFICATIONS

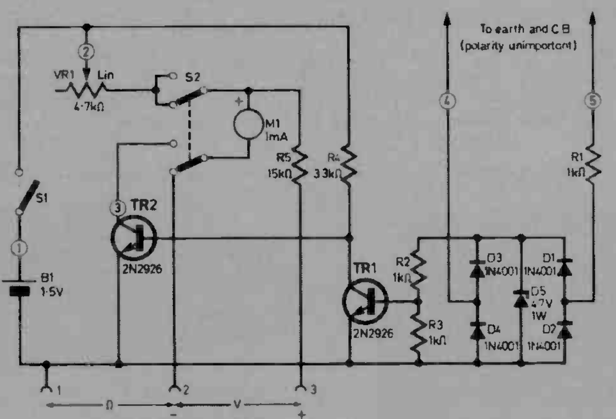


Fig. 1

WITH the simple addition of a few more components the Dwell Meter (P.E. Dec. 74) can be used as a voltmeter, ohmmeter and to check the opening of the points—as well as the original capability of being a dwell meter.

Fig. 1 shows the modified circuit. It operates in the following way.

To read dwell angle S1 made; S2 to left.

To read ohms; S1 made; S2 to right and adjust VR1 for full scale reading with terminals 1 and 2 shorted. (There is no need to calibrate the scale in ohms as one only requires an indication of good or bad continuity.)

To read volts; S1 is open and with the 15kΩ resistor in circuit a full scale reading of 15V is obtained. It is advisable to use this range and calibrate the dial from 0–15V accordingly, whereby a reasonable indication of 12V is obtained. It may be necessary to adjust this on test to obtain an accurate reading.

W. E. Priest,
Bradford-on-Avon

SIMPLE LIGHT FLASHER

THE circuit shown in Fig. 1 can be used to flash Christmas tree lights. An 80W fluorescent lamp starter is placed in series with the set of lamps and it is this that causes them to flash. No suppression is required since the starter has a capacitor included. No radio or TV interference was detected. The total power supplied should not exceed 80W.

S. Judson,
Halifax

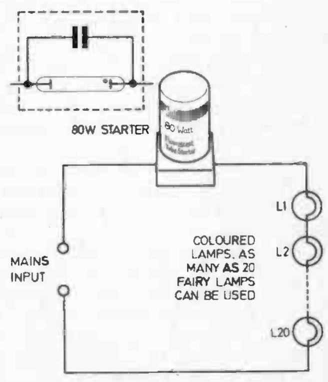


Fig. 1

MARKET PLACE

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

DIGITAL WATCH

The long awaited **Sinclair** digital watch has now been launched onto the market. Referred to as the "Black Watch", this instrument is a typical example of the individual styling expected from Sinclair. The watch is housed in a specially designed plastic case—almost unique in the field of digital watches in that the case is custom built and not just a normal type of watch housing.

Flexible diaphragms form an integral part of the plastics case and provide an economical and reliable solution to the switch problem. These "pressure pads" are easy and convenient to use. Another important feature for the user is the readily removable plug type of cover for the battery compartment.

The watch circuitry is contained within a single integrated circuit using injection logic technology (I^2L). This bipolar process is claimed to have produced very high packing density and excellent speed-power product, with important production cost benefits. The chip was designed by Sinclair and has been produced by ITT in Britain. The other components are a crystal, a trimming capacitor, the l.e.d. display and two small mercury cells.

Hours and minutes or minutes and seconds are displayed depending which switch pad is depressed. The display is internally timed for one second or will stay on as long as the switch is closed. The third switch is on the rear of the case and is used for setting the watch and holding the time.

The display is fitted with a lens magnifier which allows brightness to be maintained at lower current consumption.

Sinclair guarantee an accuracy of better than one second per day. In principle, depending upon the precision to which the quartz crystal is trimmed, the watch is capable of maintaining time to within one or two minutes per year.

The watch comes complete with a black nylon reinforced polyurethane strap.

In kit form, price £17·95, the Sinclair digital watch appears likely to offer little problem to the average constructor. (We hope to include a review of assembling the watch in a future issue.)

POWER SLAVES

It is at this time of the year that one starts to worry about the problems of winter and tries to prepare for the likelihood of any possible industrial unrest and service breakdowns.

With this in mind Jermyn's seem to have timed the launching of their new range of excellent invertors at the most opportune moment. These new invertors now use silicon transistors throughout their range. They claim this increases their reliability and back their claim with a one year guarantee.

Two versions are available, type 150-3 with a load of 150W powered from a 12V car battery and a 300W version, type 300-3, powered from two 12V car batteries.

A feature of the invertors is that if you are not at home when the mains fails, the unit will automatically switch over to battery operation. The average running time for battery operation is 3 hours, depending on load. When the mains is restored the units automatically switch back to stand-by operation and recharge the battery.

Apart from lighting other typical applications are: running central heating (pumps and thermostats); tropical fish tank heaters; powering professional equipment, dentist drills and telex machines, etc.; and office calculators and typewriters. Also the units are ideal for running any normal household mains equipment such as power drills, television and radio. For outdoor use when camping, caravaning or boating the invertors are invaluable.

Further details and prices can be obtained from **Jermyn Manufacturing, Sevenoaks, Kent.**

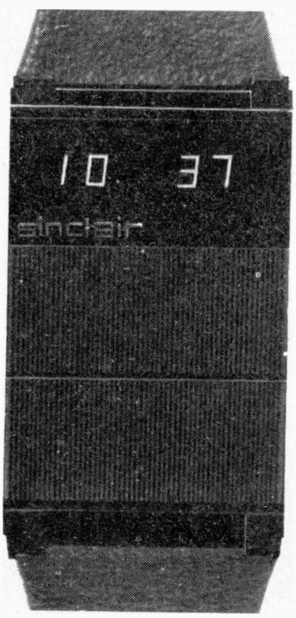
CAR RADIO

Claimed as the first all British designed and built car a.m./f.m. stereo radio, the Radiomobile 1190FMS features an interference rejection circuit module in the f.m. stereo tuner. Known as AIR, active interference rejection, this module is their latest development in combating the problem of interference.

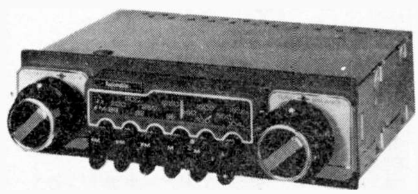
The set has an output of 5W per channel with a bass/treble tone control. The six button tuner, combined with manual tuning, permits simple pre-setting of any three f.m., twwo medium and one long wave stations. The tunning ranges cover 87·5–104MHz f.m., 525–1620kHz m.w. and 150–275kHz l.w.

Provision is provided for a tape input with a sensitivity of 30mV for 5W output per channel. In this connection Radiomoble are planning to introduce a "tape mate" at a later date.

No price has been announced for the 1190FMS but further details can be obtained from **Radiomobile Ltd, Goodwood Works, North Circular Rad, London, NW2 7JS.**



Sinclair "Black Watch"


The 1190FMS a.m./f.m. stereo radio from Radiomobile

Jermyn 300W invertor

DIGITAL CAPACITOR METER

A new digital readout capacitance meter, type DCM 302, is announced by Aim Cambridge Ltd.

The meter automatically ranges over 6 decades of measurement, from 1999pF to 19·9μF full scale, and the 3½ digit seven segment display gives a resolution of 0·05 per cent of reading.

Designed for ease and speed of operation, no complex nulling or other adjustments are required, the only control is a touch pad which is used to initiate a measurement. If powered by batteries the meter automatically switches off after 10 seconds. Two 9V (PP3) high power batteries give a typical operating life of at least 6,000 measurements. A mains power pack is available.

The DCM 302 is of British design and is available direct from **Aim Cambridge Ltd., Nuffield Road, Industrial Estate, St. Ives, Huntingdon.** The price of the meter is £89.

BATTERY

A dated battery with a stated shelf life is now being marketed by West Hyde Developments Ltd.

Known as the "Wonder Top" each battery is date stamped at manufacture with a guaranteed shelf-life of up to two years. The batteries have a plastics/cap which operates a break-off cover protecting them against unwanted discharge. The protective cap is unscrewed for testing but is overscrewed to break the seal to allow installation in equipment.

Ideal for all types of battery operated equipment the batteries are claimed to give excellent performance. For instance, the TOP 20 (HP20 etc.,) has a short circuit current of 6A. A maximum electrical capacity of 7·8Ah with a power of 2·5W. Tested to the C.E.I. intermittent 5 ohm load (4 hours a day) the life is over 20hrs to a voltage of 1V, at 40 ohms this rises to 190hrs.

The smallest of the three batteries offered, a pen cell, provides a 1·5Ah maximum with a short circuit current of 3A.

Full technical details of the complete range and addresses of nearest stockists can be obtained from **West Hyde Developments Ltd., Ryefield Crescent, Northwood Hills, Northwood, Middx, HAS 1NN.**

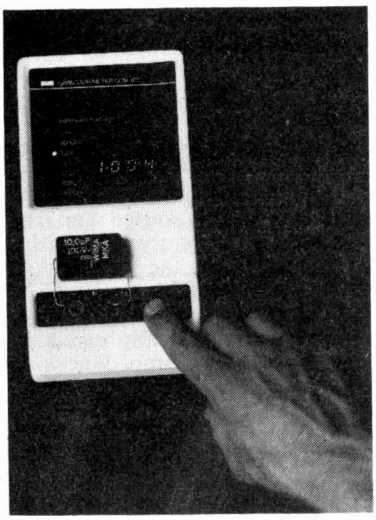
SWITCHES

A range of fire resistant plastics encapsulated rotary switches is now available from Lorlin Electronic Ltd.

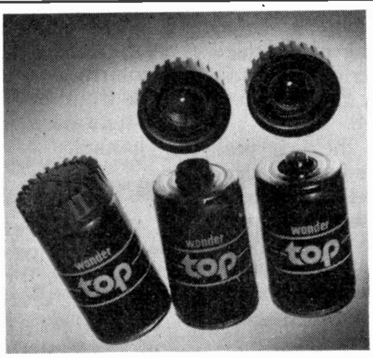
These switches, type CK, are available in 1, 2, 3 or 4-pole versions with 30 degree indexing up to 12 positions single pole. An adjustable stop allows the number of ways to be selected to individual requirements.

The silver plated brass contacts are rated at 150mA at 250V a.c./d.c. and 350mA at 110V a.c./d.c.

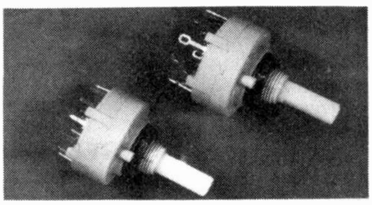
Further information on the complete range of Lorlin switches is available from **Lorlin Electronic Co. Ltd., Daux Road, Billingshurst, Sussex.**



Digital capacitor meter type DCM302 from Aim Cambridge



"Wonder Top" batteries from West Hyde



Lorlin CK Rotary switches

IN BRIEF

To coincide with the opening of two new audio shops in Reading and Notting Hill Gate, London, **Henry-Lindair** announce an audio part exchange scheme.

Customers who take their old equipment to any Henry's-Lindair store will, in future, be able to obtain a trade-in allowance which can be set against the purchase of new equipment from that particular store. The trade-in item is passed to the Service Department where it is tested and overhauled.

All selected trade-in items are then sold through one of the groups newly established "Bargain Centres" in Edgware Road, and Tottenham Court Road, London, with a three month guarantee.

We understand that **A. Marshall (London) Ltd.** have signed an agreement to supply **ITT Semiconductors** components to both the trade and the amateur.

Initial stocks will mainly be confined to products such as transistors, diodes, and rectifiers, together with selected specialist integrated circuits for television and other applications.

ITT Semiconductors manufacture specialised i.c.s. with applications in areas such as remote control, hi fi, clocks, watches and automobiles and Marshall's hope to introduce selected items and kits from this range into the consumer and amateur markets in the near future.

A new 24-page MOS products catalogue entitled "It's Standard at AMI" has just been published by AMI Microsystems.

This short form catalogue is an up-to-date listing of all current, recently introduced and future AMI products. It includes sections dealing with micro-control systems, microprocessors, memories, interface circuits, communications modules, wristwatch, clock, calculator and electronic organ circuits and liquid crystal displays.

Copies of the catalogue can be obtained from **AMI Microsystems Ltd., 108a, Commercial Road, Swindon, Wilts.**

For readers interested in Disco equipment, Saxon Entertainments Ltd. have released brochures on their System 7000 sound and light modules.

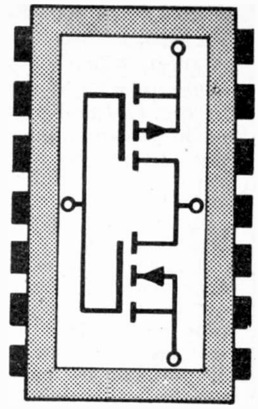
Included amongst their amplifiers, mixers and lighting units is a Sound/Lite Sequencer capable of handling up to 1000W per channel.

Copies of the brochures are available from **Saxon Entertainments Ltd., 327-333 Whitehorse Road, Croydon, Surrey.**

NOTE

We regret that an incorrect address for Barclay Electronics was given last month. This should be: **Barclay Electronics, 1115 Finchley Road, London, N.W.11.**

Using CMOS *digital* I.Cs



By D.B. JOHNSON-DAVIES & A.M. MARSHALL B.A.

PART 1

This series of articles will acquaint the reader not only with the basic characteristics but also the practical applications of CMOS as succeeding parts will give tested circuits with full description of operation.

Readers who have never used any logic family, either due to lack of funds or lack of confidence will find CMOS an excellent introduction as it is well suited to the experimenter. Its microwatt power consumption, single supply operation from non-regulated 3 to 15V supplies, high noise immunity, abilities to switch analogue signals and operate as high gain linear amplifiers are all qualities which make it ideal for this role.

THE first commercial complementary MOS device was shown by RCA in March 1967 at the New York IEEE show. The CD4000 range was launched the following year and by 1971 a wide range of plastic packaged devices with operation from 3 to 15V was available. This was the year that CMOS finally evolved into a fully-fledged rival to other logic families with Motorola announcing proprietary products of its own—the MC14500 series. The following years have seen a phenomenally rapid growth both in the range of devices and usage.

Prices have steadily fallen until, in the last year they have literally tumbled to, in many cases, below TTL prices. The one-off price of a 4-gate package is now 17p, while MSI packages which would require two TTL packages show a considerable price advantage. This year, despite the recession, RCA, which has a 40 per cent share of the CMOS market, intends to introduce a further 40 new CD4000 series devices. This will bring the total number in the series to 182.

DEVELOPMENT

For a long time bipolar TTL has been the standard medium-speed logic family. In the last few years MOS (metal oxide semiconductor) technology has made possible the fabrication of the high-density calculator, clock and, more recently, microprocessor integrated circuits.

It is the complementary form of MOS—CMOS—that has developed into a comprehensive logic family with a number of significant new features that offer a serious challenge to TTL.

MOS i.c.s are those fabricated entirely from MOS field-effect transistors or MOSFETS. Basically a MOSFET consists of a metal gate electrode insulated from a channel of silicon by a thin oxide layer. It is this metal oxide semiconductor sandwich that gives the technology its name.

The channel is doped with one polarity and two other electrodes are formed by troughs of opposite polarity on each side of the gate. These are called the drain and the source. Two types are possible: an *n*-type or a *p*-type, according to the doping of the channel.

MOSFET AS A SWITCH

The MOSFET behaves as an excellent switch, since when the gate voltage is raised to a critical level (known as the threshold voltage) the device switches on and current flows between the source and the drain. This gate voltage induces a change of polarity in the material under the gate, i.e. the channel, so that with an *n*-type a positive switching voltage is needed on the gate, and similarly a negative voltage with a *p*-type. Since the gate is electrically insulated from the silicon, MOSFETS have input impedances of the order of 10^{12} ohms (one million megohms). Therefore, to all intents and purposes, no current flows in the gate circuit, and switching is achieved by electrostatically induced charges.

MOSFETs AS LOGIC ELEMENTS

Now the question arises—how are these basic electronic switches used to build logic elements? A PMOS inverter is shown in Fig. 1.1(a); a low input (below the threshold voltage) produces a high output and vice-versa.

Suppose we require the output to go high when any one of a number of inputs is low. The circuit of Fig. 1.1(b) satisfies this requirement, and its PMOS equivalent is a 3-input NOR gate. In other words the output is high if "NOT (A OR B OR C)".

PMOS AND NMOS

In practice the resistor is replaced by a second *p*-type MOSFET which is biased on by a second supply line of about twice V_{ss}. This is called V_{gg} since it is connected to the gates of the load devices. The resulting PMOS inverter is shown in Fig. 1.1(c). In the on state a single PMOS inverter has a significant power dissipation of about 10mW.

The great advantage of PMOS is that very high packing densities can be achieved on a single chip since each gate is extremely simple. The disadvantage is the power dissipation—a typical clock chip consumes about 10mA, as much as one of the displays it is driving. Furthermore, two power supply rails are generally needed and the speed of operation is fairly low.

Integrated circuits made entirely with *n*-channel MOSFETs give a greatly improved performance and density, but until recently, the inherent fabrication difficulties have prevented NMOS from being a viable production technology. Now that these difficulties have been resolved, NMOS is making possible a whole new range of high speed, high density memories and microprocessors.

COMBINING BOTH TYPES

A third way of using MOS is to combine *p*-type and *n*-type MOSFETs on the same chip. The formidable fabrication problems involved, especially at high production levels, were overcome by RCA by the late 1960s. The inverter now becomes a *p*-type and an *n*-type connected in a complementary-symmetry (hence RCA's trade name COSMOS) push-pull configuration across the supply rails. The gates are connected together to form the input—Fig. 1.1(d). The d.c. power dissipation of the PMOS inverter is now reduced virtually to zero, being a product of the nanowatt leakage current of the MOSFETS.

A new general purpose logic family was born. Its great versatility and unique features account for the fact that it has reached its present maturity in such a remarkably short time.

MARKET GROWTH

RCA market the family as the CD4000 series with the trade name COSMOS, and there are at present more than 140 devices in the family. The first major manufacturer to second-source the 4000 series was Motorola in 1971, using the trade name MCMOS. At the same time Motorola introduced devices of their own design, designated the 14500 series. Today there are more than a dozen suppliers with the latest

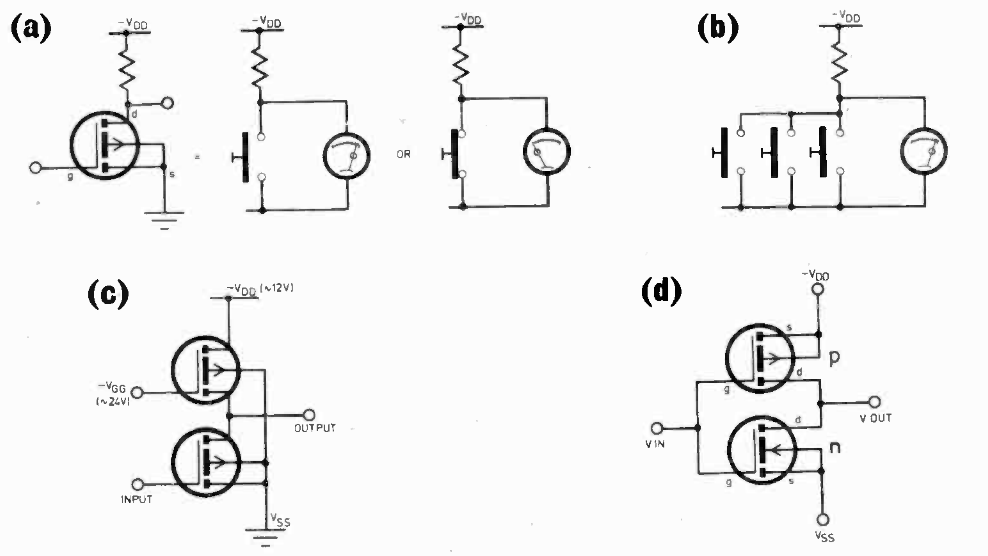


Fig. 1. 1(a) Operation of a *p*-type MOSFET with load resistor as an inverter; (b) Implementation of a 3-input NOR gate; (c) Standard PMOS inverter with load resistor replaced by a *p*-type MOSFET; (d) CMOS inverter consisting of an *n*-channel and a *p*-channel device connected in push-pull. When one device is on, the other is off. This eliminates the high d.c. power dissipation of the PMOS inverter and requires only a single supply

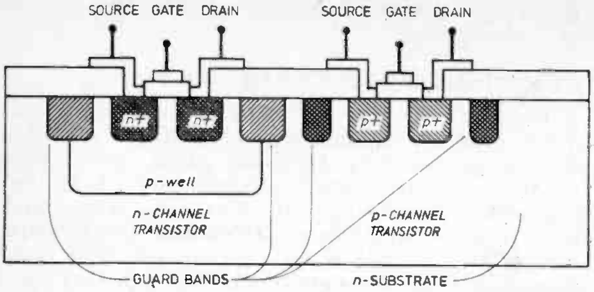


Fig. 1.2. Typical CMOS structure, showing a *p*-channel and an *n*-channel device diffused on the same substrate

entrant to the market being Philips with an initial introduction of 35 4000 and 4500 series CMOS parts.

CMOS FABRICATION

A cross section of the basic CMOS element, a *p*-channel and an *n*-channel device on the same substrate is shown in Fig. 1.2. The starting substrate is made of *n*-type silicon into which is diffused a well, forming a *p*-type substrate for the *n*-channel transistor. Each substrate then has *p* or *n*-type pockets diffused to form the sources and drains of the *p* or *n*-channel transistor.

Protective guard bands are also diffused around the *p* and *n*-type transistors, of opposite polarity to prevent leakage between the two types of device. The process generally requires seven masking steps, the last being to form the aluminium metallisation etched to form the appropriate circuit interconnections.

In spite of all this, CMOS circuits have a much higher packing density when compared with bipolar technology. Less chip area is required per function through the elimination of resistors and capacitors and the extremely low power dissipation.

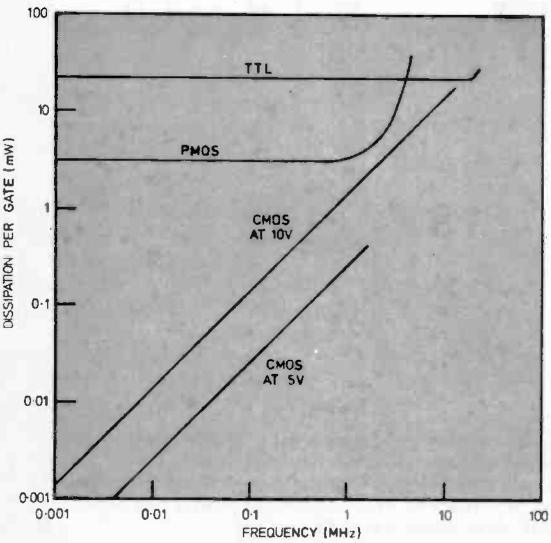


Fig. 1.3. Power versus speed comparison for CMOS, PMOS and TTL. Power consumption of CMOS approaches that of TTL at high speed, but at 1kHz is only 1μW

INVERTER STATIC OPERATION

As mentioned, one of the basic building elements of CMOS i.c.s is the complementary inverter. The *n*-channel device is connected to the negative supply and the *p*-channel device to the positive rail. When the input is at the negative supply potential, the *n*-channel device is off and appears as a resistance of several thousand megohms. The *p*-channel device is at the same time on and has a resistance of about 750 ohms. The output of the inverter is thus clamped to within a few millivolts of the positive supply rail.

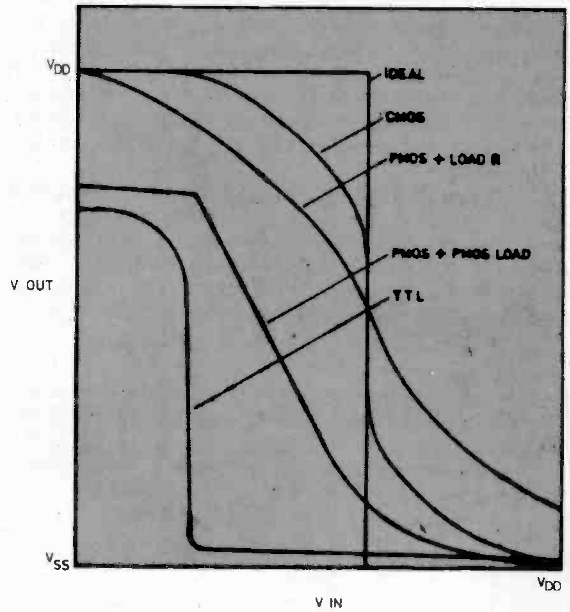


Fig. 1.4. Switching characteristics of CMOS, PMOS and TTL. CMOS approximates far more closely to the ideal switch

Equally when the input to the inverter is at the positive rail, the output is virtually at the negative rail. In either state the static power consumption is of the order of a few nanowatts only.

The MOSFETS of the inverter have threshold voltages of around 45 per cent of V_{DD}. This gives the inverter its highly symmetrical switching characteristic, coupled with high noise immunity. The transfer characteristic approaches that of an ideal switch more closely than that of any other inverter configuration—Fig. 1.4. Allowing for production spreads in threshold voltages, the guaranteed d.c. noise immunity is usually 30 per cent but will typically be 45 per cent of V_{DD}. Thus at a supply voltage of 5V, the noise immunity will be about 2V. This means that, as well as having a high immunity to input noise spikes, CMOS does not require well-regulated power supplies. Simple RC smoothing is often all that is required.

POWER DISSIPATION

Since the supply voltage is greater than the sum of the threshold voltages, both of the devices will be on simultaneously as the inverter switches during a transition of 10 per cent of V_{DD}. This causes a peak of current to be drawn from the supply. However, the majority of the dissipation does not come from the resistive flow through both the partly on transistors, but from the charging and discharging of stray and load capacitances.

The output is held at very nearly V_{SS} or V_{DD} during this simultaneous conduction period and the current is diverted to the capacitance itself. Thus the switching power dissipation of the CMOS inverter is almost entirely due to capacitive loading and the more frequently the inverter passes through this mid-point region the higher will be the power dissipation until, at 10MHz, it reaches that of TTL (Fig. 1.3).

So in order to realise the micropower operation of CMOS the operating frequency should be kept low. While the CMOS inverter shows an idling or quiescent power dissipation, P_Q of the order of nanowatts, when switching the power dissipation, P_D is given by $P_D = P_Q + C_L \cdot V_{DD}^2 \cdot f$ (where f is the operating frequency).

OPERATING VOLTAGE RANGE

As we have seen the CMOS inverter operates from a single supply (Fig. 1.1). Thus V_{SS} is 0V when the input swing is positive. However, if it is also negative, then V_{SS} must be negative by at least the same amount. Standard CMOS devices operate from 3 to 15V, with an output logic swing within a few millivolts of the supply rails.

HANDLING AND USAGE

The extremely high input impedance of MOS allows electrostatic charges to build up which could easily puncture the very thin input gate oxide layer. Present day CMOS devices are pretty thoroughly protected against such charges by diode-resistor-capacitor input networks and, provided simple earthing precautions are taken, devices can be handled quite safely.

One precaution, however, must be emphasised. Devices can be destroyed when driven by low impedance sources, such as a signal generator or even the outputs of other CMOS devices, if the V_{DD} supply is disconnected. In this case one of the protective diodes may become forward biased causing possible damage to the diode or the input metallisation.

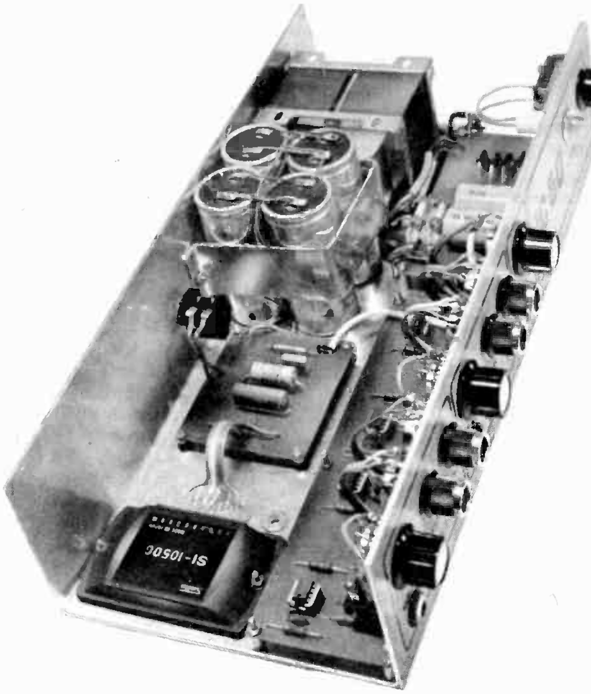
UNUSED INPUTS

All unused inputs should be connected to one or other of the supply rails, as appropriate. Floating inputs not only waste power but can cause erratic operation of the rest of the device. The outputs of most devices are virtually short-circuit proof. This is because of the inherent current-limiting characteristic of the complementary inverter, whereby the output current is limited to one or two milliamps. The only restriction is that the total package dissipation of 200mW should not be exceeded.

Next month: The other basic element from which CMOS i.c.s are built; the transmission gate. Also included are practical CMOS circuits.

GUITAR AMPLIFIER

continued from page 30



The voltage reading at the output socket (SK3) should be almost zero. On the prototype this reading was minus 200 millivolts.

Swith off and replace FS1 with an ammeter. Switch on and measure the quiescent current. It should be in the order of 20 milliamps.

If all the above tests have been successful, a suitably rated 8 ohm loudspeaker can be connected and the amplifier tested with an input signal such as from a signal generator (if available—in which case further tests can be carried out) or from a guitar pick-up, microphone or eletronic organ.

Check the performance of the volume controls by slowly turning them clockwise to increase the volume. Clockwise rotation of the treble and bass controls should boost treble and bass frequencies.

CASE

Construction details of the amplifier case as used in the prototype are given in Fig. 12. The material used was 12mm thick blockboard, glue and nails being suitable for the butt joints. The inside front was faced with 10mm quadrant glued and nailed all round, with mitred joints.

Two holes need to be drilled on the underside to align with the chassis fixing nuts, through which two 25mm long 2BA bolts fitted with large washers will hold the chassis assembly firmly in position against the quadrant facing.

Thoroughly sand down and fill in any indents there may be in the finished case and paint or cover the case as required. Black Rexine was used on the prototype case and glued on using pearl/crystal glue. To finish off, fit four rubber feet and a snap-back flush carrying handle on the top, see photographs. ★

SEMICONDUCTOR UPDATE... By R.W. COLES

ULN2275 AY-3-9400/10
ULN2277 M142
ULX2276 ILQ74

STEREO TRIO

If you're like me, its possible that you sometimes wonder whether the integrated circuit manufacturers do not so much *make* the little blighters, as *breed* them! I must confess to having taken these suspicions a little further than reasonably necessary, because I once imprisoned a couple of 741 op-amps in a matchbox, just to see what would happen.

Well, to cut a long story short, I never actually caught them at it, and not so much as a bonny bouncing quad two i/p nand gate ever resulted, but I still have nagging doubts, and these have been aroused once more by a trio of new devices from Sprague.

If I'm wrong and Sprague actually do *make* i.c.s, they're doing a grand job, because these three new chips form a closeknit little family which promises to make audio amplifier problems a thing of the past. The type numbers are **ULN 2275, ULN 2277** and **ULX 2276,** and each of these handy little 14-pin i.c.s contains not one, but two audio amplifiers, each with an impressive specification

You may think that putting two audio amplifiers in one d.i.l. package will mean that their output power capability must be very restricted, but this certainly isn't so. The 2275 gives a creditable 1W per channel of continuous power over a supply voltage range of from 9 to 20V, for only 28mV of signal input. The 2277 is even more powerful at 2W per channel, and the 2276 (which is still undergoing evaluation tests) promises an incredible 4W each side, making it a definite candidate for the *Guinness Book of Records*!

These powerful devices don't necessarily need special heatsinks either, since they can dissipate the heat, via their tabs, to the copper areas of the p.c.b. A trio of real thoroughbreds in fact!

PHONE TONES

You may remember that I recently featured the Plessey MP 9100 dial code generator (October '75), which is intended for use with Strowger-type telephone systems. In the MP 9100, dialled digits are sent out as a series of slow on/off pulses to activate stepping uniselectors at the exchange. This is not the only system in use for telephone dialling, and a new chip from General Instrument, the **AY-3-9400**, demonstrates the other point of view.

Like the MP 9100, the AY-3-9400 is intended for use with push-button telephones, but instead of sending out a string of pulses for each digit, the new chip sends out a pair of m.f. tones. The push buttons on the telephone instrument are arranged as a key-pad, or matrix, and when a single key is depressed, two signals, one for the row position and one for the column position, are generated. If the key-pad has 4-rows and 3-columns (i.e. 12 keys) it is possible to allocate a unique tone pair from seven basic tone generators.

The AY-3-9400 generates seven accurate tone frequencies between 695·28Hz and 1,631·78Hz, and is controlled by a 559·7KHz ceramic resonator (or crystal) external to the chip. The chip is made with an *n*-channel ion-implant m.o.s. technology which ensures operation from a single low voltage supply.

The operation of the circuitry is mainly digital, consisting of some keyboard logic, two programmable prescaler counters to generate the necessary frequencies from the main clock oscillator, and two digital to analogue converters to give a fair approximation of a sinewave for each m.f. tone.

Now, I don't suppose that anyone is thinking of going into competition with the Post Office by providing an alternative telephone system, but this new device could be used for many other things besides. An obvious use is as a remote control tone generator for an ultrasonic or radio link, perhaps to control a T.V. set or model.

The 9400 comes in a 14-pin package, but if seven tones and 12 key positions aren't sufficient for your needs, there is the **9410** version which handles 16 keys with eight tones and comes in a 16-pin pack.

BIG SHIFT

If you dabble in t.t.l. logic (and who doesn't) you may have occasionally cast envious glances at some of the logic power available in the more exotic m.o.s. technology. If you have ever wanted a long shift register, for example, the prospects for building it with t.t.l. are a bit bleak, since an eight bit device is about the biggest available.

With *p*-m.o.s. on the other hand, registers very much longer are commonly available, but unfortunately they don't help much, because to put a *p*-m.o.s. register in a t.t.l. system often means extra power supplies and special interface circuits which makes the m.o.s. solution about as broad as it is long (no pun intended!).

Thanks to the relatively new *n*-m.o.s. technology, however, the mixing of m.o.s. power with t.t.l. versatility has now become a real possibility, even for small amateur projects. Take, for example, the SGS-ATES **M142** quad 80-bit static shift register (yes, that's right, *four* 80-bit shift registers in a 16-pin d.i.l.!). This common or garden *n*-m.o.s. device is fully t.t.l. compatible on all inputs and outputs, and even works from the standard +5V t.t.l. supply rail. The data in the register can remain static if required, or can be shifted at a clock rate of up to 3MHz.

Four 80-bit registers in parallel could be used to store 80-b.c.d. digits (0–9) and so could provide a powerful but simple data storage system for many kinds of digital projects.

QUAD COUPLER

Opto-couplers consist of an l.e.d. in close proximity to a photo diode or transistor, the whole thing being sealed in a small plastic or hermetic package. Input signals to the l.e.d. cause a light output which is sensed by the photo diode or transistor to produce an output. The name of the game is isolation, and by using light as the coupling medium, isolation resistances of 100 megohms and breakdown voltages of over 1,000V can be achieved.

All this is history, but Litronix have recently introduced a new i.c., the **ILQ74,** which consists of no fewer than four opto-couplers in a single 16-pin d.i.l.! Applications include thyristor triggering, high voltage stabilised power supplies and signal isolation circuits, with inputs and outputs being t.t.l. compatible.

NEXT MONTH

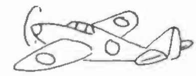
CAR/CARAVAN CLOCK

A crystal controlled clock with combined independent journey timer. Jumbo size six digit display with automatic intensity control makes for easy readability. An alarm facility is included

SOIL SATURATION METER...

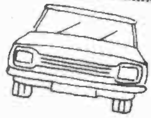
With food prices causing more and more people to embark on the "grow your own" course, this simple device is bound to find popularity with gardeners trying to get that little extra from their plot or greenhouse

LIGHT COUPLED REV COUNTER...



Measures the propeller speed of a model aircraft engine without connection. Ideal for getting peak performance from fuel mixtures

Programmable WASH/WIPE CONTROLLER



A car windscreen wiper delay unit with a difference. As well as the standard "variwipe" control, a programmable wash-wipe facility is also incorporated

Plus...

Using CMOS Digital I.Cs.

PART 2 Continues the description of the basic elements used in this important technology

PRACTICAL

ELECTRONICS

FEBRUARY ISSUE ON SALE JANUARY 9, 1976

TO AVOID DISAPPOINTMENT PLACE A REGULAR ORDER WITH YOUR NEWSAGENT—*NOW!*

Now...the most exciting Sinclair kit ever

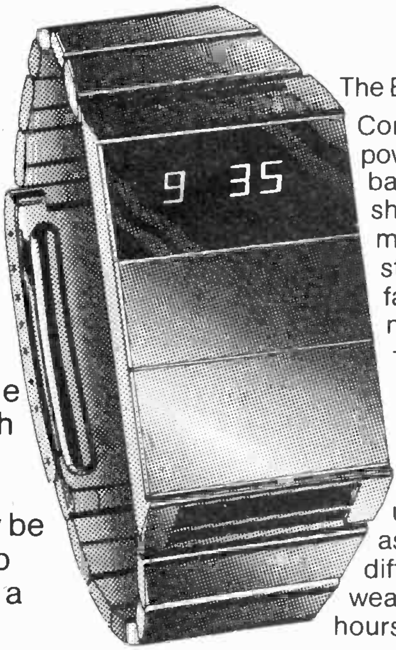
The Black Watch kit

At £17.95, it's

★ **practical** – easily built by anyone in an evening's straightforward assembly.

★ **complete** – right down to strap and batteries.

★ **guaranteed.** A correctly-assembled watch is guaranteed for a year. It works as soon as you put the batteries in. On a built watch we guarantee an accuracy within a second a day – but building it yourself you may be able to adjust the trimmer to achieve an accuracy within a second a week.



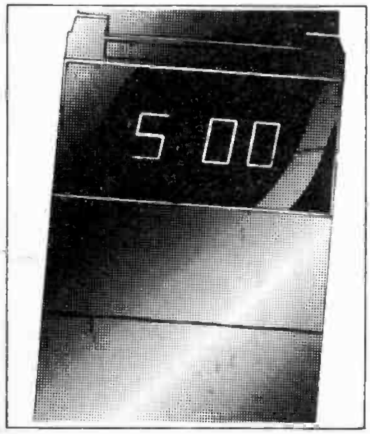
The Black Watch by Sinclair is unique. Controlled by a quartz crystal... powered by two hearing aid batteries... using bright red LEDs to show hours and minutes and minutes and seconds... it's also styled in the cool prestige Sinclair fashion: no knobs, no buttons, no flash.

The Black Watch kit is unique, too. It's rational – Sinclair have reduced the separate components to just four.

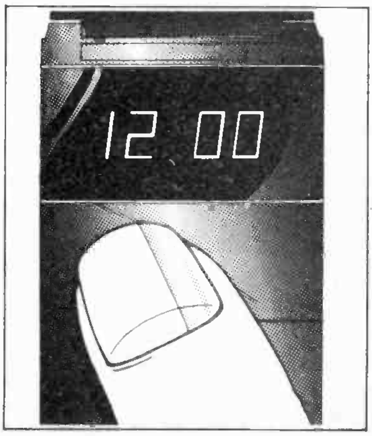
It's simple – anybody who can use a soldering iron can assemble a Black Watch without difficulty. From opening the kit to wearing the watch is a couple of hours' work.

The special features of The Black Watch

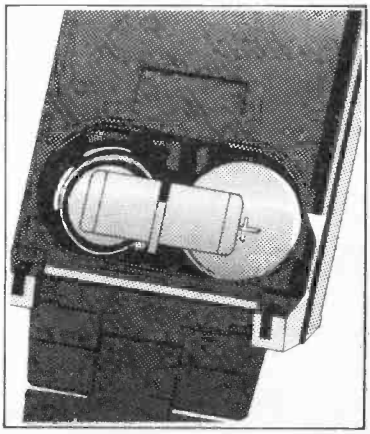
Smooth, chunky, matt-black case, with black strap. (Black stainless-steel bracelet available as extra – see order form.)



Large, bright, red display – easily read at night.
Touch-and-see case – no unprofessional buttons.

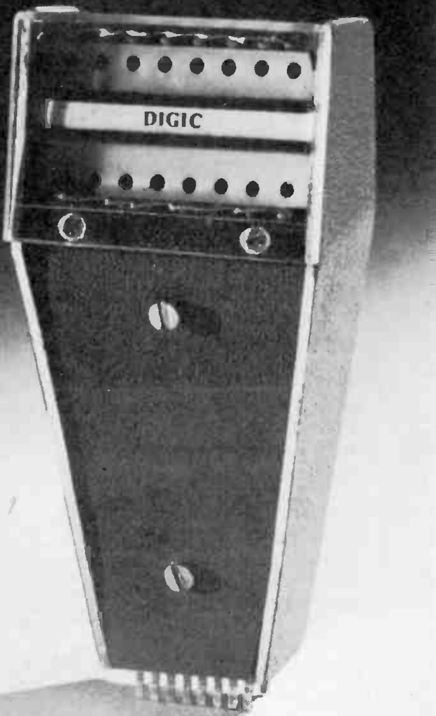


Runs on two hearing-aid batteries (supplied). Change your batteries yourself – no expensive jeweller's service.



DIGITAL LOGIC CHECKER

By D. COLES



SEVERAL devices have recently appeared on the market which display the logic conditions of an in-circuit i.c. upon a matrix of light emitting diodes. These devices cost about £30 and while they are of sophisticated design, they are out of the reach of many amateurs' pockets.

The device described below can be built for under £4 and, in the author's opinion, the lack of sophistication is more than balanced by the difference in cost.

Power for the logic checker is taken directly from the i.c. under test so that separate batteries are not required. High and low logic levels and the power supply are indicated by appropriate l.e.d.s being activated; the l.e.d. position indicating the i.c. pin in question. The checker can be used to display the logic states of any integrated circuit having up to 16 dual-in-line pins at a 0·1in pitch.

THE CIRCUIT

The circuit consists of a pair of electrical pathways between each pin connection and a common rail (see Fig. 1). Only one of each pair is open to current, the other being blocked by a diode or light emitting diode.

In order to demonstrate the circuit function in greater detail, the following assumptions are made for Fig. 1: pin 16 is at logic level 1, pin 15 is at logic level zero and pin 1 is ground or negative supply.

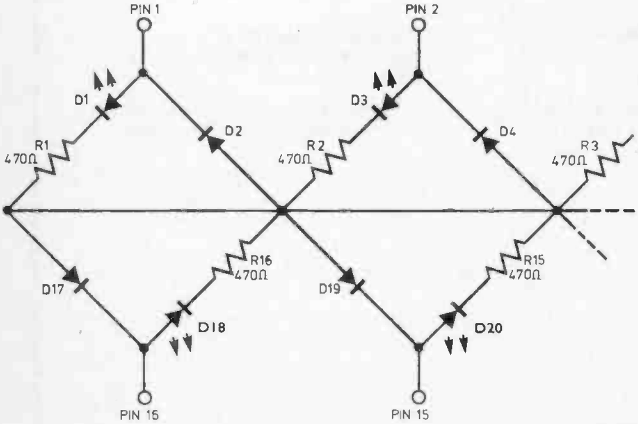


Fig. 1. Four of the 16 networks needed

COMPONENTS . . .

Resistors
R1–R16 470Ω (16 off)
All 5% $\frac{1}{8}$ watt carbon

Diodes
D1–D3–D5–D7–D9–D11–D13–D15–D18–D20–D22–D24–D26–D28–D30–D32 All RL54 l.e.d.s (A. Marshall Ltd.)
D2–D4–D6–D8–D10–D12–D14–D16–D17–D19–D21–D23–D25–D27–D29–D31 All OA200

Miscellaneous
Veroboard, edge connector contacts, plastic case, scrap perspex sheet

Conventional current flow will proceed from pin 16 to pin 1 via D18, R16 and D2; its passage along the alternate route being blocked by D17 and D1. D18 will be activated by the passage of current and the positive voltage on pin 16 will be indicated. Resistor R16 limits the current flowing in D18. In practice, some current will also flow from pin 16 to pin 15 via D18, R16 and D19.

Pin 15 is assumed to be at logic zero and will thus have a voltage of between zero and 0·4 volts; this is too low a voltage to overcome the forward voltage threshold of the l.e.d. and diode which lie in its path to ground. (In exceptional cases, the two thresholds may be overcome and a small but insignificant current will flow.)

In considering all 16 circuits networks, some current will flow between pins at logic level 1 and those at logic level zero as well as the ground pin. However, these do not upset the functioning of the circuit.

The positive supply pin is treated as a pin at logic level 1 and is also displayed by an illuminated l.e.d. in the appropriate position.

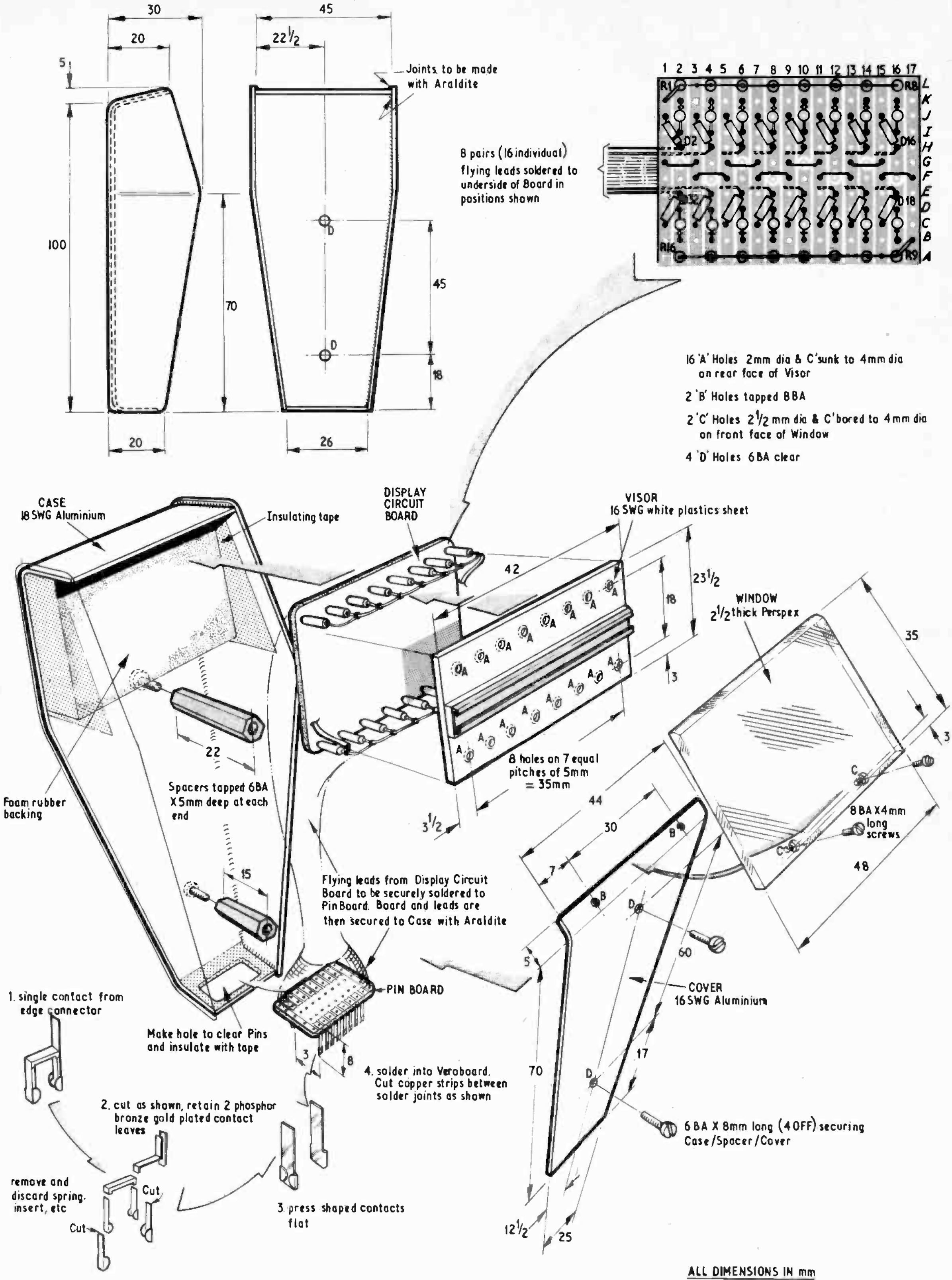
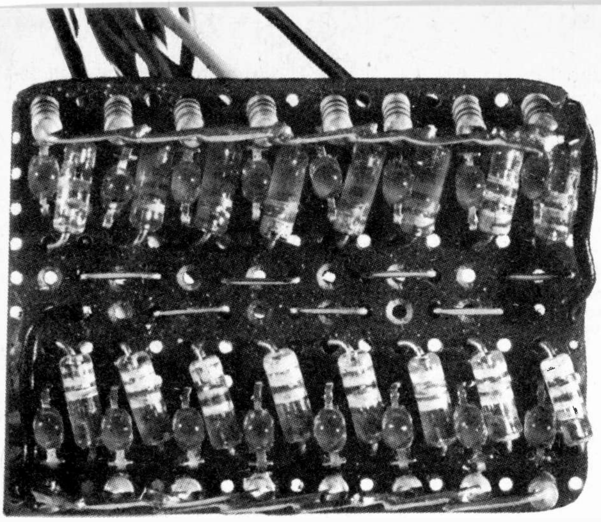


Fig. 2. Constructional details of the Digital Logic Checker



CIRCUIT AND DISPLAY BOARD

A 16 by 12 hole piece of Veroboard of 0·1in pitch is used for the circuit. Layout and the positions of the cuts in the copper strips are shown in Fig. 2. The resistors are mounted first followed by the diodes and, finally, the light emitting diodes. Care should be taken to avoid overheating the diodes and, particularly the l.e.d.s which are very small and therefore particularly sensitive. The resistors are mounted vertically while the diodes are soldered in a horizontal position. The l.e.d.s are mounted so that the plastic lens part is above the diodes and about on a level with the top edge of the resistors.

THE SPRING CONTACT BOARD

A second piece of Veroboard is used for the base. The pitch is, again, 0·1in; with ten copper strips and six rows of holes. The outer two copper strips are scraped off with a sharp knife. The 16 spring contacts are fashioned from the individual contacts from an edge connector and soldered into the Veroboard, slight widening of the Veroboard holes with a knife will allow the contacts to be eased in without their bending. The sequence of operations for making the contacts is shown in Fig. 2; the gold plated contacts make excellent prongs for this project and, being individually sprung, they allow all 16 contacts to slide tightly over the i.c. pins.

It is important that the tips of all the contacts are arranged at the same height, alterations to the angle at which each contact is soldered can be made by bending each one slightly until they are all in line.

Flying leads of thin stranded wire are used to connect the two Veroboards together. In both cases the leads are attached on the copper side of the Veroboard.

Fourteen to 16 pin i.c. test clips are available from Guest Electronic Distribution Ltd. While this component would make a much more professional job of the i.c. contact assembly, the cost would increase by over 50 per cent and the case would require a different design.

TESTING

A four and a half volt battery, or other power source, can be used for testing. Briefly touch the battery contacts against any of the spring contacts and, wherever the positive supply touches a contact, the appropriate l.e.d. should light. Faults may be due to crossed leads, damaged l.e.d.s or diodes and l.e.d.s being connected in reverse.

THE CASE

The shape of the case has been chosen to provide a convenient hand grip and a small sized base. The small base and tapering shape allow it to be inserted onto an in-circuit i.c. without interfering with neighbouring components.

Aluminium was chosen as the material but, because of the small size of the case, it is difficult to bend a single piece of aluminium at the necessary points. In order to avoid this difficulty, four separate pieces of aluminium were cut, bent and glued together with Araldite, the areas of metal covered by the glue being well roughened to give good adhesion. Fig. 2 shows the separate aluminium pieces and their assembly into a somewhat coffin-shaped box.

The display area where the l.e.d.s are viewed is covered by thin Perspex. Araldite is not recommended for securing Perspex and Evostik was used for this operation.

The small base end of the case is cut to provide a hole for the spring contacts to protrude through and this piece of Veroboard is secured into the base with generous amounts of Araldite. The copper strip side of the Veroboard is also smeared with Araldite to reinforce the soldered joints of the spring contacts.

The circuit and display board is fitted behind the Perspex window and wedged into position with small scraps of foam plastic. It is advisable to insulate the interior of the case with insulation tape to ensure that accidental shorting of the display board does not occur.

USING THE LOGIC CHECKER

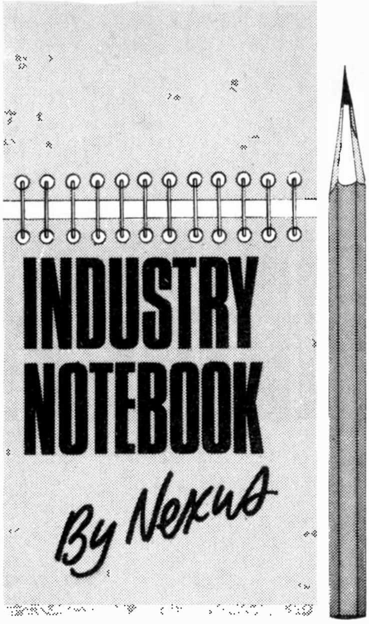
In use, the spring contacts are pushed over the operating i.c. to be tested, care being taken to ensure that the spring contacts do not bridge the small gaps between the i.c. pins.

The l.e.d.s on the display board will now glow and indicate the positive supply pin and those pins which are at logic level 1.

The constructor should be warned that where i.c.s are being used with capacitors, for instance, where gates are cross coupled to form an astable multivibrator, the checker will disturb and may freeze the circuit action. This is because alternative charge/discharge paths are set up through the checker which will significantly alter the time constants in the circuit.

At a nominal supply voltage of 5 volts, each l.e.d. is limited to a current of about 10·5mA by the series resistor. The l.e.d.s are quoted as a 40mA device but the reduced current is still sufficient to provide a light output which can be easily seen in most conditions. Most d.i.l. i.c. devices can provide a logic 1 output of 160mA, quite sufficient to power the checker. If an operating i.c. is already approaching its maximum fan-out (usually 10) it is a wise precaution to disconnect some of the devices being fed from the well loaded gate outputs before using the checker.

If two sewing pins are cut to about 5mm length, heated and pushed into the Perspex window at either end, these can be used for attaching a piece of card or stiff paper. The block diagram of the i.c. can be sketched on the card with the input/output lines to each gate drawn to each l.e.d. The logic levels for each gate can then be seen with ease. ★



OUTLOOK '76

The Autumn season of electronic exhibitions and a few company reports and news items gave forecasters for '76 little on which to base firm conclusions because the general economic outlook was, and is, filled with uncertainties.

Consumer electronics is still in the doldrums. Colour TV deliveries last August, for example, were 36 per cent down on the previous August. And, because of this, component suppliers really suffered. AB Electronic Components reported a heavy drop in volume of components supplied although inflation kept turnover at £11·15 million compared with £12·05 million a year earlier.

Profits were down from a pre-tax figure of £908,063 to £379,205 reflecting lower margins. On the other hand AB went ahead with a heavy investment programme showing confidence in the future but at the same time stated that more emphasis is being placed on business outside the area of consumer products.

Erie Electronics also suffered from the consumer slump and the sale of the UK operation to ITT Components Group Europe should be established, according to industry sources, by early in the New Year if not before.

Decca's big interests in TV, radio, audio and records, showed a decline in pre-tax profits from £10·9 million to £6·8 million but the balance was redressed by the radar, navigation, and other professional capital goods output which showed an increase in profit from £6·7 million to £9·1 million.

Fortunate indeed are those companies strong in capital goods. EMI Electronics has to thank its world-beating EMI-Scanner X-ray equipment for a doubling in profit from £7 million to £14·6 million. The total order book for these machines has now topped 300, worth some £60 million. And as there is no competition there is a handsome profit on every delivery. Strange to say, this project was nearly abandoned at one stage.

If we look across the Atlantic, the Wescon show in San Francisco last September was full of optimism with strong support for the view that business was on the upturn although some cautious opinions were expressed that it would be a long haul and positive results may not be apparent before mid-'76. European electronics would follow on, it was said, with a time lag of seven to eight months.

In Britain, the Internepcon/UK '75 show held in October was the biggest ever and one of the busiest. The show concentrates on plant and equipment for electronics manufacture and there was plenty of evidence that manufacturers are investing now for future production. Perhaps not as heavily as they should in some cases, but there was movement and that's better than nothing.

The immediate outlook, then, is for consumer electronics to remain depressed but for capital goods to do well, especially in the export market where, with a devalued pound, British goods are very competitive.

MOBILES AND PAGING

Every cloud has a silver lining. Vandalism and terrorism on London's famous double-decker bus fleet has brought Redifon Telecommunications back into mobile radio. The company has an initial order for 200 radiotelephones to enable bus crews to call for help if need be.

Apart from ordinary two-way telephony there will be a number of strategically sited emergency buttons on the bus which actuate an auto-alarm. But later, the sets will also be used for data transmission as part of a new scheme being introduced for en-route control of the fleet.

Pocket radio paging is to go ahead in the London area under a Post Office scheme due to start next Spring. This follows on from field trials in the Reading area. The Post Office expects to get 20,000 subscribers initially and each one, of course, will need to be supplied with a pocket "bleeper" which will respond to a radio signal personally coded.

On the Reading trials the Post Office used pagers manufactured by Motorola. But for the London scheme they have ordered 10,000 units from the British company Multitone at a reported contract price of £1 million.

The Multitone equipment has already been proved in service in wide area paging systems in Toronto and Ottawa. One of its features is a muting switch which cuts out the "bleep" and stores the signal in a memory circuit. The user can access the memory to see if he has been paged when it is convenient for him to do so.

The use of the mobile radiotelephone continues its upward growth almost unnoticed. In 1971 there were 90,000 licences issued. Today there are some 200,000 mobiles operating in the UK including a staggering figure of 50,000 within a 50-mile radius of Central London.

REMSCON

A little-publicised sector of industry emerged into prominence in November with an international gathering of industrial telemetry experts for a three-day conference in London. The event was REMSCON with a strong panel of speakers led by conference chairman Professor H. C. A. Hankins of the University of Manchester Institute of Science and Technology.

The big users of remote control and supervisory equipment are water, gas and electricity authorities and petrochemical companies, with many of the larger systems now being controlled by computer. I hope to comment more fully on this event in a future issue.

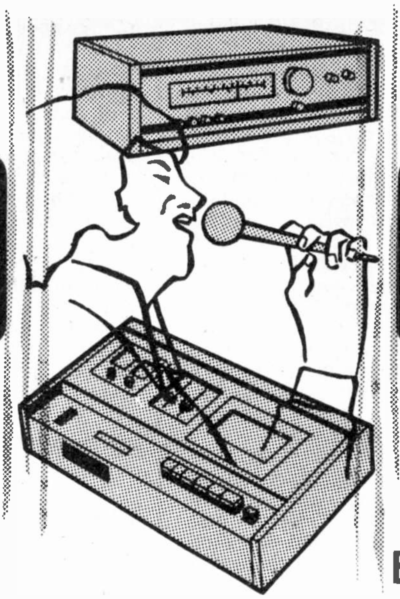
DEFENCE SCENE

Minister of Defence, Mr Roy Mason, is hinting hard at new methods of military procurement. His defence budget is under attack from the left wing of his party and he is now telling industry that he must buy in the cheapest market, even if this means shopping overseas. At the same time, his political colleagues are urging the nation to buy British. The Minister's posture on this occasion was clearly defensive following the cancellation of two British missile projects in favour of U.S. missiles.

Apart from any change in outright purchasing policy there also seems to be a move away from Ministry-sponsored R and D. There is a new tendency to look at PV (private venture) projects for military use and so the old-style development contracts which have kept many a laboratory in funds may soon be a thing of the past. If this is the case and risk capital goes on speculative development, it is bound to be reflected in the final product price and this, in turn, could affect defence exports.

Of course, Ministers don't always say what they mean, or mean what they say, but it is clear that the defence scene will become more intensely competitive.

AUDIO COMPRESSOR



By S. WHITT

An easy-to-build device for the home recording enthusiast

THIS simple audio compressor can be built simply and cheaply, and probably with components from one's spares box. It will compensate for fading signals in a radio, prevent overmodulation of a transmitter and will adjust to whispers or shouts into a microphone.

Its basic function is to maintain a relatively constant amplitude output over a varying range of input amplitudes. Although it will cope with several hundred millivolts input, smaller inputs cause less harmonic distortion (low enough for most applications).

CIRCUIT OPERATION

The circuit diagram of the compressor is shown in Fig. 1. The signal is first amplified by TR1 in the common emitter mode and then passed on to the next stage via C4. Large input signals cause a larger voltage to be induced in the secondary of T1. This voltage is rectified by D1 and reapplied as a negative-going d.c. voltage to the base of TR1, thus lowering the bias voltage and consequently lowering the gain.

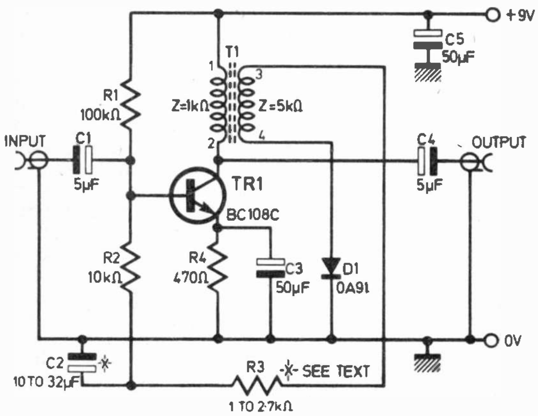


Fig. 1. Circuit diagram of the audio compressor

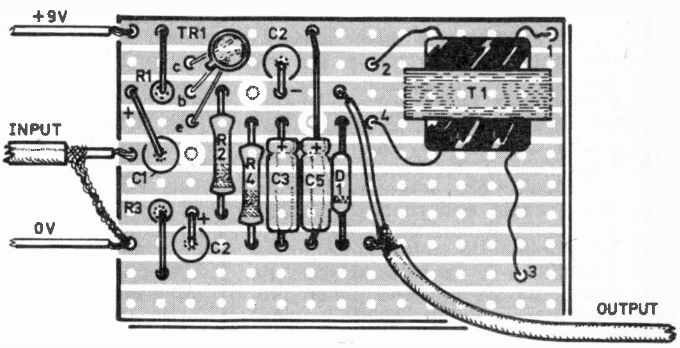


Fig. 2. Component layout and Veroboard cutting details

TIME CONSTANT

When a small signal is applied though, the gain of this stage rises after about 50ms (the time constant of C2R3). This time constant should maintain the gain between syllables of speech. It can, however, be easily altered to suit the application by varying either C2 or R3.

TRANSFORMER

There is much room for experimentation, especially with T1, which must be a step-up transformer and should have impedances approximately as shown. However, an unlabelled driver transformer from an old radio was found to work just as well.

CONSTRUCTION AND USE

The circuit was built on a small piece of Veroboard as shown in Fig. 2 and the layout is not at all critical.

The author found that when positioned directly after the volume control and before his headphones, the compressor all but eliminated fading in his receiver. It was also found to function well between a microphone and a tape recorder, compensating for varying voice levels and varying distances from the microphone.

ALTERATIONS

If too large an input signal is applied, the negative a.g.c. voltage can be high enough to cause TR1 to clip the signal. If R2 is increased to 120kΩ, apart from increasing the overall gain, it will allow higher input levels to be accommodated before clipping.

For small signals (such as microphone inputs) the original circuit could be used unaltered. A preset potentiometer (about 100kΩ) in series with R2 would make the compressor more versatile, however. ★

COMPONENTS . . .

Resistors
R1 100kΩ
R2 10kΩ
R3 1kΩ–2·7kΩ (see text)
R4 470Ω
All resistors 10% ¼W

Capacitors
C1 5μF elect.
C2 10μF–32μF elect. (see text)
C3 50μF elect.
C4 5μF elect.
C5 50μF elect.
All capacitors 12V

Diode
D1 OA91

Transformer
T1 See text

Transistors
TR1 BC108, BC107 or other *npn* silicon (e.g. 2N2926, 2N2925, etc.)

Miscellaneous
Veroboard (see Fig. 2). Phono socket, case

RANDOM TONE GENERATOR

By W. G. ROSS

THE Random Tone Generator was primarily designed as an electronic door bell which would produce an endless variety of "tunes" at the press of the door switch. Thus the boredom of continual repetition of a single tune along with the difficulty in selection of a suitable tune are removed. However, it is thought that the random tone generator may provide an aid to musical composition as well as providing amusement.

In operation it produces a train of notes which is seldom duplicated and musical interest is maintained by not only changes in pitch but in note duration.

U.J.T. CLOCKS

The circuit (Fig. 1) uses two unijunction transistors, TR1 and TR2, as relaxation oscillators producing frequencies of approximately 50kHz and 2Hz respectively. The 50kHz pulses at the base 1 of TR1 are used to clock a decade counter type SN7490. The four output lines (A, B, C and D) are fed to a quad latch where the binary information is periodically sampled and stored. The sampling rate is determined by the oscillation frequency of TR2 and may be varied by means of VR1.

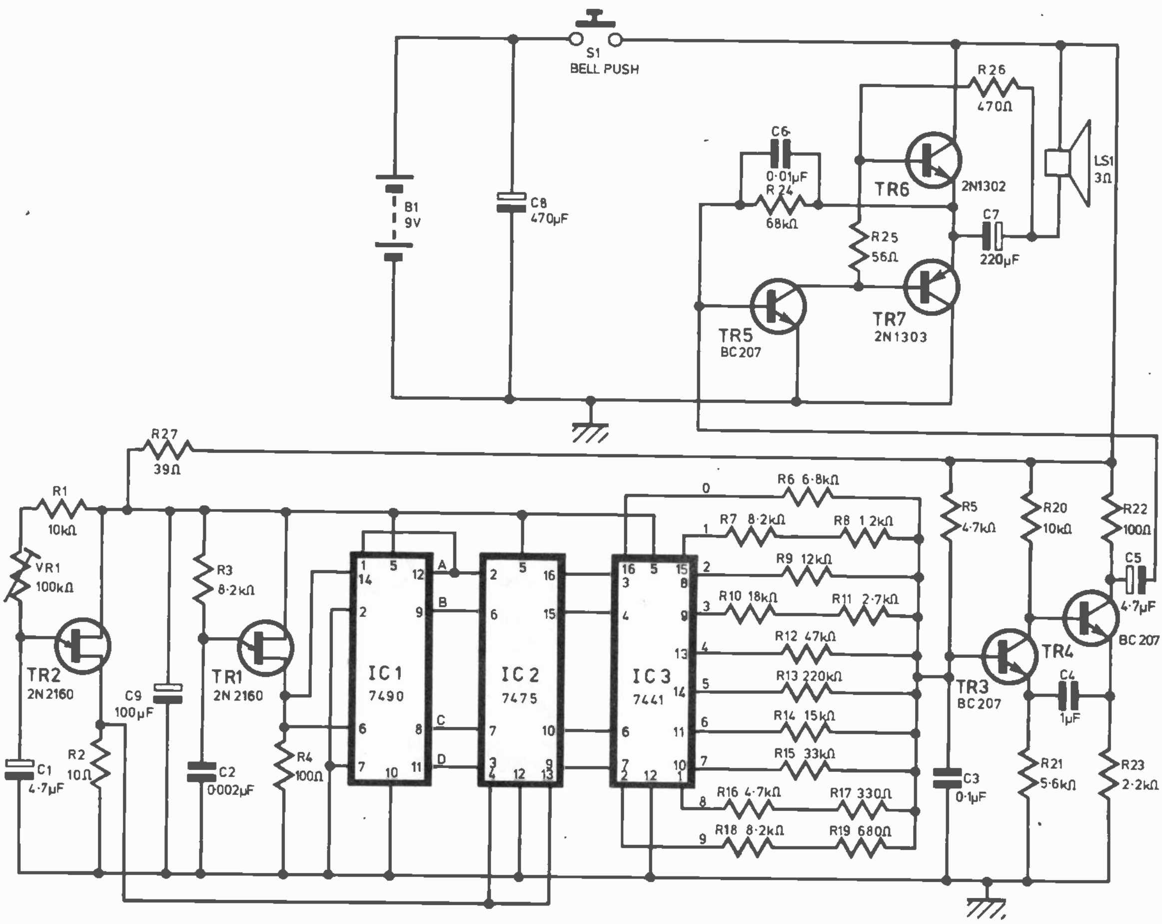
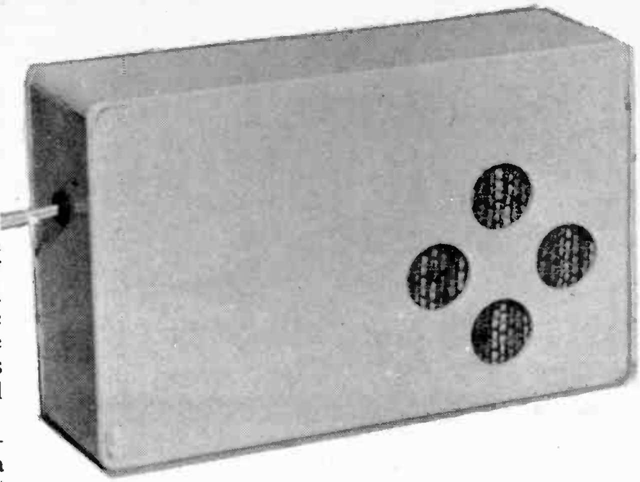


Fig. 1. Circuit diagram of Random Tone Generator

Decoding of the stored binary information is performed by a Nixie tube decoder/driver type SN7441 which provides 10 open-collector outputs. The output transistors of the decoder conduct randomly because of the wide frequency difference between the two unijunction oscillators and the temperature dependence of their frequency determining components.

An emitter coupled multivibrator provides a harmonically rich tone from TR4 collector, the frequency of which can be altered by variation of TR3 base voltage. This is achieved by using a potential divider comprising R5 and R6 to R19, the latter being selected randomly by the decoder. The values of R6 to R19 are chosen such that the notes generated correspond approximately to the musical scale over one octave.

Audio amplification is provided by a simple class-B push-pull amplifier, TR5, TR6, TR7, driving a 3 ohm speaker. The unit is powered by a 9 volt battery, the 5 volt supply for the integrated circuits being obtained via resistor R27.



Generator housing

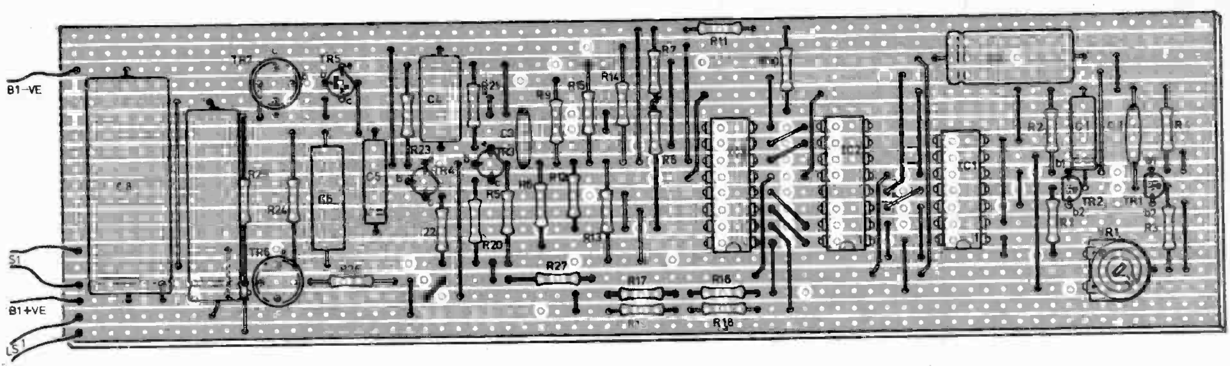


Fig. 2. Component layout and wiring details

COMPONENTS . . .

Resistors

R1 10kΩ
R2 10Ω
R3 8·2kΩ
R4 100Ω
R5 4·7kΩ
R6 6·8kΩ
R7 8·2kΩ
R8 1·2kΩ
R9 12kΩ
R10 18kΩ
R11 2·7kΩ
R12 47kΩ
R13 220kΩ
R14 15kΩ
R15 33kΩ
R16 4·7kΩ
R17 330Ω
R18 8·2kΩ
R19 680Ω
R20 10kΩ
R21 5·6kΩ
R22 100Ω
R23 2·2kΩ
R24 68kΩ
R25 56Ω
R26 470Ω

All $\frac{1}{2}$W, 10% carbon

Capacitors

C1 4·7μF elect. 63V
C2 0·002μF
C3 0·1μF
C4 1μF polyester
C5 4·7μF elect. 63V
C6 0·01μF
C7 220μF elect. 25V
C8 470μF elect. 25V
C9 100μF elect. 25V

Potentiometer

VR1 100kΩ skeleton preset

Transistors

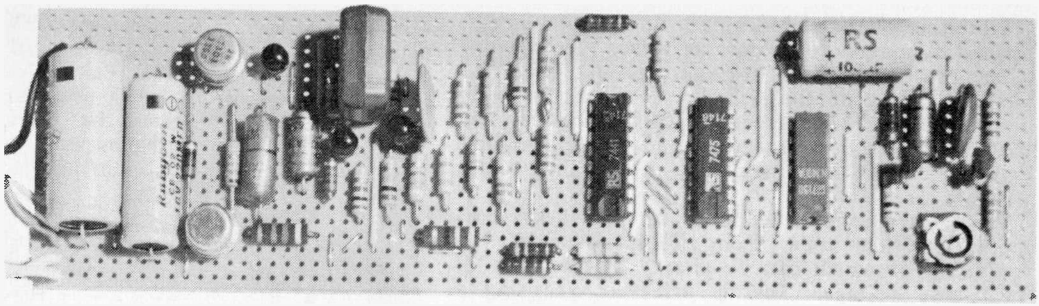
TR1–TR2 2N2160 (2 off)
TR3–TR5 BC207 (3 off)
TR6 2N1302
TR7 2N1303

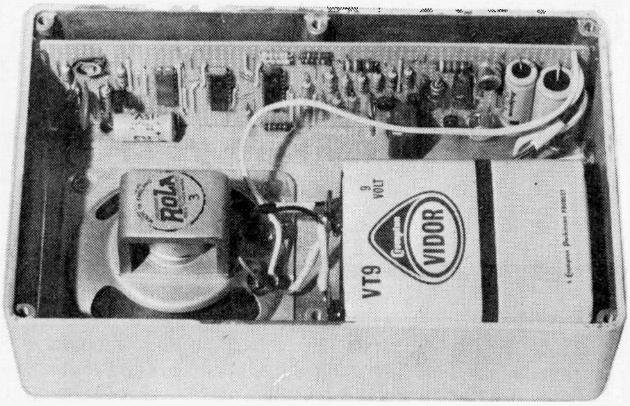
Integrated Circuits

IC1 SN7490
IC2 SN7475
IC3 SN7441

Miscellaneous

S1—Push switch, LS1–3Ω 3in speaker, Veroboard $7\frac{3}{8}$in (188mm) × $4\frac{11}{16}$ (119mm) × $2\frac{1}{8}$in (54 mm).





Interior layout for Generator

CONSTRUCTION

All the components, with the exception of the battery and speaker, are soldered on to a single piece of 0·1in Veroboard. The prototype was built in a die-cast box which also contains the loudspeaker and battery. The Veroboard was cut to slot lengthwise into the box, as can be seen from the photograph. Soldering should be thoroughly inspected before power is applied as short circuits on adjacent copper tracks can cause some curious effects such as tone "hang-up" or no sound at all.

TESTING

With assembly and inspection completed VR1 wiper should be adjusted to mid-range and power applied to the circuit. The Random Tone Generator should immediately start "composing" an endless train of note patterns. According to taste the rate can be varied by VR1. The frequency range of the output can be changed by altering the value of C4. ★

NEWS BRIEFS

Post Office Unveils Viewdata

A RADICALLY new telephone service, in which a wide range of information can be called up over the telephone and displayed quickly on an ordinary television set, is being planned by the Post Office.

Known as Viewdata, the service would be completely automatic, providing information at the touch of a button. Trials for the new system are due to start in January and a full public service could start in 1978-79.

With Viewdata, information on a wide range of subjects such as news, entertainment, holidays, job advertisements and commercial intelligence would be stored in a computer databank connected to the public telephone network. By having their telephone linked to their t.v. sets users would have access to the wide range of information services which Viewdata can provide. The user would control the entire service with a simple hand-held control unit.

To receive Viewdata information, users would first switch on the t.v. set and then call up the service over the 'phone by pressing a button on the control unit. They would not even have to lift the telephone receiver. Then, at another touch of the button, the Viewdata opening display (an index listing the subjects on which information is available) would appear on the t.v. screen. Following simple instructions displayed on the screen, users would select the information they wanted by pressing further buttons.

As an alternative to the telephone link to a domestic television, business users could have a purpose-made Viewdata terminal, with built-in controls and telephone.

MAIL BAG

The on-going increase in postal and telephone charges does not seem to have made any difference to our post bag or our telephone bell. Enquiries continue to flood in.

We find that there are two points we are constantly mentioning. In the first place we just cannot afford to reply to any *readers' letters*, particularly those not associated with projects we have pubished, unless they are accompanied by a *stamped addressed envelope*. Were we to undertake to do so our post bill would become astronomic.

We cannot deal with *technical enquiries by telephone*. Readers should write in, giving details of symptoms and perhaps some test point readings, when requesting technical help so that we can at least give the relevant author some idea of the problems involved.

Finally, whilst we normally supply details as to source of components in each project we do assume that the constructor refers to advertisements and has an awareness of general sources. Thus, where goods are generally available we do not specify a source. You could save the cost of a letter by reading the advertisement pages first.

AUDIO FAIR 75

By R. LAWRENCE

THE Audio Fair this year was rather smaller than in previous years, with a lot of companies not exhibiting. The largest stands at the Fair were taken for the most part by Japanese or foreign based firms and there was a distinctive lack of British representation.

It is difficult to guess the reasons behind this, but some say that the basic character of the Fair has altered and perhaps moved from the connoisseur to the consumer market, where electronic gadgetry is playing a greater and greater part.

Prices of equipments continue to boggle the mind and soar ever higher and higher. Sony have actually introduced a "Higher-Fi" range of equipment and both the equipment and the corresponding prices have to be heard to be believed (just one speaker in the top range costs £700).

VFETs

One or two new terms are likely to be added to the hi-fi buff's repertoire after visiting the show. VFET is one of these terms and this at present is found in the specifications of a couple of popular Japanese manufacturers. It stands for Vertical Field Effect Transistor. The f.e.t.s are being used in the output stages of the amplifiers where they are replacing transistors with their attendant crossover and biasing problems. Yamaha and Sony are the two major pioneers in this field.

It will be interesting to see how Quad's recently released "current-dumping" amplifier compares with them. (They have got around output stage problems by using novel circuit techniques.) Quad incidentally, were one of the British manufacturers not present at the show.

LINEAR PHASE

Another relatively new term heard at the Fair is "linear phase". This is not a new guitar effect but describes the operation of a new development in loudspeakers. Bang and Olufsen have hit upon a method of overcoming phase distortion—a rather nebulous quantity, the existence of which is apparently debatable. One of the effects of having no phase distortion is to enable speakers to reproduce square waves with minimum waveform distortion.

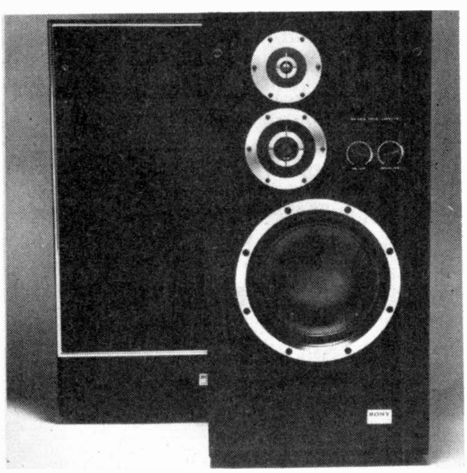
The system uses an extra drive unit known as a "Filler Driver" which operates in the crossover region of the base and mid-range units. The result is certainly a clean sounding speaker, whether or not it is attributable to the lack of phase distortion.

TURNTABLES

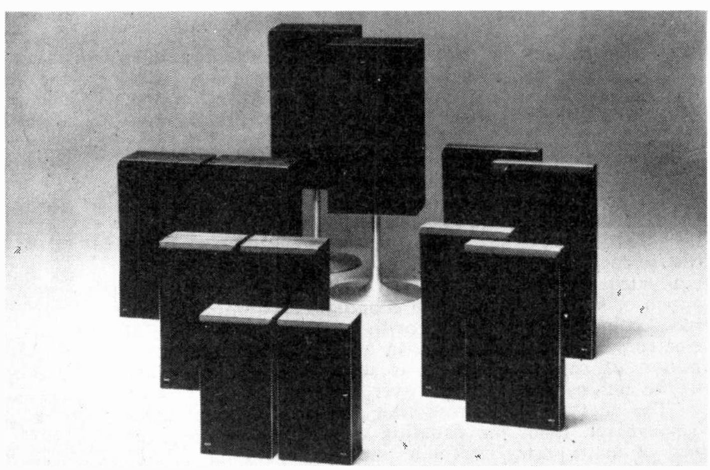
The vogue in turntables has moved from idler drive to belt drive in its time. The latest trend is to electronic speed control with direct drive to the turntable. A relatively new firm, Strathearn Audio Limited, have produced several models with these features. Their SMA2 turntable also has touch start, stop, and speed controls and is attractively styled in a sleek case with a tinted dust cover.

Strathearn is also shortly to introduce a new speaker which uses ribbon techniques. The sound quality is equivalent to if not better

The Sony "High-Fi" speakers



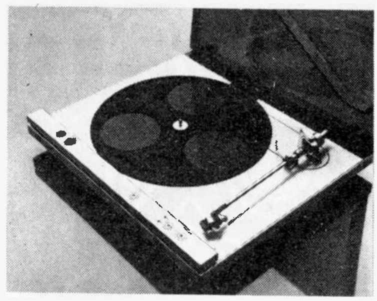
New "Linear Phase" range from B & O



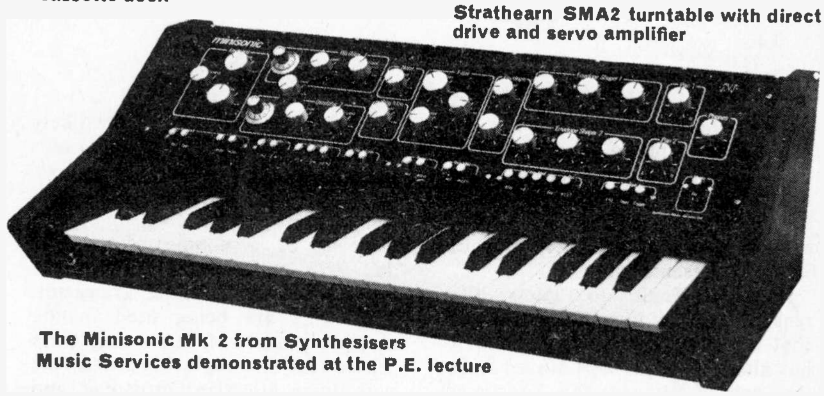
than that obtained with electrostatics and the speaker should have a very promising future.

Connoisseur, makers of the simple but very effective BD1 and BD2 turntables, have brought out a BD3 type which uses a servo-system for speed control. An external power source is also used to keep the possibilities of hum pick-up down.

Yamaha B1 amplifier with VFET output stage featured with their CT800 GL cassette deck



Strathearn SMA2 turntable with direct drive and servo amplifier



The Minisonic Mk 2 from Synthesisers Music Services demonstrated at the P.E. lecture

SOUND THEATRE

One of the major centres of interest at the Fair was the Sound Theatre. A fully functioning modern recording studio was constructed using high quality equipment from a large number of top manufacturers. The BBC, LBC and Capital Radio broadcast from the theatre, and various impressive quad and stereo demonstrations also took place. Procuring and setting up the studio equipment was very competently co-ordinated by Ian Grant.

One of the lectures given in the Theatre was by Doug Shaw on synthesiser techniques. He demonstrated the Minisonic Mk 2, and the highlight of the lecture was a live performance with several musicians and minisonics, and despite a last minute time change his lecture was very well attended.

CHANGE OF CHARACTER

It is interesting to note that where in the past there have been a multiplicity of technical lectures and demonstrations, this year's Fair saw very few. This tends to go along with the observation that the Audio Fair is changing its character and pandering less and less to the connoisseur. Rather a pity, most will agree.

NEWS BRIEFS

IERE GOLDEN JUBILEE

THE Institution of Electronic and Radio Engineers celebrated its 50th anniversary during 1975. Last October, at the Annual General Meeting held in London, the Duke of Kent was installed as 25th President of the Institution.

In his inaugural address, the new President reviewed some of the developments in electronics.

"I don't think any of you need reminding of the great changes that have swept over the world during this last half century; changes which are without question the widest and deepest that have taken place in any equivalent period of history. That this extraordinary epoch of social, political and economic revolution should have coincided with the growth of the new science of electronics is not I am sure an accident—although attribution of cause and effect is something for historians of the 20th century to argue over, not me.

"The fact is that throughout this period, electronics has evolved from the fledgling of 'wireless' to a great and in many cases dominant industry spanning a huge field from communications to data management, transport to process control and medicine to entertainment. It was the belief in the great future that lay ahead that stirred our founding fathers—not that even they could have foreseen what was to come—to establish our Institution, despite some cynicism from the older institutions of that day."

The President then went on to predict probable advances of the next 50 years in communications, domestic equipment, manufacture, aircraft safety and medicine. The last example holding promise of some very striking and praiseworthy achievements in alleviating the handicap of a few—"but if access and connection to the brain becomes a matter of standard practice, what dramatic developments might not ensue?" The possibility of contact with the brain via electromagnetic waves leads to the possibility of thought control, and this brings one on to some very tricky ground. The idea may be appalling—but it is essential that we recognize such possibilities even if for one reason or another they have eventually to be rejected.

POINTS ARISING

LIGHT MODULATION UNIT *(October 1975)*

The 40430 outline connections in Fig. 1 are incorrect. The MT1 and Gate terminals should be transposed.

In the circuit diagram MT1 and MT2 connections should also be transposed, i.e. MT2 terminals for CSR3 and 4 should be connected to L1 and L2 respectively.

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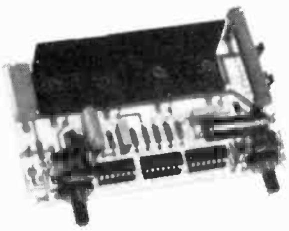

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- Full logic integrated circuitry with optical isolation for amplifier protection
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- 13 easy connections

Patents applied for **£22·00**

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- Full wave control
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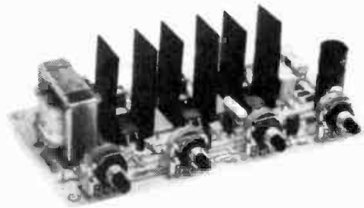

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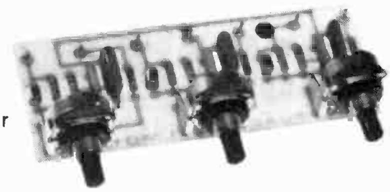

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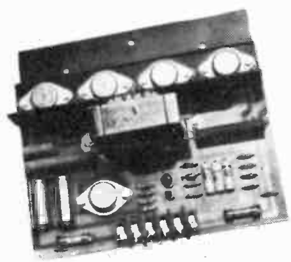

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TP125
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- Short—Open—and Thermal overload protection
- Only 6 connections

Specifications on all power modules: All output power ratings ±0·5dB; Output Impedance 8–15 ohms; THD at full power 2% typically 1%; Input sensitivity 60mV into 10kΩ; Frequency response 20Hz–20kHz ±2dB; Hum and noise better than −70dB.

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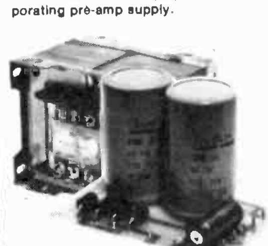
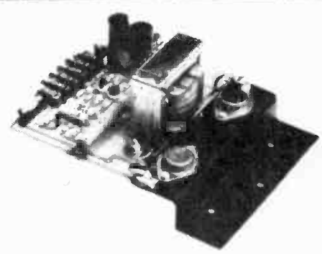
Designed for the discerning D.J. of professional standard. Offering a vast variety of functions. Controls: Mic Vol; Tone, over-ride depth; auto/Manual Sw; Tape Vol; L & R Deck Faders; Deck Volume; Treble and Bass; H. Phon Vol Selector; Master Vol On/Off Sw. Max output 1 V RMS.
Specification: Deck Inputs—50mV into 1MΩ; Deck Tone Controls—treble +20 −10dB at 12kHz, Bass +22 −15dB at 40Hz; Mic input—200 ohms upwards, 2mV into 10kΩ; Mic Tone Control—Total Variation Treble 15dB, Total Variation Bass 10dB; Tape input—30mV into 47kΩ; Power Requirements—30–50 volts at 50mA.

PANEL SIZE 18 × 4½in DEPTH 3in **£31·50**

Power supplies vacuum impregnated. Transformers with supply board incorporating pre-amp supply.



PS 125 ± 45 volts for TP125	£12·25
PS 100 ± 43 volts for TL100	£11·25
PS 60 ± 38 volts for TL60	£10·00
PS 30 ± 25 volts for TL30	£5·90
PSU 2 for supplying disco mixer	£4·75



TL60
5 × 5 × 3in

- 60 watts RMS continuous sine wave output
- 2 RCA 110 watt 15 amp transistors

£12·50

TL100
5 × 5 × 3in

- 100 watts RMS continuous sine wave output
- 2 RCA 150 watt 15 amp transistors

£15·00

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PATENTS REVIEW...

TAPE NOISE REDUCTION

In BP 1 382 096, Matsushita Electrical Industrial Co. Ltd. patents an automatic noise reduction system for use with tape recorders. Using compression and expansion techniques the block diagram of the system is shown in Fig. 1.

The compression characteristic (a) on record, the expansion characteristic (b) on playback and the resultant, theoretical, linear characteristic (c) which follows from the combination of (a) and (b) is shown in Fig. 2. Thus, the process is complimentary and therefore the output should be a replica of the input.

Noise is reduced because it is introduced between the two stages and is thus subjected only to the expansion curve. In other words, process noise is reduced relative to programme content.

Because the expansion-compression effect is active only below a threshold point (where the curves in Fig. 2 (a) and (b) become linear), noise is reduced only when the signal level is low. This avoids overloading the tape with excessive signal and is acceptable because the subjective level of noise present in a high level signal is less noticeable because it is masked by the signal.

In practice, the compression and expansion operation is effected only in the presence of high frequency signal components. The circuit shown in the patent is designed to provide processing of only the high frequency signal components, because the majority of tape noise is in the upper frequency range, i.e. tape hiss.

The system outlined in the patent more closely resembles that marketed by JVC than Dolby.

ELECTROSTATIC LOUDSPEAKER

BP 1 387 453

In BP 1 387 453, Matsushita Electric Industrial Co. Ltd. describes an electrostatic loudspeaker which requires no d.c. polarising voltage.

A vibratile film electret, made of a polymer such as plastics resin and with a permanent surface charge, is coated on one side by a very thin layer of a conductive paint or metal. Fixed perforated electrodes permit acoustic radiation and are spaced one each side of the coated electret.

An a.c. audio frequency signal is applied between the fixed electrodes via a matching transformer, balance capacitors and a resistor which controls higher harmonic distortion. Alternatively, a push-pull transformer may be employed as the audio power source.

The conductive layer acts as an electrostatic earth, so the electric field due to the permanent charge on the film electret exists in one air gap between the electret and the fixed plates, but not in the other air gap. Thus no static electricity due to the charge is generated between the film and the non-charged electrode and the only force between the film and this electrode is generated by the audio signal.

However, the force between the film and the charged electrode is generated by the superposition of the electrostatic voltage due to the electret charge on to the audio signal. The resultant imbalance causes vibration of the electret and transduction of the audio signal into sound waves propagated through the perforations in the electrodes.

BP 1 382 096

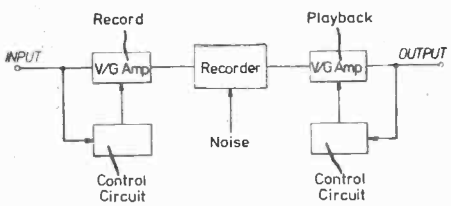

Fig. 1

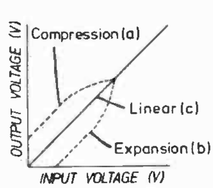

Fig. 2

PATENT NEWS

Of necessity, patents for inventions reported in this column are relatively simple. It is physically impossible to précis an invention covered by a hundred-page patent in a few lines of print. For this reason, the most complicated inventions and the most lengthy patents must usually pass unrecorded.

This is a pity, because a lengthy patent can be a valuable source of information. It can also be a very cheap one, because all British Patents cost only 33p each, regardless of length. They may also be studied free of charge by any member of the public at various libraries around the country, such as the Science Reference Library attached to the Patent Office at Southampton Buildings, Chancery Lane, London WC2.

With this in mind, we shall in future be referring simply by name, number and the briefest of explanatory comment to any lengthy new electronics patents that may be of value to readers with a specialist interest.

BP 1 402 320—Sansui Electric Co. Ltd. *Decoder for use in 4 : 2 : 4 matrix playback system*. One of many patents now appearing for the various four channel and quadraphonic systems, this one covers the Sansui Variomatrix principle. Separation between channels is enhanced by sensing the amplitude of signals in the various channels and varying the matrix parameters to accentuate them.

BP 1 404 460—Standard Telephones & Cables Ltd. *Device for transmitting cursive script or drawing over a telephone*. A matrix of metal conductive strips is mounted under a domestic telephone, to translate a sketched diagram into different resistance values which are transmitted via the telephone.

BP 1 402 571—Mitches and Jeffrey. *Method for identifying the components of a file*. A system for reading the contents of any data file, which may for instance be a punched card, to aid automatic data retrieval. (See also BP 1 402 572.)

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

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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.

Good-Bye ?

Sir,—This is a farewell letter. For nine years, to the exact month, I have enjoyed every issue of PRACTICAL ELECTRONICS. Its specially written articles have added to my knowledge of electronics. Its construction projects have brightened my spare moments, and even helped in my work. Indeed, my subscriptions to P.E. have been one of the wisest investments I ever made.

But now, your publishers inform me that they are discontinuing the subscription service. This means that those of us outside the U.K. who had relied on subscriptions for obtaining regular supplies of P.E. can no longer do so. I know there must have been genuine economic reasons for taking such decisions, but this seems to ignore the confidence we have had in you for a long time. It is, after all, very true, isn't it, that economic considerations are hardly the best recipe for maintaining a friendship. But then, even the publishers of P.E. are in business too!

So, it is good-bye to P.E. God bless.

A. J. Isong,
Nigeria.

We trust this is not "farewell" as you suggest, but only *au revoir*. Our agent in Nigeria should be able to supply you with PE regularly.

Other subscribers, home or overseas, please see notice on page 32.

A Bit Flat

Sir,—I was interested to read your article in the November P.E. on an "Electronic Tuning Fork". I should like to point out that this device would not be suitable for tuning a piano.

I have already developed a tuner using a cathode ray tube for visual aid, I have experimented with the master oscillator 12-note frequency derivative integrated circuit, but so far, I have not used it, as I am in favour of using a tapped oscillator coil for greater accuracy.

When tuning a piano, the treble end of the scale is slightly sharp, and the bass end slightly flat. "Zero" deviation occurs at the centre of the keyboard.

Pianos are tuned only by aural means, and when tuned, become mathematically incorrect.

Therefore, by introducing a plus and minus frequency deviation switch, a much more realistic tuned piano is possible. On this theory, I claim that no frequency divider organs are in tune but nobody seems to mind, but I have tuned several pianos flat, but they are noticeable.

I don't suppose you were really trying to encourage your readers to put piano tuners out of business, so perhaps you may consider your circuit good enough.

D. Marquis,
Essex.

Your observations on piano tuning are very interesting, I have, in fact, heard that some professional tuners do tune sharp at the top of the scale and flat at the bottom end. Unfortunately, nobody has told me why they do this, if in fact they do.

When researching this project, I took as my main source of reference a book entitled "The Physics of Music" by Alexander Wood (Pub Methuen), which goes into considerable detail on the subject of piano tuning. This book definitely states that pianos are tuned in perfect accordance with the tempered scale. Illustrated in the book (Page 200) are graphs of the state of tune three days after tuning has taken place. The trend is for the low notes to drop considerably whilst the upper notes show considerable variations but all on the high side. This deterioration is similar to their figures. I have taken these figures to be percentages of a semitone interval, as percentages of the actual frequency are clearly a nonsense for the values you give.

If indeed, pianos are tuned in this fashion, one wonders if the same applies for other orchestral instruments when played in the extreme registers.

Finally, I'm sure piano tuners aren't going to become redundant, perhaps this instrument will save some piano's from the scrap heap. Should any piano tuner feel threatened, he should retaliate. I'm sure you'll agree, there are tremendous prospects in the electronic musical instrument field!—P.W.B.

Happy Chance

Sir,—By a happy chance I have come across your article "Electronic Tuning Fork" in P.E. for Nov.

It would be much more convenient if each octave began on C according to usual musical usage, i.e. the C2 C1 c c′ c″ etc., notation, and the 16′ 8′ 4′ etc. of organ nomenclature. Would it be possible to incorporate a circuit to double the frequency of the A♯ and B outputs from IC1? Or failing that, alternatively to halve the frequency of the other ten outputs?

For my purposes, I think the most convenient form of display would be a centre-zero meter calibrated to indicate the pitch difference in vibrations/second + or −. Is this at all feasible?

For many purposes the tuning errors of your instrument (maximum on C♯ of −0·29 in an interval of 15·6) are not really acceptable and one would certainly have to make a correction according to the beat indication.

M. B. Card, Herts.

Your requirement for a range spanning C to C1 is simply facilitated by increasing the master oscillator frequency to 999·68 kHz. The tuning core of the coil L1 will probably accommodate this, but should this be not so, decrease C5 and C4.

Your further requirements are not so easily satisfied; although it is possible to determine and indicate whether the pitch is greater or less than standard, the extra complexity would not be worthwhile as when using the "fork" it is at once obvious when the instrument is detuned, and opposite action is applied without thought.

A meter indication of your description would indeed be a great improvement, however, the problems involved are considerable. The advantages of the beat method are simplicity, but the drawback is a variation in accuracy over the range of the scale.

A meter performing the beat counting task would have to sample for at least the period between two beats which becomes infinite when the tuning is spot on.

Your final comment on the accuracy rests with the i.c. manufacturer. The worst case I concede is C# which is less than 2% of the semitone interval or 2 cents in musical parlance. Ideally, errors should be less than one cent and it is unfortunate that General Instruments did not choose to divide by larger integers, especially as master clock frequencies of up to 2·5MHz can be accommodated, so the top end of the scale need not be sacrificed.

In conclusion, it is well documented that a good piano will give errors greater than 10 per cent only three days after "perfect" tuning so I feel that only the most discerning ears will be grieved by our small inaccuracies.—P.W.B.

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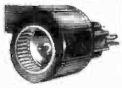

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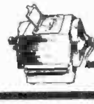

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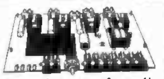

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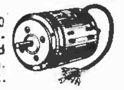

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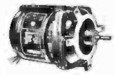

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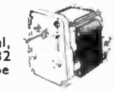

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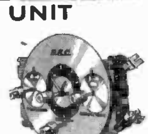

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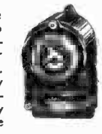

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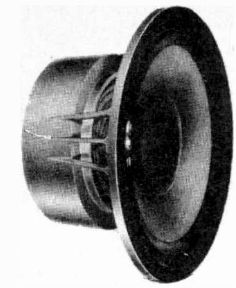

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WILMSLOW AUDIO (Dept. PE)

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Discount TV, Hi-Fi: Swift of Wilmslow, 5 Swan Street, Wilmslow.

The Ultimate Radio!

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VHF/FM, MW, LW 10 SW bands plus bandspread, 27 transistors and 22 diodes, Battery/Mains (110/240V) 2 speakers, 57in telescopic aerial.

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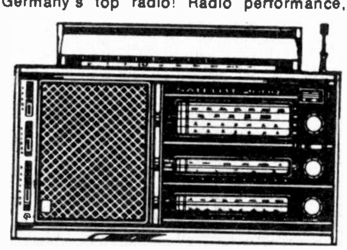
Big discounts on Grundig ITT, Koyo, etc. Send stamp for list.



WILMSLOW AUDIO

(Dept. PE)
10 SWAN STREET
WILMSLOW, CHESHIRE

THE RADIO SHOP

16 CHERRY LANE
BRISTOL BS1 3NG

TELEPHONE
0272-421196

TRIACS

1·6AMP PLASTIC*		6AMP ISOLATED TAB	
NAS 0161W 100W	0·28	NAS 0651W 100V	0·65
NAS 0161X 100V	0·28	NAS 0651X 100V	0·65
NAS 0162W 200V	0·30	NAS 0652W 200V	0·61
NAS 0162X 200V	0·29	NAS 0652X 200V	0·61
NAS 0164W 400V	0·40	NAS 0654W 400V	0·70
NAS 0164X 400V	0·38	NAS 0654X 400V	0·70
NAS 0166W 600V	0·50	NAS 0656W 600V	0·88
NAS 0166X 600V	0·48	NAS 0656X 600V	0·76
10AMP ISOLATED TAB		**3·5AMP CLIPPED TAB**	
NAS 1001W 100V	0·72	NAS 0351W 100V	0·52
NAS 1001X 100V	0·72	NAS 0351X 100V	0·52
NAS 1002W 200V	0·78	NAS 0352W 200V	0·56
NAS 1002X 200V	0·76	NAS 0352X 200V	0·56
NAS 1004W 100V	1·09	NAS 0354W 400V	0·68
NAS 1004X 400V	1·04	NAS 0354X 400V	0·67
NAS 1006W 600V	1·36	NAS 0356W 600V	0·65
NAS 1006X 600V	1·36	NAS 0356X 600V	0·84
8·5AMP ISOLATED TAB		**15AMP ISOLATED TAB**	
NAS 0851W 100V	0·68	NAS 1501W 100V	1·05
NAS 0851X 100V	0·68	NAS 1501X 100V	0·95
NAS 0852W 200V	0·76	NAS 1502W 200V	1·02
NAS 0852X 200V	0·76	NAS 1502X 200V	1·02
NAS 0854W 400V	0·88	NAS 1504W 400V	1·51
NAS 0854X 400V	0·85	NAS 1504X 400V	1·48
NAS 0856W 600V	1·10	NAS 1506W 600V	1·89
NAS 0856X 600V	1·06	NAS 1506X 600V	1·84

Devices with internal trigger have "W" suffix; "X" denotes standard triac.

THYRISTORS

1·6AMP TO5*		4AMP ISOLATED TAB	
NAS 006P 50PIV	0·25	NAS 106P 50PIV	0·26
NAS 006Q 100PIV	0·28	NAS 106Q 100PIV	0·30
NAS 006R 200PIV	0·31	NAS 106R 200PIV	0·36
NAS 006S 400PIV	0·40	NAS 106S 400PIV	0·57
NAS 006T 600PIV	0·52	NAS 106T 600PIV	0·90
6AMP ISOLATED TAB		**8AMP ISOLATED TAB**	
NAS 206P 50PIV	0·37	NAS 306P 50PIV	0·41
NAS 206Q 100PIV	0·42	NAS 306Q 100PIV	0·47
NAS 206R 200PIV	0·50	NAS 306R 200PIV	0·56
NAS 206S 400PIV	0·77	NAS 306S 400PIV	0·65

CLOCK CHIPS

CT 7001 28 pin	4·95	AY-5-1224 16 pin	3·75
28 pin skt	0·55	16 pin skt	0·16
Data	0·15	Data	0·15

707 LED 0·3" Common Anode Display	1·00
704 LED 0·3" Common Cathode Display	0·90
747 LED 0·6" Common Anode Display	1·65

Thyristors C106 Series 4Amp
50V 0·32 100V 0·37 200V 0·46 400V 0·56 600V 0·70

INTEGRATED CIRCUITS

TAA 550 TO18	0·54	*TBA 800	0·78	*709 14 pin	0·27
TAA 263 TO18	0·82	*TBA 810AS	1·08	*741 8 pin	0·36
555 8 pin	0·40	*ZN 414 TO18	0·75	*748 14 pin	0·50
556 8 pin	1·05			*723 14 pin	0·67

* Please add 25% VAT. Remainder 8%. Postage and packing 20p per order.
Phone in your Access and Barclaycard order.

NEW CHIPS AND PRICES

LITRONIX FULL SPEC LEDs

DL701, 704, 707	£1·48
DL721, 727, 728	£3·75
DL746, 747, 750	£2·45

LITRONIX CLASS 11 PRODUCTS

DL707E	£0·70
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6 digit UP/DOWN with BCD preset, compare and clear. BCD and 7 segment multiplexed outputs with latch, LZB, etc.
MK50395 (6 decade)
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MM5309	£5·69
MM5311	£5·69
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MM5316	£10·17
MM5318	£3·36
MM5371	£8·14
MM5378*	£6·73

*Also available in MHI kit form.

All other National clock chips available —S.A.E. for details.

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BARCLAY ELECTRONICS

MONEY SAVERS

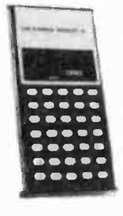
CBM SR7919D

- 8 digit or 5 digit +2 exponent
- Sine, Tan, Cos and their inverse
- Natural Logs, Common Logs, Anti Logs
- Square Root
- Reciprocals
- Y^x
- x^2
- π
- Register Exchange
- Memory plus
- Store Recall
- Sign Change
- Algebraic Logic

ONLY £12·50 +8% VAT

1 year Manufacturer's Guarantee CBM mains adaptor. Please add £2·50 to total

DECIMO 2001E



THE ONLY TRUE SCIENTIFIC CALCULATOR WE KNOW THAT ACTUALLY FITS IN YOUR POCKET (WITHOUT STRETCHING IT TO THE LIMIT) AND YET HAS A LARGE BRIGHT AND CLEAR 12 DIGIT L.E.D. DISPLAY AND SINGLE FUNCTION KEYBOARD

We can continue this special offer only till Dec. 31st

- Only 6·75 × 1·75 × 14cm
- 10 figure mantissa
- 2 figure exponents
- 2 sign display
- Common logs, natural logs and antilogs
- Memory
- Memory + −
- Sign change
- Reciprocals
- Square roots
- π
- Automatic constant
- Exponent key
- Y^x
- Clear last entry
- Register exchange
- Memory exchange (can be used as a parenthesis)
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- Own carry case
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- Full 1 year manufacturer's guarantee
- Cos, Sine, Tan and their inverse

FUNCTION FOR FUNCTION THIS IS UNBEATABLE

ONLY **£24·90** +8% VAT

If mains adaptor required, please add £3 to total

NOVOUS 4515 100 STEP PROGRAMMABLE

The new 4515 (by National Semiconductors) 100 step programmable is the answer to those ridiculous prices one had to pay for a machine that could do what this beautifully made machine can do, and it costs a fraction of what it should cost.

The programming is simple to operate, and many different programmes can be contained at the same time. Constant and variable factors can be inserted when or where you want. You can correct mistakes, and even skip out programmes out of a number of other programmes.

This is truly an unbeatable machine

- 8 digit
- Common and natural logs, and anti log
- Sine, Cos, Tan and their inverse
- Reciprocals
- Y^x
- x^2
- 3 level stack
- π
- Register exchange
- Sign change
- Memory
- Memory $+ x^2$
- Degree radian conversion
- Rechargeable (Recharger included in price)
- Vynyl case (full instruction manual)

OUR PRICE **£39·50** +8% VAT including recharger

If you need scientific notation, then the Novous 4525 is your answer.
8 digit +2 exponent 100 step programmable +4 roll stack and everything else the 4515 has.

ONLY **£59·90** +8% VAT

Full one year manufacturer's guarantee

SCIENTIFIC — ORDINARY — RANGE OF CALCULATORS

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CBM 4148 12 digit +2 exp.	39·95
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ROCKWELL 51R 8 digit conversion	27·50
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SINCLAIR OXFORD 300 5 digit +2 exp.	21·95
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REALTONE SC60 (10) 10 digit +2 exp. (similar functions to the HP45) 10 memory, scientific statistion	62·00

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NOVOUS 6010 8 digit conversion	21·50
NOVOUS 6020 8 digit financial	33·50
NOVOUS 6025 8 digit financial, 100 step programmable	59·90
NOVOUS 6030 8 digit statistical	38·00
NOVOUS 6035 8 digit statistical, 100 step programmable	59·90

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DECIMO VATMAN green	9·75
SUPER VATMAN green, M, %	14·95
ROCKWELL 8R	7·50
ROCKWELL 20R, M, %	12·50
ROCKWELL 21R, M, %	14·80
ROCKWELL 31R, √	16·95
ROCKWELL 51R, Metric	27·50
NOVOUS 850	6·50
NOVOUS 826	7·90
NOVOUS QUIZ KID	8·95
TEXSAS +1200	7·50
TEXSAS +1250	9·95
TEXSAS SR10	19·95
CBM 774D	5·80
CBM 766D	6·40
CBM 976D	8·75
CBM 887D, M, %	9·50
CBM 976R, M, %	10·95
CBM 989R	12·90
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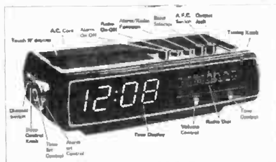
SINCLAIR CAMBRIDGE Memory	11·95
SINCLAIR OXFORD 100	8·95
SINCLAIR OXFORD 200	13·95

THE NEW DECIMO DIGITAL CLOCK RADIO AS ON TV



Recommended price £50
Our price **£35·90** inc. VAT
plus £1 packing

What is unique about this beautiful Clock Radio? Besides being a first class AM and FM radio, is its unique 1½in computer type display. You don't have to fret about the irritating blip or pulsating glare of other types of clock radios—this has a soft, restful and silent orange glow, with a dimmer to adjust its brightness to suit your taste.

Just look at these superb features!

- Unique light emitting 1½in computer-type orange numerals are large, clear and easy to read from across the room and can be seen from any angle.
- Time setting can be done clockwise or anti-clockwise. Wake-to-music or Wake-to-alarm system.
- Touch N' drowse—to give you extra minutes to sleep without re-setting the buzzer alarm.
- Sleep switch shuts off radio automatically. Adjustable up to 80 minutes: Lets you go to sleep to music.
- Electronic 12-hour alarm that can be set at 10 minute intervals.
- Dimmer switch for time display brightness control.
- Radio features highest quality components. Solid state circuitry and advanced engineering for crisp, clean sound in full tonal range. Convenient top-mounted push-button controls.
- Side mounted tuning control knob. Front mounted tone and volume slide controls
- Precision vernier tuning slide rule dial with black-out green-lighted log scale, also lighted pointer for easy and accurate tuning. Continuous slide type tone control for adjusting tone and bass response.
- Switchable automatic frequency control (A.F.C.) On FM. Switch in for drift-free listening. Switch-out for precision tuning. Automatic gain control (A.G.C.) on MW stabilises signal.
- Three-inch top-mounted speaker to float sound around the room.
- Dual built-in FM antennas. One on line cord, and an indoor line-wire tube for hard-to-get FM stations. Built-in ferrite rod antenna for MW
- Output Jack to accommodate optional earphone: Pillow or auxiliary speaker.
- Charcoal Grey high impact resistent-styrene cabinet, with Teak finish and silver front.
- Dimensions 4in H, 12½in W, 6½in D. Power Source AC 240 Volts, 50 Hz

Although correct at time of going to press prices may be subject to alteration without notice. Please add 8% VAT to total plus 55p postage.

PHONE CALLS AND PERSONAL CALLERS WELCOME
MONDAY–THURSDAY BETWEEN 2 and 5 p.m.

FRONTIER

POSSIBLY THE MOST ACCURATE FULL 6 FUNCTION L.E.D. QUARTZ CRYSTAL WRISTWATCH ON THE MARKET TODAY

This offer can continue only to the 31st Dec.

- **FULL 6 FUNCTIONS** (do not confuse with cheaper 2, 3 or 4 function watches) ● Single button operation
- Displays hours, minutes, seconds, month, date of month
- **ULTRA ACCURATE** to less than 1 second a week
- Easily readable, bright L.E.D. display
- Automatic 3 second **HOLD** and **FADEOUT** display
- **AUTOMATIC COMPUTERIZATION** for 28, 30 and 31 day month. ● Top quality stainless steel. ● Manufacturer's full 1 year guarantee. ● Arrives in free presentation gift box. ● Includes **BEAUTIFUL MATCHING STAINLESS STEEL BRACELET**. ● Replace battery only once a year. ● Water and shock resistant. ● Anti-magnetic. ● Silent.

ONLY **£34·50** +8% VAT

To: **BARCLAY ELECTRONICS** Dept. 2PE
STANLEY HOUSE, 1115 FINCHLEY ROAD, LONDON N.W.11

Please send me ....

with/without optional mains adaptor. I enclose cheque/money order

total value £.............................. Including 55p to cover packing.

NAME ....

ADDRESS ....

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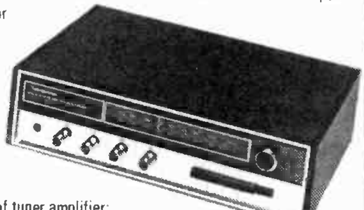
SCOOP! AUDIO MAGNETIC GOLD LABEL BLANK CASSETTES—Price per box of ten: C60 £3·00, C90 £4·20, C120 £5·40. Post 22p per order

ALL GOODS ARE FULLY GUARANTEED. IF NOT SATISFIED MONEY REFUNDED IF RETURNED UNDAMAGED WITHIN 7 DAYS

RTVC FOR SPEAKERS AT FANTASTIC REDUCTIONS

ELIZABETHAN STEREO TUNER AMPLIFIER

This compact Tuner Amplifier gives you full medium wave and V.H.F. coverage and FM stereo. With inputs for your turntable and tape recorder. It has rotary tuning, Volume, Balance, Bass and Treble controls and push button selection switches for Phono/tape FM Stereo, FM mono, Medium wave and A.F.C. has built-in stereo beacon and switched headphone socket.



Technical Specifications
15 transistors, 11 diodes, integrated circuit.
Power output 8 watts. Size of tuner amplifier: 4" x 10" x 15½" approx. Finished in selected rosewood veneer with brushed aluminium front panel and matching controls.

£29.00 +p & p £1.50

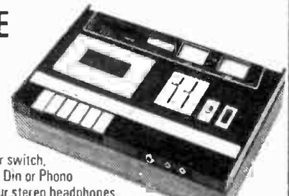
NEW! THE 'COMPACT'

EASY BUILD SPEAKER KIT

A compact bookshelf speaker system giving a high electro accoustic efficiency for the low powered amplifier.
The professional finish can be obtained with the minimum of tools, the infinite baffle type enclosures come ready mitred and professionally finished, simply apply glue, fold up around baffle board, and fix together with masking tape till glue dries.
The cabinet measures 12"x9"x5" deep approx finished in simulated teak, incorporating a quality 7"x4" elliptical speaker, power handling 4 watts, flux density 30,000 maxwells, impedance 8-15 ohms nominal, voice coil dia ¾" magnet size 2⅞" approx.

£6.00 pair inclusive. P & P £1.70

STEREO CASSETTE TAPE DECK

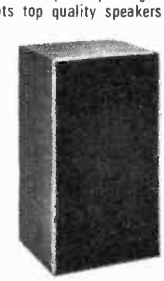


This compact stereo cassette deck is designed to link up with your stereo system. It incorporates features normally found in machines costing far more, these include large illuminated recording level meters, slider level controls, Chromium Dioxide (CrO_2) selector switch, pause control, and autostop, tape/digit counter, Din or Phono connections, two mic. inputs and outputs for your stereo headphones.
Technical Specifications – Input level Mic – 65dB into 10KΩ. Line in – 20dB into 1MΩ. DIN – 47dB into 100KΩ. Output levels Line out – 500Mv 10KΩ. DIN – 500Mv 10KΩ. Frequency response – Normal 50-10KHz. Chrome 50-14KHz. Signal noise ratio – better than 40dB.

£35.00 +p & p £1.50

EASY TO BUILD SPEAKER KITS

These superb simulated teak-finished speaker kits have been specially designed by RT-VC for the cost-conscious hi-fi enthusiast who wants top quality speakers but doesn't want to spend the earth. Built to EMI's exacting specification, these new RT-VC speaker kits (350 type kit) incorporate 13" x 8" woofer, 3¼" tweeter and matching crossover.
Easily put together with just a few basic tools.



Specification (each speaker): Impedance 8 ohms. Power handling 15 watts RMS (30 watts peak). Response 20–20,000 Hz. Size 20" x 11" x 9½" approx. Comparable built units (EMI LE3) sold elsewhere for over £45 pair.

£22.00 pair complete +£5.20 p & p.

Complete with crossover Components and circuit diagram

EMI 350 KIT

£7.25 +£1.20 p & p.
Complete with crossover Components and circuit diagram

System consists of a 13" x 8" approx. woofer with a 3" tweeter, crossover components and circuit diagram. Frequency response: 20 Hz to 20 KHz. Power handling 15 watts RMS into 8 ohms. (Peak 30 watts.)

RTVC*

VISCOUNT IV STEREO SYSTEM

System 1a. £69.00

The new 20+20 watt Stereo Amplifier incorporating the latest silicon transistor solid-state circuitry, the RT-VC VISCOUNT IV gives you a powerful 20 watts RMS per channel into 8 ohms. Superb teak-finished cabinet, with anodised fascia to harmonise with any decor. Polished trim and knobs.
The VISCOUNT IV has a comprehensive range of controls – volume, bass, treble, balance, mono/stereo, mode selector, and scratch filter.
Front panel socket for stereo headphones. And a host of sockets at the rear – for left and right speakers, tape recorder, auxiliary, tuner, disc and microphone.
SPECIFICATION: 20 watts RMS per channel 40 watts peak. Suitable 8-15 ohms speakers. Total distortion @ 10 watts better than 0.2%. Six switched inputs: 1. Magnetic P.U. – 3 millivolts @ 47 K ohms (R.I.A.A.); 2. Crystal/ceramic P.U. – 50 millivolts @ 50 K ohms (R.I.A.A.); 3, 4, 6. Tape Tuner/Aux. – 140 millivolts @ 50 K ohms (flat frequency response); 5. Microphone – 3 millivolts @ 50 K ohms (flat frequency response).
CONTROLS: Push button ON/OFF, stereo/mono, scratch filter, 6 position rotary selector. Individual rotary controls for treble, bass, balance and volume. Headphone socket, tape out socket. Aux. mains output. **Frequency response:** 25 Hz to 25 KHz @ full rated output. **Signal to noise ratio:** better than –50 dB on all inputs. **Tone control range:** Bass ±15 dB @ 50 Hz; Treble ±12 dB @ 10 KHz.
Power requirements: 200-250V A.C. mains @ 60 watts. Approx. size: 15¼" x 3" x 10".
MP60 type deck with magnetic cartridge, de luxe plinth and cover.
Two Duo Type IIa matched speakers – Enclosure size approx. 19½" x 10¾" x 7¾" in simulated teak. Drive unit 13" x 8" with 3" tweeter. 15 watts handling. 30 watts peak.
Complete System with these speakers £69.00 +£6.50 p & p.

System 2. £85.00

Viscount IV amplifier (As System 1a)
MP60 type deck (As System 1a)
Two Duo Type III matched speakers – Enclosure size approx. 27" x 13" x 11½". Finished in teak simulate. Drive units 13" x 8" bass driver, and two 3" (approx.) tweeters. 20 watts RMS. 8 ohms frequency range – 20 Hz to 18,000 Hz.
Complete System with these speakers £85.00 +£7.60 p & p.

PRICES: SYSTEM 1a

Viscount IV R103 amplifier	£27.50 + £1.90 p & p.
2 Duo Type IIa speakers	£30.00 + £6.50 p & p.
MP60 type deck with Mag. cartridge de luxe plinth and cover	£22.00 + £3.30 p & p.
Total if purchased separately:	**£79.50**

Available complete for only: £69.00 +£6.50 p & p.

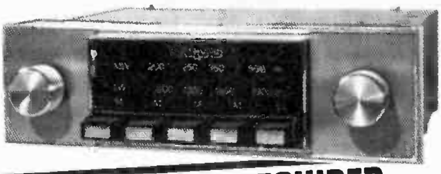
PRICES: SYSTEM 2

Viscount IV R103 amplifier	£27.50 + £1.90 p & p.
2 Duo Type III speakers	£46.00 + £7.50 p & p.
MP60 type deck with Mag. cartridge de luxe plinth and cover	£22.00 + £3.30 p & p.
Total if purchased separately:	**£95.50**

Available complete for only £85.00 +£7.60 p & p.

Scotland and the Orkneys P & P Surcharge
System 1a £1.75 System 2 £3.50

PUSH BUTTON CAR RADIO KIT– THE TOURIST TT*



NO SOLDERING REQUIRED

NOW BUILD YOUR OWN PUSH BUTTON CAR RADIO

Easy to assemble construction kit comprising fully completed and tested printed circuit board on which no soldering is required. All connections are simple push fit type making for easy assembly. Fine tuning push button mechanism is fully built and tested to mate with printed circuit board. **TECHNICAL SPECIFICATION:** (1) Output 4 watts RMS output. For 12 volt operation on negative or positive earth. (2) **Integrated circuit** output stage, pre-built three stage IF Module.

Controls volume manual tuning and five push buttons for station selection, illuminated tuning scale covering full, medium and long wave bands. Size chassis 7" wide 2" high and 4¾" deep approx. **£9.50** + £1.05 p & p. Speaker including baffle and fixing strip £2.00 + 45p p & p. Car Aerial Recommended – fully retractable £1.60 + 40p p & p.

The Tourist I Kit For the experienced constructor. If you can solder on a printed circuit board you can build this model. Same technical specification as Tourist TT. **Price £8.20** + £1.05 p & p.

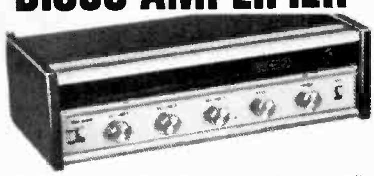
*STEREO 21 QUALITY SOUND FOR LESS THAN £24.00

Stereo 21, easy to assemble audio system kit. No soldering required.
The unit is finished in white P.V.C. and the acrylic top presents an unusually interesting variation on the modern deck plinth.
Includes – **BSR** 3 speed deck, automatic, manual facilities together with stereo cartridge.
Two speakers with cabinets.
Amplifier module. Ready built with control panel, speaker leads and full, easy to follow assembly instructions.
Specifications – For the technically minded:
Input sensitivity 600mV. Aux. input sensitivity 120mV. Power output 2.7 watts per channel. Output impedance 8–15 ohms. Stereo headphone socket with automatic speaker cutout. Provision for auxiliary inputs – radio, tape, etc., and outputs for taping discs.
Overall Dimensions. Speakers approx 15½"×8"×4". Complete deck and cover in closed position approx. 15½"×12"×6".

Complete only £23.20 + £3.00 p & p.

Extras if required. Optional Diamond Styli £1.60.
Specially selected pair of stereo headphones with individual level controls and padded earpieces to give optimum performance £5.80.

*DISCO AMPLIFIER



Reliant Mk IV Mono Amplifier, ideal for the small disco or house parties. Output 20 watts RMS into 8 ohms (suitable for 15 ohms).
Inputs *4 electrically mixed inputs. *3 individual mixing controls. *Separate bass and treble controls common to all 4 inputs. *Mixer employing F.E.T. (Field Effect Transistors). *Solid State circuitry. *Attractive styling.
INPUT SENSITIVITIES – Input – 1). Crystal mic. guitar or moving coil mic. 2 and 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.

8 TRACK HOME CARTRIDGE PLAYER

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.

Yours for only
£16.20 + £1.70 p & p.

BUILD YOUR OWN STEREO AMPLIFIER*

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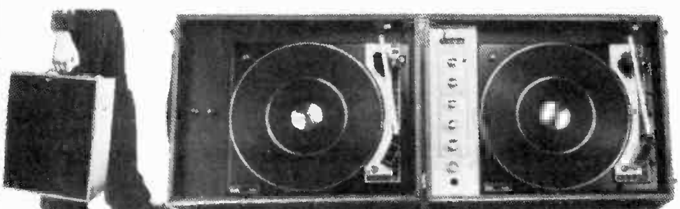

TECHNICAL SPECIFICATION:
Pre-amp – Output – 200mV. Auxiliary inputs – 200mV and 750mV into 1 meg. Mic input – 6mV into 100K. 240 volt operation. **Turntables capacity** – 7", 10" or 12" records. **Rumble, wow and flutter** Rumble Better than –35dB. Wow Better than 0.2%. Flutter Better than 0.06% (Gaumont kalee meter).
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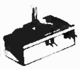

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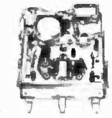

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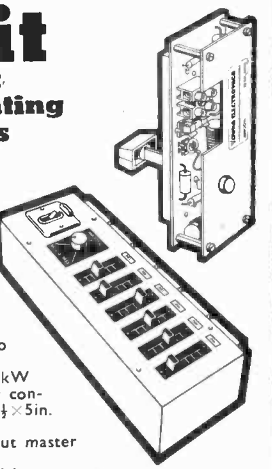

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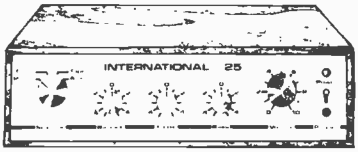

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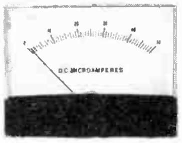

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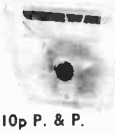

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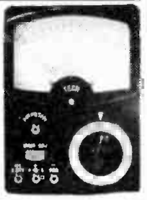

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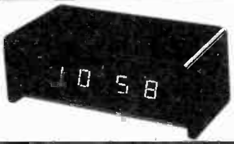

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152	250	10·32	1·41
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70	6	3	4·43	72
108	8	4	5·09	85
72	10	5	5·50	85
116	12	6	5·80	97
17	16	8	7·48	97
115	20	10	10·91	1·61
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103	1·0	3·55	72
104	2·0	4·95	85
105	3·0	6·10	97
106	4·0	7·98	1·12
107	6·0	12·71	1·25
118	8·0	13·63	1·61
119	10·0	17·75	BRS

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Prim. 200/240V. Sec. 0-24-30-40-48-60V

Ref. No.	Amps.	£	P & P p
124	0·5	2·48	72
126	1·0	3·68	72
127	2·0	5·33	85
125	3·0	7·90	97
123	4·0	9·19	1·41
40	5·0	10·24	1·25
120	6·0	12·07	1·41
121	8·0	15·75	BRS
122	10·0	19·40	BRS
189	12·0	20·25	BRS

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Ref. No.	VA (Watts)	Auto Taps	£	P & P p
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64	75	0-115-210-240	3·05	72
4	150	0-115-200-220-240	4·33	72
66	300	0-115-200-220-240	6·11	85
67	500	0-115-200-220-240	9·36	1·25
84	1000	0-115-200-220-240	14·36	1·61
93	1500	0-115-200-220-240	19·02	BRS
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238	200	3-0-3	1·62	39
212	1A, 1A	0-6, 0-6	1·93	46
13	100	9-0-9	1·56	25
235	330, 330	0-9, 0-9	1·64	25
207	500, 500	0-8-9, 0-8-9	2·02	51
208	1A, 1A	0-8-9, 0-8-9	3·07	58
236	200, 200	0-15, 0-15	1·56	25
214	300, 300	0-20, 0-20	2·83	58
221	700 (d.c.)	20-12-0-12-20	2·38	58
208	1A, 1A	0-15-20-0-15-20	3·63	72
203	500, 500	0-15-27-0-15-27	3·15	72
204	1A, 1A	0-15-27-0-15-27	4·14	72
S112	500	12-15-20-24-30	1·97	58

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2000	252	44·12	BRS

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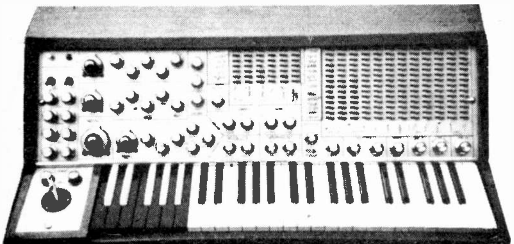

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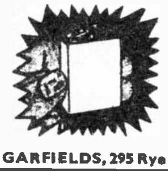

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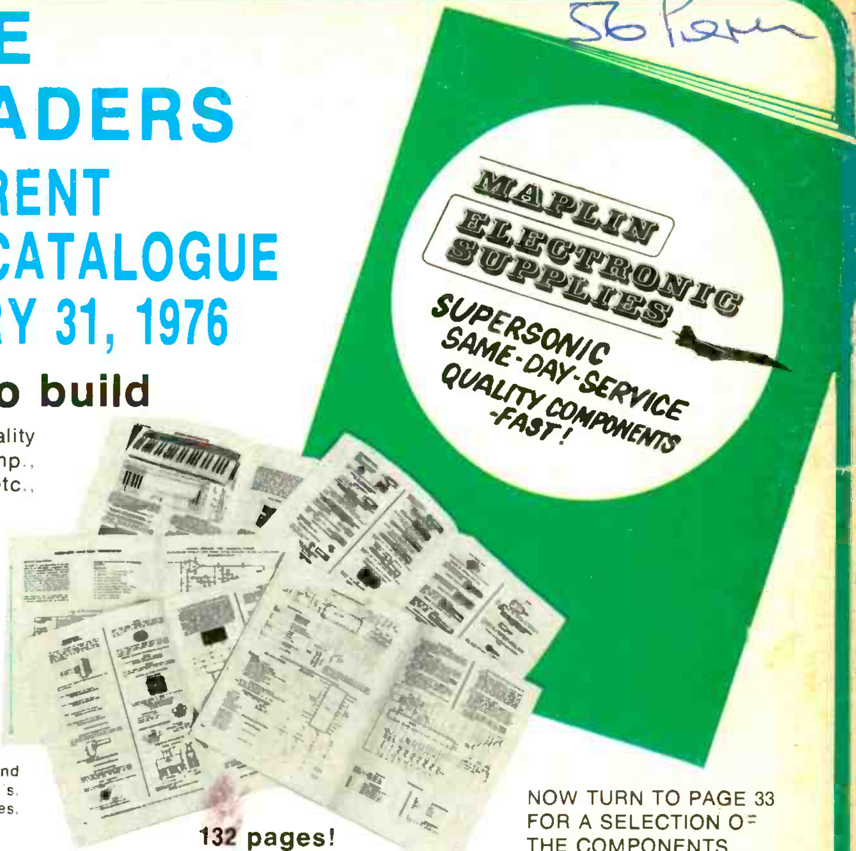

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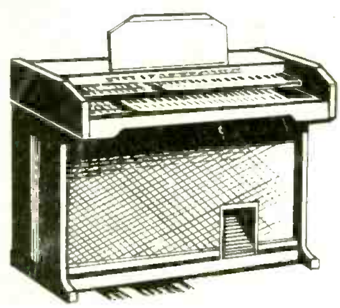

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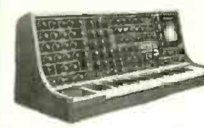

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