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VOL. 11 NO. 5 **MAY 1982**

PROJECTS . . . THEORY . . . NEWS . . .
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All participants have been notified of the results for Stage 1.

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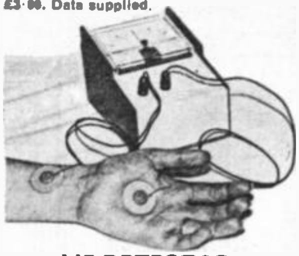

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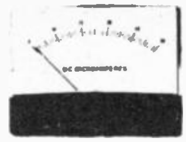

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BARCLAYCARD VISA

COMPONENT KITS

An ideal opportunity for the beginner or the experienced constructor to obtain a wide range of components at reduced prices.
¼W 5% Resistor Kit. Contains 10 of each value from 4·7Ω to 1M (650 resistors) 480p
Ceramic Capacitor Kit. Contains 5 of each value from 22p to 0.01 (135 caps.) 370p.
Polyester Capacitor Kit. Contains 5 of each value from 0·01 to 1μF (65 caps.) 575p each.
Preset Kit. Contains 5 of each hor. Value from 100Ω to 1M (total 65 presets). 425p each.
Nut and Bolt Kit. Total 300 items. 140p.

25 6BA ½" bolts	25 4BA ½" bolts
25 6BA ¼" bolts	25 4BA ¼" bolts
50 6BA nuts	50 6BA nuts
50 6BA washers	50 6BA washers

BRIDGE RECTIFIERS

1A 50V	22	6A 100V	80
1A 400V	35	6A 400V	95
2A 200V	40	VM18 DIL	
2A 400V	45	0·9A200V	50

CABLES

20 metre pack single core connecting cable, ten different colours	65p
Speaker cable	10p/m
Standard screened	16p/m
Twin screened	24p/m
2·5A 3 core mains	23p/m
10 way ribbon	65p/m
20 way ribbon	120p/m

CAPACITORS

Polyester. Radial leads. 250V 280 type.
0·01, 0·015, 0·022, 0·033, 6p; 0·047, 0·068, 0·1, 7p; 0·15, 0·22, 9p; 0·33, 0·47, 13p; 0·68, 20p; 1μ, 23p.
Electrolytic. Radial or Axial leads.
0·47/63V, 1/63V, 2·2/63V, 4·7/63V, 10/25V, 7p; 22/25V, 47/25V, 8p; 100/25V, 9p; 220/25V, 14p; 470/25V, 22p; 1000/25V, 30p.
Polyester. Siemens PCB
1n, 2n2, 3n3, 4n7, 6n8, 10n, 15n, 7p; 22n, 33n, 47n, 68n, 8p; 100n, 9p; 150n, 11p; 220n, 13p; 330n, 20p; 470n, 26p; 680n, 29p; 1μ, 33p; 2μ2, 50p.
Tantalum bead.
0·1, 0·22, 0·33, 0·47, 1·0 @ 35V, 12p; 2·2, 4·7, 10 @ 25V, 20p; 15/16V, 30p; 22/16V, 27p; 33/16V, 45p; 47/6V, 27p; 47/16V, 70p; 68/6V, 40p; 100/10V, 90p.
Ceramic.
22p–0·01μ. 50V. 3p each.
Polystyrene, 5% tolerance.
10p–1000p 6p. 1500p–4700p 8p. 6800p–0·012 10p.
Trimmers. Mullard 808 series.
2–10pF 22p. 2–22pF 30p. 5·5–65pF 35p.

REGULATORS

Positive		Negative	
★78L05	25p	79L05	65p
78L12	30p	79L12	65p
78L15	30p	79L15	65p
★7805	45p	★7905	45p
★7812	45p	★7912	45p
7815	60p	7915	60p
LM309K	130p	LM317K	350p
★LM317T	120p	★LM323K	350p

SOCKETS

★8 pin	7p	22 pin	20p
★14 pin	9p	24 pin	22p
★16 pin	10p	28 pin	26p
18 pin	15p	40 pin	32p
20 pin	18p		

Soldercon pins 60p/100.

RESISTORS

¼W 5% Carbon film E12 series. 4·7Ω–10M. 1p each
½W 5% Carbon film E12 series 4·7Ω–4M7. 2p each
¼W 1% Metal film. E24 series 10Ω-1M 6p each

TRANSFORMERS

Please add carriage charges to our normal post charges.
Miniature mains.
606V, 909V, 12012V all @ 100mA 100p each
High quality. Split bobbin construction.

6VA	0-6, 0-6 @ 0.5A; 0-9, 0-9V @ 0.4A 0-12, 0-12V @ 0.3A. 220p each
12VA	0-6, 0-6 @ 1A; 0-9, 0-9V @ 1.2A; 0-12, 0-12 @ 0-5A; 0-15, 0-15V @ 0.4A 275p each (plus 40p carriage).
24VA	0-6, 0-6V @ 1.5A; 0-9, 0-9V @ 1.2A; 0-12, 0-12V @ 1A; 0-15, 0-15V @ 0.8A; 330p each (plus 60p carriage)
50VA	0-12, 0-12V @ 2A; 0-15, 0-15V @ 1.5A; 400p each (plus 70p carriage)
100VA	0-30, 0-30V @ 1.6A 920p each (plus 80p carriage).

PANEL METERS

Size 60 × 46 × 35mm.

0–50μA	0–500mA
0–100μA	0–1A
0–500μA	0–50V AC
0–1mA	VU
0–10mA	0–300V AC
0–50mA	0–25V
0–100mA	0–30V DC

495p each.

★★★★★★★★★ OPTO SPECIAL!

Special pack containing thirty 5mm LEDS. Ten red, ten green, ten yellow. Our normal price is 320p. Special Offer price just 250p! Offer expires 30th May 82. Please note these are top quality grade 1 devices.

★★★★★★★★★★

BOXES

Dimensions in inches. Aluminium.

3×2×1	70p	6×4×2	120p
4×3×1½	85p	6×4×3	150p
4×3×2	100p	8×6×2	180p

★ Plastic Project Boxes ★
★ Complete with lid and screws. ★
★ 3 × 2 × 1in. 55p ★
★ 4½ × 3 × 1½in. 88p ★
★ 7 × 4 × 2in. 160p ★

VERO

★ Verobloc 350p
Size 0·1 matrix

2·5 × 1"	22p
2·5 × 3·75"	75p
2·5 × 5"	85p
3·75 × 5"	95p
VQ board	160p

Veropins per 100
Single sided 50p
Double sided 60p
Spot face cutter 105p

THERMISTORS FOR PROJECTS

VA1067S 40p | GL16 350p

OPTO

★3mm red	8p	★5mm red	8p
★3mm green	12p	★5mm green	12p
★3mm yellow	12p	★5mm yellow	12p

Clips to suit 3p each.

Rectangular			
★Red	12p	TIL32	40p
Green	17p	TIL78	40p
Yellow	17p	TIL111	60p
		ORP12	85p

Seven Segment Displays

Com. cathode			Com. anode		
DL704	0·3in	95p	DL707	0·3in	95p
★FND500	0·5in	80p	FND507	0·5in	90p
TIL313	0·3in	105p	TIL312	0·3in	105p
TIL322	0·5in	115p	TIL321	0·5in	115p

All seven segment displays are supplied with connection details.
2N5777 45p Dual colour LED 60p

CONNECTORS

DIN	Plug	Skt	Jack	Plug	Skt
2 pin	9p	9p	2.5mm	10p	10p
3 pin	12p	10p	3.5mm	★8p	★8p
5 pin	13p	11p	Standard	16p	20p
Phono	10p	12p	Stereo	24p	25p
1mm	13p	13p	4mm	18p	17p

UHF (CB) Connectors
PL259 Plug 40p Reducer 14p
SO239 Square chassis socket 38p
SO239S Round chassis socket 40p

IEC 3 pin 250V/6A
Plug chassis mounting 38p
Socket free hanging 60p
Socket with 2m lead 120p

● ORDERING INFO ●

● All prices exclude VAT. Please add to total order. ●
● Please add 50p carriage on all orders under £10 in value. Send cheque/PO or Access/Visa number with your order. Please note our new address. ●
● Callers most welcome—we are just 10 minutes from the centre of Colchester. Telephone orders welcome with Access and Visa. Official orders welcome from colleges and schools etc. Export orders no VAT but please add carriage. ●

SOLDERING IRONS

Antex CX 17W Soldering Iron	420p
2.3mm and 4.7mm bits to suit	55p
CX 17W element	190p
Antex X25 25W Soldering Iron	440p
3.3mm and 4.7mm bits to suit	55p
X25 25W element	190p
Solder pump desoldering tool	480p
Spare nozzle for above	70p
10 metres 22 swg solder	100p

HARDWARE

PP3 Battery clips	6p
Red or black crocodile clips	6p
Black pointer control knob	15p
Pair Ultrasonics	350p
★6V Electronic buzzer	60p
★12V Electronic buzzer	65p
★PB2720 Piezo transducer	75p
TO18 transistor socket	15p
64mm 64 ohm speaker	70p
64mm 8 ohm speaker	70p

Just phone us on 0206 36412 with your order!

DIODES

BY127	12p	★1N4001	3p
OA47	10p	1N4002	5p
OA90	8p	1N4006	7p
OA91	7p	1N4007	7p
OA200	8p	1N5401	15p
OA202	8p	1N5404	16p
1N914	4p	1N5406	17p
★1N4148	2p	400mW zen.	6p

★BZX61 Series Zeners.
★1·3W. 4V7-39V 15p each.

PCB MATERIALS

Alfac PCB transfer sheets-please state type (e.g. DIL pads etc.) 45p
Dalo etch resist pen 100p
Fibre glass board 3·75" × 8" 75p
Ferric Chloride 250ml bottle 100p

POTENTIOMETERS

Rotary. Carbon track Log or Lin 1K-2M2. Single 32p. Stereo 85p each. Single switched 80p. Slide. 60mm travel single Log or Lin 5K-500K. 63p. Preset. Submin horiz. 100Ω-1M. 7p.

TRIACS & SCRS

SCRs	
★C106D	30p
400V 8A	70p
400V 12A	99p
TRIACs	
400V 4A	60p
400V 8A	70p
400V 16A	105p

TRANSISTORS

				BC549	10	BFX29	25	TIP29C	60	VN88AF	95	2N3053	23
AC125	35	BC157	10	BC558	10	BFX84	25	TIP30	45	★ZTX107	8	2N3054	55
AC126	25	BC158	10	BCY70	18	BFX85	25	TIP30A	45	★ZTX108	8	2N3055	50
AC127	25	★BC159	8	BCY71	18	BFX86	28	TIP30B	50	ZTX109	12	2N3442	120
★AC128	20	BC160	45	BCY72	18	BFX87	25	TIP30C	60	ZTX300	14	★2N3702	8
AC176	25	BC168C	10	BD115	80	BFX88	25	TIP31A	48	ZTX301	16	2N3703	9
AC187	22	BC169C	10	BD131	35	BFY50	23	TIP31B	45	ZTX302	15	★2N3704	8
AC188	22	BC170	8	BD132	35	BFY51	23	TIP31C	55	ZTX304	17	2N3705	9
AD142	120	BC171	10	BD133	50	BFY52	23	TIP32A	45	ZTX341	30	2N3706	9
AD149	80	BC172	8	BD135	50	BFY53	32	TIP32B	55	ZTX500	15	2N3707	10
AD161	40	BC177	18	BD136	30	BFY55	32	TIP32C	60	ZTX501	15	2N3708	10
AD162	40	BC178	18	BD137	30	BFY56	32	TIP33A	50	ZTX502	15	2N3709	10
AF124	60	BC179	18	BD138	30	BRY39	40	TIP33C	75	ZTX503	18	2N3772	190
AF126	50	BC182	10	BD139	35	BSX20	20	TIP34A	60	ZTX504	25	2N3773	210
AF139	40	★BC182L	8	BD140	35	BSX21	35	TIP34C	85	2N697	20	★2N3819	15
AF186	70	BC183	10	BD204	110	BSY95A	25	TIP35A	160	2N698	40	2N3820	40
AF239	75	BC183L	10	BD206	110	BU205	160	TIP35C	180	2N706A	20	2N3823	65
		BC184	10	BD222	85	BU206	200	TIP36A	170	2N708	20	2N3866	90
BC107	10	★BC184L	7	BF180	35	BU208	170	TIP36C	195	2N918	35	2N3903	10
BC107B	10	BC212	10	BF182	35	MJ2955	99	TIP41A	60	2N1132	22	2N3904	10
★BC108	9	BC212L	10	BF184	25	MJE340	50	TIP42A	60	2N1613	30	★2N3905	8
BC108B	12	BC213	10	BF185	25	MJE520	65	TIP120	90	2N2218A	25	2N3906	10
BC108C	12	BC213L	10	BF194	12	MJE521	95	TIP121	90	2N2219A	25	2N4037	45
★BC109	9	BC214	10	BF195	12	MJE3055	70	TIP122	90	2N2221A	25	2N4058	10
BC109C	12	★BC214L	8	BF196	12	MPF102	40	TIP141	120	2N2222A	20	2N4060	10
BC114	22	BC237	8	BF197	12	MPF104	40	TIP142	120	2N2368	25	2N4061	10
BC115	22	BC238	14	BF198	10	MPSA05	22	TIP147	120	2N2369	16	2N4062	10
BC117	22	BC308	15	BF199	18	MPSA06	25	TIP2955	80	2N2484	25	2N5457	36
BC119	35	BC327	14	BF200	30	MPSA12	30	TIP3055	55	2N2646	45	2N5458	36
BC137	40	BC328	14	★BF244B	22	MPSA55	30	TIS43	40	2N2904	20	2N5459	30
BC139	40	BC337	14	BF245	30	MPSA56	30	TIS44	45	2N2904A	20	2N5485	36
BC140	38	BC338	14	BF256B	45	MPSU05	55	TIS45	45	2N2905	22	2N5777	45
BC141	30	BC477	30	BF257	32	MPSU06	55	TIS90	30	2N2905A	22	2N6027	30
BC142	25	BC478	30	BF258	25	MPSU55	60	TIS91	30	2N2906	25	40360	40
BC143	25	BC479	30	BF259	35	MPSU56	60	★VN10KM		2N2906A	25	40361	50
BC147	8	BC517	40	BFR39	23	TIP29	35		45	2N2907	25	40362	50
BC148	8	★BC547	7	BFR40	23	TIP29A	40	VN46AF	75	2N2907A	25	40408	70
BC149	9	BC548	10	BFR80	25	TIP29B	55	VN66AF	85	2N2926	9	40594	100

LINEAR

		CA3161E	140	LM377	150	LM3900	50	NE566	150	TLO71	45
		CA3189E	290	★LM380	65	LM3909	70	★NE567	100	TLO72	75
★709	25	ICL7106	790	★LM381	120	LM3911	120	NE571	425	TLO81	30
★741	14	ICL8038	320	LM382	120	★LM3914	200	RC4136	90	TLO82	70
748	35	ICM7555	80	★LM386	65	★LM3915	22	SN76018	150	TLO84	95
AY-3-1270	840	★LF351	45	LM387	120	LM13600	120	★SN76477	250	★XR2206	300
AY-3-8910	700	LF353	85	LM393	100	MC1310	150	TBA800	80	ZN414	100
★AY-3-8912	625	LF356	90	★LM709	25	MC3302	150	TBA810	95	ZN423	195
		LM10	395	LM710	50	MC3340	135	TBA820	80	ZN424	135
CA3046	60	★LM301A	25	LM725	350	NE515	270	TBA950	290	ZN425E	390
★CA3080	65	LM311	70	LM733	75	NE529	225	TCA940	170	ZN426E	330
CA3089	215	LM318	120	★LM741	14	NE531	150	TDA1004	300	ZN427E	650
CA3090AQ	375	★LM324	40	LM747	75	NE544	185	TDA1008	320	ZN428E	480
CA3130E	90	LM339	50	LM748	35	★NE555	16	TDA1010	225	ZN1034E	200
CA3140E	45	LM348	65	LM1458	40	★NE556	45	TDA1022	560		
CA3160E	100	LM358	50	LM2917	200	NE565	120	TDA1024	125		

CMOS

		★4017	43	4036	285	4055	115	4082	20	4502	78	4529	150
		4018	60	4039	295	4059	480	4085	65	4503	50	4532	95
4000	14	4019	35	4040	55	4060	85	4086	65	4507	38	4534	495
★4001	12	★4020	55	4041	75	4063	90	4089	140	4508	200	4538	110
4002	14	4021	65	4042	55	4066	35	★4093	33	4510	65	4543	110
4006	65	4022	70	4043	60	4067	395	4094	14	★4511	50	4549	380
4007	17	4023	18	4044	65	★4068	15	4095	90	4512	70	4553	295
4008	58	4024	40	4046	70	4069	18	4097	340	4514	180	4555	45
4009	30	4025	18	4047	70	4070	18	4098	85	4515	180	4556	48
4010	35	★4026	98	4048	55	4071	18	4099	85	4516	75	4559	390
★4011	13	4027	30	★4049	28	4072	18	40106	50	★4518	45	4560	180
4012	17	4028	55	4050	28	4073	20	40109	100	4520	70	4584	45
★4013	26	4029	75	4051	60	4075	20	40163	100	4521	200	4585	99
4014	60	4030	35	4052	60	4076	20	40173	100	4526	80	4724	140
4015	60	4031	170	4053	60	4077	25	40175	100	4527	90		
★4016	26	4034	170	4054	110	4081	18	40193	120	★4528	75		

TTL

		7413	28	7442	40	7480	45	74107	30	74155	60	74177	75
		7414	35	7444	85	7482	70	74109	32	74156	60	74179	65
7400	11	7416	25	7446	60	7483	50	74121	28	74157	43	74180	65
7401	11	7417	25	7447	48	7485	75	74122	45	74160	60	74181	135
7402	12	7420	15	7448	50	7486	25	74123	48	74161	60	74182	75
7403	14	7421	20	7450	16	7489	180	74125	40	74162	60	74190	70
7404	14	7422	20	7451	16	7490	28	74126	40	74163	60	74191	70
7405	17	7427	28	7453	16	7491	45	74132	40	74164	60	74192	70
7406	26	7428	28	7454	16	7492	40	74141	65	74165	60	74193	65
7407	26	7430	15	7460	16	7493	40	74145	65	74167	180	74194	70
7408	15	7432	25	7472	25	7494	35	74147	100	74170	165	74195	63
7409	15	7433	27	7473	28	7495	35	74148	75	74173	80	74196	63
7410	14	7437	27	7474	25	7496	45	74150	75	74174	65	74197	63
7411	20	7438	27	7475	38	7497	120	74153	45	74175	70	74198	95
7412	20	7440	17	7476	30	74100	80	74154	75	74176	55	74199	95

LS TTL

		LS21	15	LS76	20	LS125	30	LS161	42	LS221	60	LS365	38
		LS22	15	LS78	24	LS126	30	LS162	42	LS240	90	LS366	38
LS00	13	LS26	16	LS83	50	LS132	45	LS163	42	LS241	80	LS367	38
LS01	14	LS27	15	LS85	70	LS136	30	LS164	50	LS242	80	LS368	50
LS02	14	LS30	16	LS86	25	LS138	35	LS165	120	LS243	85	LS373	80
LS03	14	LS32	16	LS90	35	LS139	35	LS166	85	LS244	80	LS374	80
LS04	15	LS37	16	LS92	35	LS145	95	LS170	170	LS245	120	LS375	50
LS05	15	LS38	16	LS93	35	LS147	160	LS173	70	LS247	75	LS377	90
LS08	15	LS40	16	LS95	45	LS148	95	LS174	60	LS251	40	LS378	70
LS09	16	LS42	38	LS96	110	LS151	40	LS175	60	LS257	48	LS390	75
LS10	16	LS47	40	LS107	45	LS153	40	LS190	55	LS258	45	LS393	75
LS11	16	LS48	60	LS109	30	LS154	120	LS191	55	LS259	95	LS399	220
LS12	15	LS51	16	LS112	30	LS155	45	LS192	55	LS266	25	LS541	135
LS13	25	LS55	30	LS113	30	LS156	45	LS193	60	LS273	90	LS670	175
LS14	48	LS73	25	LS114	30	LS157	35	LS195	50	LS279	50		
LS15	15	LS74	25	LS122	42	LS158	35	LS196	60	LS283	45		
LS20	15	LS75	27	LS123	55	LS160	42	LS197	68	LS353	100		

SWITCHES

Submin. Toggle
SPST 55p SPDT 60p ★DPDT 50p
Miniature toggle
SPDT 80p SPDT centre off 90p
DPDT 90p DPDT centre off 100p
Standard toggle
SPST 35p DPDT 46p
★Miniature DPDT slide 12p
★Push to make 12p Push to break 22p
Rotary type adjustable stop
1P12W, 2P6W, 3P4W, 4P3W all 55p each
DIL switches
4 SPST 80p 6 SPST 80p 8 SPST 100p

CRYSTALS

100KHz	290p	6·0M	200p
200KHz	370p	6·144M	180p
1MHz	300p	7·00M	250p
1·008M	370p	8·0M	170p
1·8432M	300p	10·0M	180p
2·0M	270p	12·0M	200p
2·4576M	220p	16·0M	240p
3·276M	240p	18·0M	240p
3·579M	120p	18·432M	220p
4·0M	150p	19·968M	300p
4·194M	150p	38·6667M	320p
4·43M	125p	48·0M	220p
5·0M	240p	116M	300p

The Rapid Guarantee

★ Same day despatch ★ Competitive prices
★ Top quality components ★ In-depth stock

WE WILL BEAT BY 5% ANY LOWER PRICE ADVERTISED BY COMPETITORS★

WATER RESISTANT WATCHES

With Alarm, Hourly Time Signal, Stopwatch and Calendar

100 METRE WATER RESISTANT

W-100	W-150C	W-150
Resin case/strap	S/S case, resin strap	All S/S
£19·95	£21·95	£24·95

Time and auto calendar. Alarm and hourly chimes. Countdown alarm timer with repeat memory function. Professional 1/100 second stopwatch. Time is always on display, regardless of display mode. Amazing 5 year lithium battery life. Superior to the W-250.

50 METRE WATER RESISTANT

W-20	W-21	W-30
Resin case/strap	Resin S/S trim	All S/S
£12·95	£14·95	£19·95

12/24 hour time and auto calendar. Alarm and hourly chimes. Professional 1/100 second stopwatch to 12 hrs. Compact and slim cases, approx. 8mm thick. Lithium.

OTHER MODELS

AX-210. The world's most versatile watch?
Analog Display
LC Display of hours and minutes
Digital display
★ Local time, 12 or 24 hour
★ Full calendar display
★ Dual time, 12 or 24 hour
★ Alarm time display
★ Countdown alarm timer with memory function
★ Professional 1/100 second stopwatch
Hourly time signal. Daily alarm electronic buzzer or 3 selectable melodies. Rapid forward/back setting. 9·4 × 35·4 × 36mm.
Usual Price £29·95
Lowest price elsewhere
★ £27·95

CA-85	CA-901	J-100
Resin	Chrome	Resin
Usually £19·95	Usually £29·95	£19·95
Price elsewhere	Price elsewhere	
★ £18·95	★ £27·95	

CA 85/901. Time and auto calendar. Calculator-Alarm and hourly chimes. Stopwatch. Dual time. **DIGITAL SPACE INVADER** game.
J-100. Similar to the CA-85 but without dual time and with a **JOGGING COMPUTER** instead of the game function.
GM-10. Alarm chrono with SPACE INTERCEPTOR game £19·95

THE SENSATIONAL NEW SHARP PORTABLE COLOUR COMPUTER

CE-150 PRINTER £149·95

PC-1500 POCKET COMPUTER £169·95

A complete system that can fit in a briefcase. For Business, Management, Engineering and Hobby applications. BASIC computer with QWERTY keyboard. 2·5K bytes of RAM, with optional 4K expansion module (£49·95). 8K module available soon. 4-colour high resolution printer with two cassette interface and system expansion adaptor. RS-232C interface soon. Mains/rechargeable/battery powered. Full colour information pack on request—serious enquiries only, please—15½p stamp appreciated.

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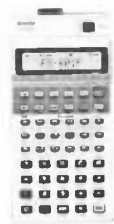

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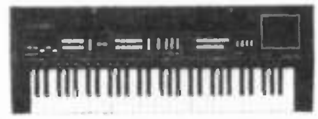

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3-way replay:—Automatic; One Key Play; Melody Guide, (lights above the keyboard indicate the next note to play). Split keyboard; 20 superb instrument voices; 16 rhythm accompaniments; fingered or auto chords with walking bass and arpeggio; fill-in and effect buttons. 37¾ × 13 7/16 × 5". Weight: 12·5kg (27·6lbs).
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25 instruments over 4 octaves. Four voice memory function with push button selection. Vibrato and sustain switches. 16 rhythm accompaniments with fill-in variation Casio Auto Chord for one finger or auto playing of major, minor and 7th chords with bass. Ten functional controls 4⅝ × 30⅝ × 11½. Weight 17·6lbs.

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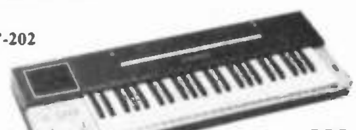

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Everyday ELECTRONICS

VOL. 11 NO. 5 MAY 1982

TOWARDS THE WIRED SOCIETY

Little more than three months into Information Year, and the Government's Information Technology Advisory Panel makes its first major impact on the news pages. In its report "Cable Systems" (published in March) the Panel argues strongly in favour of an extensive commercially operated wide bandwidth cable system to cover most of the United Kingdom. The report has been received enthusiastically by the Government and private enterprise is being urged to make a start on the realisation of such a network as soon as possible.

It is easy to understand the Government's wish to exploit new technology in any way it considers will create jobs and wealth. Moreover, this could be a very significant move leading to the introduction of the so called Wired Society. Some new form of "cottage industry" could emerge in time, to replace the existing order of things. Many business activities could be conducted from home rather than from large central offices. Commuting to city centres could become a thing of the past for many thousands of workers.

Yet this exciting futuristic picture, with the many social implications that "cable" conjures up, is overshadowed in the report by a constant reference to the additional t.v. programmes that will be made possible. (We can hear the ironic cheers.) There are far more important and imaginative uses for a wide bandwidth cable system.

The emphasis on cable t.v. throughout the report gives grounds for suspecting that the ordinary consumer is going to be made to foot the bill for the establishment of a cable system, and the very profitable spin off will go to those commercial interests who will operate and use to their own business advantage the additional telecommunications facilities the wide bandwidth cable network will then make available. True, there are other attractive possibilities for the home-subscriber: viewdata and teletext information, remote metering and security monitoring, and so on. But these specialised services are likely to remain of minority interest.

If the resuscitation of Britain's industry and commerce depends much upon the use of computer and data services coupled into a national network permitting rapid access in all parts of the country, then it could be argued that industry and commerce should finance the cable system themselves, and not ride on the backs of the general public who will of course have to pay directly or indirectly for these additional entertainment programmes—for which there is questionable demand.

There are many questions to be asked about the proposed cable system —and remember few, if any, of us will escape its ramifications in the future. The Government's determination to press on at speed suggests that many of these questions will not be adequately aired and taken into account.

TWO-TONE TRAIN HORN

FOR MODEL RAILWAYS

By R.A.Penfold

THIS simple model railway sound effect unit gives a reasonably accurate simulation of the sound made by the horn of a modern diesel or electric train. Two-tone horns of this type normally have the second tone about a third higher or lower in pitch than the original tone. Neither is actually a simple tone and both are quite complex signals containing strong harmonics. In this design the second tone is set a third higher in pitch than the first, and a second tone generator operating at a slightly lower frequency than the main one is used to enrich the output signal to give a more realistic result.

REMOTE TRIGGERING

The basic unit is operated using a push-button switch which is depressed for about 1½ seconds, with the change in pitch being produced automatically about half-way through this period of time. A simple add-on unit enables the horn to be remotely triggered by the train as it passes any desired point on the track. This unit will be treated separately after the description of the basic Two-Tone Horn.

The unit has a built-in battery supply and miniature loudspeaker.

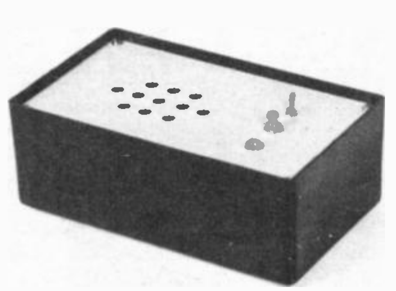
THE HORN CIRCUIT

Fig. 1 shows the circuit diagram of the Two-Tone Horn in its basic form without the automatic triggering circuitry.

The two tone generators both use the familiar 555 timer devices in the conventional astable mode. IC3 is the main tone generator and this has its output frequency set at a little under 200Hz by timing components R6, R7 and C6. IC2 forms the other tone generator, and VR2 is adjusted to produce an operating frequency that gives a realistic effect.

C5 and C8 couple the outputs of the tone generators to a mixer which is a simple passive type comprised of R5 and R8. R8 has been made much lower in value than R5 so that the signal from the main tone generator is made much stronger than the signal from the other oscillator.

The output from the mixer is strong enough to drive a high impedance loudspeaker (LS1) at reasonable volume, but the output could be taken to a separate amplifier and loudspeaker if greater volume is required. In this case the loudspeaker would be replaced by a 68 ohm resistor and the output signal would be taken from across this resistor.



Completed Two-Tone Horn unit.

MONOSTABLE

The monostable section of the unit uses the third 555 i.c. (IC1) connected in the appropriate manner. In order to trigger the device and produce a positive output pulse at pin 3 it is necessary for the trigger input at pin 2 of the device to be briefly taken below one third of the supply voltage. R1 and C2 produce a suitable trigger pulse each time S1 is operated and power is applied to the circuit. The length of the output pulse is controlled by the values of R2 and C3, and is approximately $1{\cdot}1 \times C3 \times R2$ seconds. This gives a pulse length of roughly 0·75 seconds with the specified values.

There are several ways of altering the frequencies of the tone generators, and one of these is by altering the control voltage at pin 5 of each 555 astable. This voltage is nominally two thirds of the supply potential, and applying a higher voltage produces a reduction in the operating frequency of the astables. Applying a lower voltage gives an increase in operating frequency.

The output of IC1 is coupled to pin 5 of both IC2 and IC3 by way of D1 and VR1, D1 blocking any current

COMPONENTS

Resistors
- R1 100kΩ
- R2 6·8MΩ ±10%
- R3, 4, 6 10kΩ (3 off)
- R5 270Ω
- R7 27kΩ
- R8 27Ω
- All ¼W carbon ±5% except where stated

Capacitors
- C1 100μF 10V elect
- C2, 3, 4, 6 100nF polyester, C280 (4 off)
- C5, 8 10μF 16V elect (2 off)
- C7 470nF polyester, C280

Semiconductors
- D1 1N4001 silicon
- IC1, 2, 3 555 timer (3 off)

Miscellaneous
- VR1, 2 47kΩ miniature horizontal preset (2 off)
- B1 9V PP6 battery
- LS1 64Ω, 57mm diameter miniature speaker
- S1 Push-to-make, momentary action switch
- 0·1in. matrix stripboard, 15 strips by 50 holes; case, 160 × 100 × 60mm (Maplin type M4005); battery clip; 7/0·2 equipment wire; M3 or 6BA mounting hardware.

Heading photographs: electric multiple unit train, 3-rail d.c. system; and (inset) diesel multiple unit train—*courtesy British Rail.*

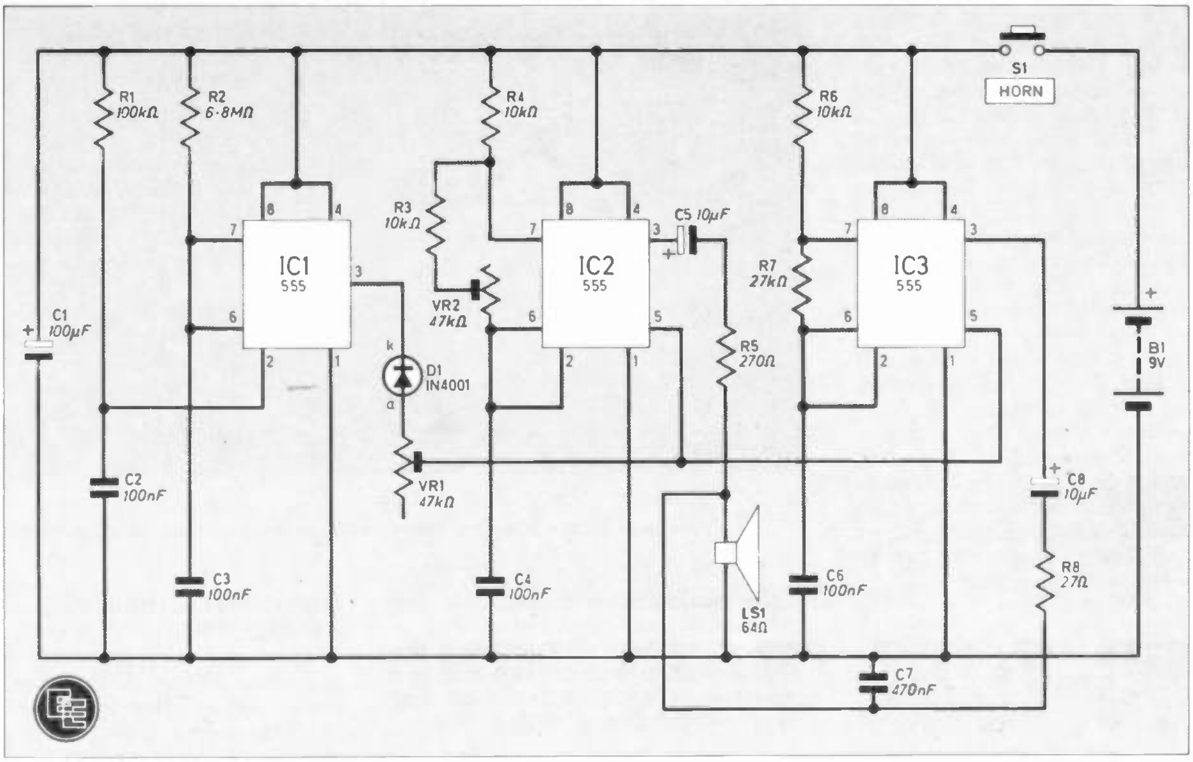


Fig. 1. Circuit diagram of the Two-Tone Horn. Note that S1 and B1 are only required if the remote triggering circuit is not used.

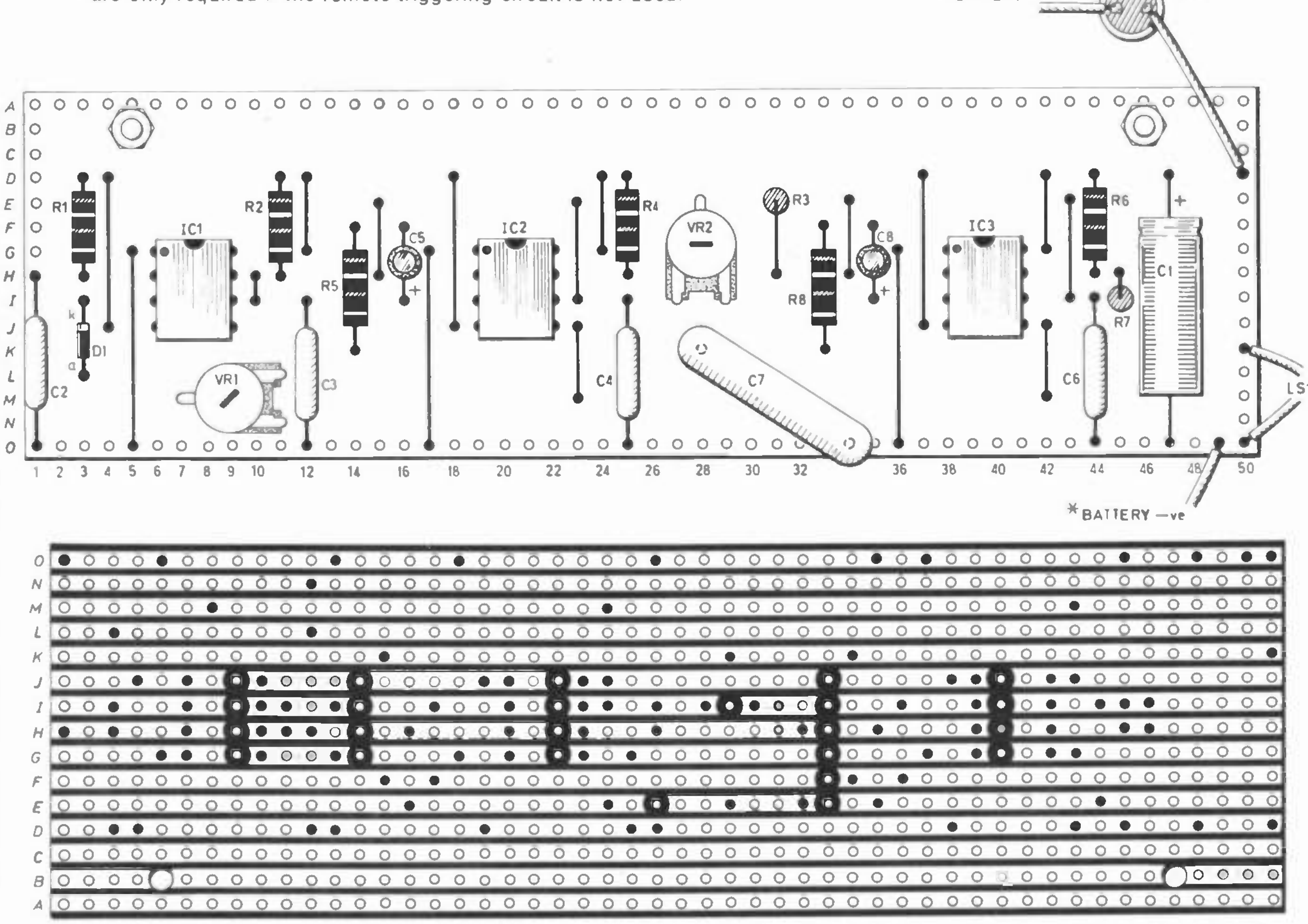


Fig. 2. Stripboard layout of the Two-Tone Horn. Wires marked thus-* to be omitted if the remote triggering circuit is used. See Fig. 4 for the wiring of this additional feature.

flow through this path when IC1 output is high. At the end of the 0·75 second output pulse when IC1's output goes low, D1 does permit a current flow and the pin 5 terminals of IC2 and IC3 are pulled lower in potential. This gives the required increase in pitch, and VR1 is adjusted to give the appropriate increase in pitch.

The circuit would still give the two-tone effect if D1 was to be replaced with a shorting link, but the setting of R3 would then effect the pitch of both the high and low tones. This would not be a good idea as it would make it difficult to set the correct interval between the two tones.

Although the circuit has a rather high current consumption figure of around 35mA or so, battery operation is still feasible, even using a small nine volt battery such as a PP6 size as the unit will only be operated briefly and intermittently in normal use.

CONSTRUCTION starts here

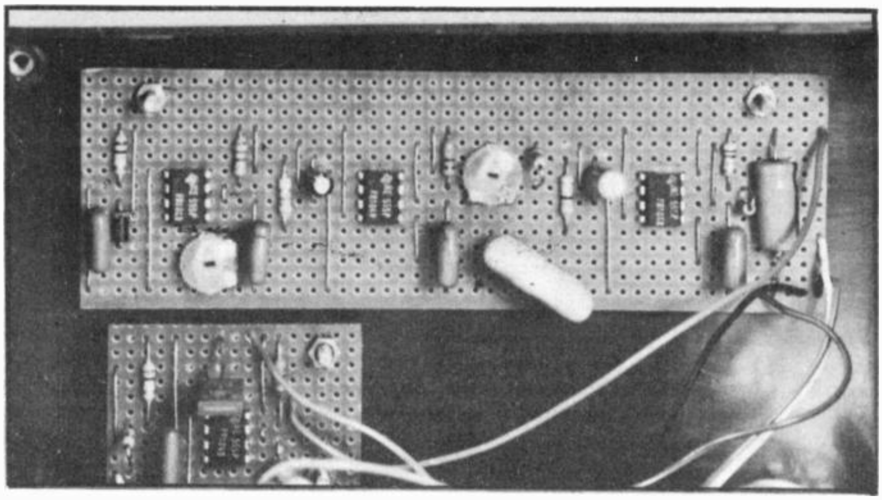
CASE CONSTRUCTION

A plastic case having approximate outside dimensions of 160×100×60mm is large enough to comfortably accommodate all the components, including those of the automatic triggering circuit if necessary.

A grille for the loudspeaker is made in the front panel, and this can simply consist of 11 holes about 6·5mm in diameter, as can be seen from the accompanying photographs. The loudspeaker is carefully glued in place behind the grille with the adhesive only being applied to the front rim of the speaker and none being smeared over its diaphragm. The loudspeaker must be a high impedance type incidentally, and should *not* have an impedance of less than 40 ohms. S1 is also mounted on the front panel, and assuming it is a standard push button switch it will require a 7mm diameter mounting hole.

CIRCUIT BOARD

The component panel uses a 0·1in matrix stripboard, 50 holes by 15 strips, and this can conveniently be a full length piece of board cut from a standard 5in×2·5in or 5in×3$\frac{3}{4}$in board. Fig. 2 gives the component layout and other details of the board. Make the two M3 or 6BA clearance mounting holes first, and then make 24 breaks in the copper strips.



View inside case showing both circuit boards mounted onto the base.

The board is then ready for the components and link wires to be soldered into place. Start with the link wires, then add the resistors and capacitors, and finally insert D1 and the three integrated circuits.

Fit the completed board on the rear panel of the case, well towards the top of the panel, using 6BA or M3 fixings. Then temporarily remove the board so that S1, the loudspeaker, and the battery clip can be wired into the circuit. This wiring is also shown in Fig. 2.

ADJUSTMENT

With VR1 and VR2 both adjusted to their midway settings, operating S1 should give roughly the correct two-tone effect. If no tone is obtained, or the output is obviously far from correct, check the component panel and wiring for the usual mistakes, like accidental short circuits between copper strips on the component board caused by pieces of excess solder.

When the unit is working correctly, repeatedly operate the unit and adjust VR1 to give the correct second tone. Clockwise adjustment of VR1 increases the pitch of the second tone, anticlockwise adjustment decreases the tone. It should have no effect on the first tone.

VR2 is then adjusted to give the best effect. This will probably be obtained with the second tone generator a little lower in frequency than the main one, but this is really just a matter of experimenting a little to find the effect you like best. Do not have the two frequencies too close together as this will produce an unrealistic low frequency phasing effect, and it is likely that the two oscillators would have a tendency to lock onto the same frequency so that the second oscillator would become ineffective.

AUTOMATIC REMOTE TRIGGERING

Automatic operation is provided using a reed switch fitted under the track and operated by a bar magnet mounted under the train. The reed switch will only close briefly as the train passes, so it cannot be used to control the horn circuit directly as this circuit must be switched on for a period of about one and a half seconds. The reed switch is therefore used to trigger a monostable multivibrator which gives an output pulse of about 1·5 seconds and thus activates the horn circuit for the appropriate length of time.

THE CIRCUIT

Fig. 3 shows the additional circuit needed for automatic operation, and the original circuitry remains unaltered except for the removal of S1 and the battery, both of which are used in the new circuit.

The monostable uses another 555 i.c. in the standard configuration. R11 and C10 set the required pulse length of about 1·5 seconds, and whilst the output of IC4 is high, power is supplied to the horn circuit via emitter follower buffer stage, TR1. This is a power transistor as there is a high surge current to the horn circuitry at the beginning of each pulse due to C1 charging up. There is a small voltage drop across TR1, but this is not large enough to have any significant effect on the horn circuitry.

R9 normally holds the trigger input (pin 2) of IC4 at virtually the positive supply voltage, but briefly operating S1 produces a brief negative input pulse to IC4 as C9 charges via R9 and the horn is operated. The reed switch connects to SK1, and if this is briefly activated it obviously has the

TWO-TONE TRAIN HORN
FOR MODEL RAILWAYS

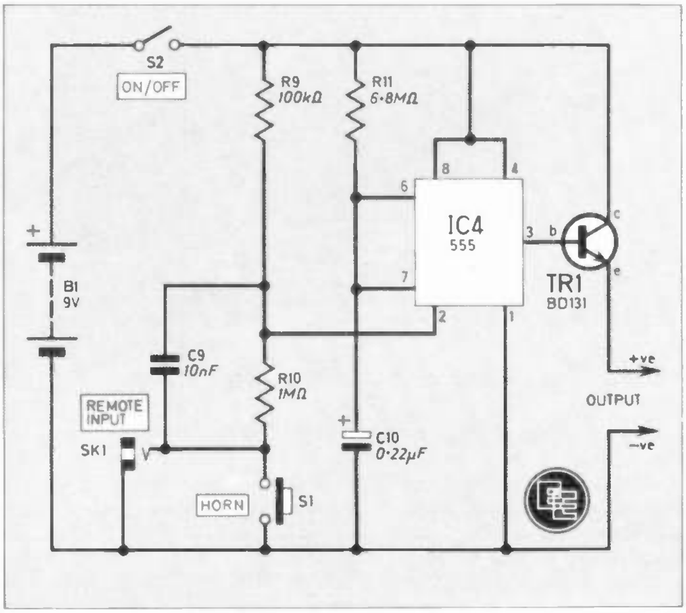


Fig. 3. Circuit diagram of the remote triggering device. The reed switch is connected via SK1.

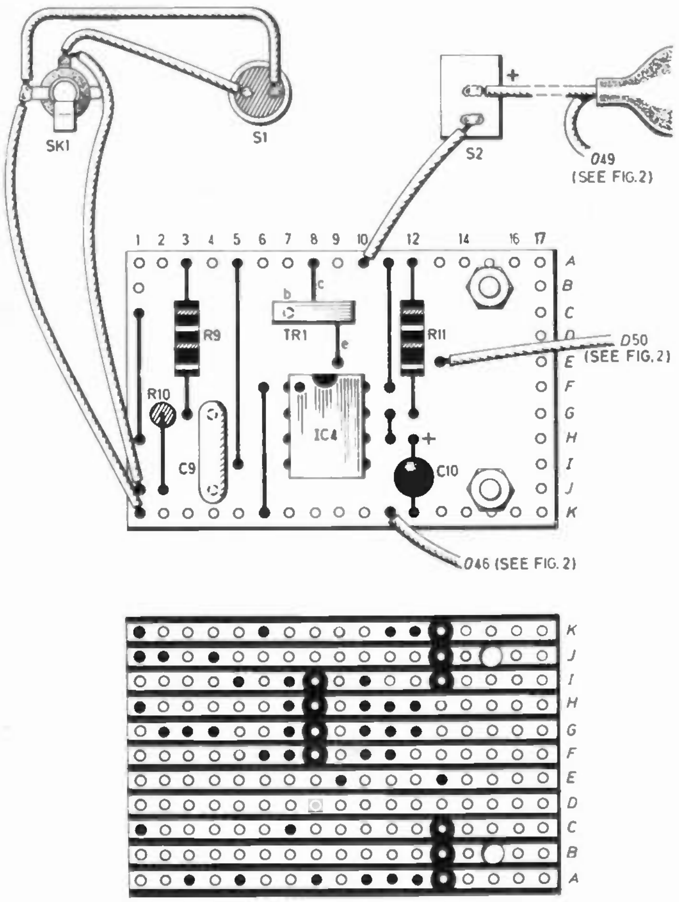
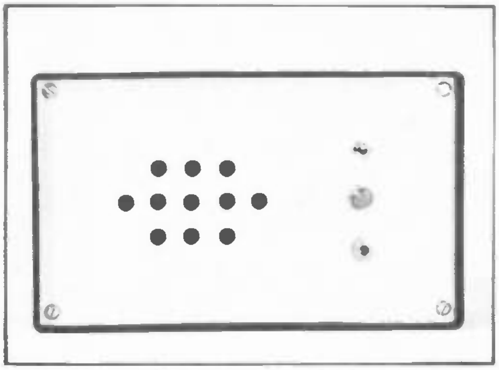


Fig. 4. Stripboard layout of the Automatic Remote Triggering circuit. Refer also to Fig. 2 for the wiring-in of this board to the Horn generating board.



Top view of the unit clearly showing the speaker grille.

COMPONENTS

Resistors
R9 100kΩ
R10 1MΩ±10%
R11 6·8MΩ ±10%
All ¼W carbon ±5% except where stated

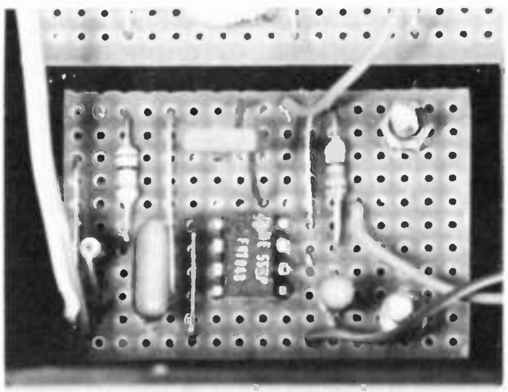
See **Shop Talk** page 305

Capacitors
C9 10nF polyester, C280
C10 0·22μF tantalum bead

Semiconductors
TR1 BD131 silicon *npn*
IC1 555 timer

Miscellaneous
SK1 3·5mm jack socket
PL1 3·5mm jack plug
S2 s.p.s.t. miniature toggle
0·1in. matrix stripboard, 11 strips by 17 holes; miniature reed switch; magnet (see text); two way lead.

COMPONENTS approximate cost £14·50 Both units



Remote triggering board. The leads of TR1 must be carefully preformed as shown.

same effect as operating S1. If the train happens to stop with the magnet over the reed switch, or S1 is operated for several seconds, there will still only be a brief trigger pulse to IC4 so that the output pulse will not be prolonged and proper operation of the circuit will be maintained. R10 discharges C9 almost immediately when S1 or the reed switch open, and the circuit is then ready for the next operation.

S2 is the ON/OFF switch, and is necessary because IC4 will consume current from the battery (about 8mA) even when the horn circuitry is not operating.

Finished assembly with case lid folded down.

CONSTRUCTION starts here

CONSTRUCTION

The additional circuitry is accommodated on another piece of 0·1 inch matrix stripboard measuring 11 strips by 17 holes. Fig. 4 gives details of this board and the additional wiring of the unit. Note that in the automatic version of the unit, S1 and the battery clip are wired as shown in Fig. 4, and not as shown in Fig. 2. The front panel must be drilled with two more mounting holes for S2 and SK1, and on the prototype these are mounted above and below S1 respectively. (See photo of finished unit.)

When the components panel has been completed and wired to the rest of the unit it is mounted on the rear panel of the case, on the left hand side and below the main board. This leaves sufficient space for the battery on the lower right hand side of the case.

A suitable reed switch for this application is the "miniature" type sold by Maplin Electronic Supplies, and the "small" magnet sold by Maplin will operate this at a distance of about 10 or 11mm, which should be sufficient. The "large" Maplin magnet will operate the miniature reed switch at a distance of up to about 26mm, and with dimensions of 25·2×6·3×6·3mm it can easily be fitted into trains that are OO or a larger gauge.

The reed switch connects to SK1 on the Two-Tone Horn via a twin lead terminated in a 3·5mm jack plug. It is not essential to use a screened lead, but using this will reduce the risk of spurious operation due to stray pick-up in the lead.

An important point to bear in mind is that the reed switch must be parallel to the bar magnet in order to obtain a good maximum operating distance. It is unlikely that the reed switch will operate at all with the magnet at right angles or positioned end-on to the switch.

In practice this means that it will either be necessary to fit the reed switch across the track and the magnet across one of the items of rolling stock, or the reed switch along the centre of the track with the magnet similarly mounted in one of the pieces of rolling stock. With a large layout it is quite acceptable to have reed switches fitted to the track at several points and wired in parallel so that the horn is operated whenever the train passes one of the reed switches. ⌑

JACK PLUG & FAMILY...

BY DOUG BAKER

By Dave Barrington

Display Accessories

With so many projects using digital readout displays, we thought readers may be interested in news of two small items that have reached us.

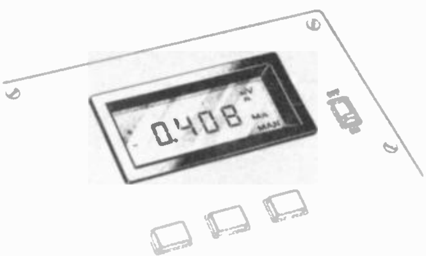
After marking out a rectangular area, drilling a guide hole at the four corners and then drilling a series of holes joining up the four, it always seems to be a problem to file a neat "square" looking opening for the displays.

To overcome this, front panel display bezels are being manufactured and used more and more to hide "ragged" edges. Most of these bezels necessitate drilling extra mounting holes, but now some companies are producing snap-in bezels. One of these is Broadoak Co., who are producing a range of sizes from 35mm to 203mm.

A feature of these bezels is the facility for sliding colour filters into slots in the rear of the bezels. The assembly is then pushed in to the panel cutout from the front and snaps into position. Serrated plastics clips hold the bezel firmly in position.

Black bezels are standard with a choice of red, green, amber and clear filters. Other colour bezels can be moulded to special order.

Further information, prices and details of stockists can be obtained from Broadoak Company, Dept EE, Broadoak House, Cricket Green, Hartley Witney, Hants RG27 8PH.



Snap-in display from Broadoak.

On the subject of filters, S. E. Noon are able to supply cut-to-size blanks, discs, filters and covers in acrylic, p.v.c., or polycarbonate. They are available in 1 off to 1,000 off quantities with a choice of colours and thicknesses.

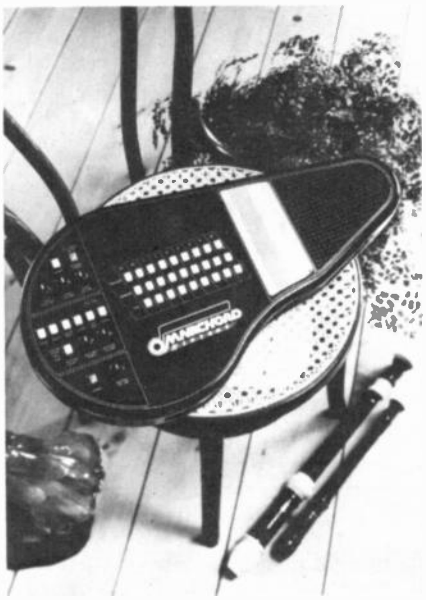
The edges of the filters can also be profile machined to enable flush mounting with the front panel.

For more details contact S. E. Noon, Dept EE, 59 Twickenham Road, Isleworth, Middlesex TW7 6AR.

In Tune

Readers who've had an hankering to play a musical instrument but never had the patience, time or talent will welcome a new musical instrument available in the UK that is claimed to allow the performer to "turn-in" a professional rendition in hours as against months or years of practice.

Using microtechnology, the Suzuki Omnichord is a portable instrument that is designed to be played in various ways. It can be strummed like a guitar, even though it has no strings to tune or break. Finger touch sensitive "SonicStrings" are activated by the touch of your fingers.



Suzuki Omnichord from Craftmaster

It will sound like a piano or organ and by pressing any of its 27 major, minor or seventh chord buttons produce vibrant tones through built-in speakers. It can combine either of these features with a "walking bass". It automatically plays the correct bass notes in rhythm with your selected chord.

The sound of drums can be included and it's possible to key in a full electronic rhythm section with many different rhythmic patterns. All these features can be played individually or in combinations.

The Omnichord is available through local music shops, department stores or direct from the distributors at £99, including VAT. Further information can be obtained from Craftmaster UK Ltd., Dept EE, Tower House, Lea Valley Trading Estate, Edmonton, London N18 3HR.

Catalogues

Readers just starting in computers may care to send off for the latest book catalogue from Kuma Computers.

More like a "broadsheet" than a catalogue, the list includes new books on the BBC microcomputer, ZX81 and the Sharp MZ-80K.

Copies can be obtained free of charge by writing to Kuma Computers, Dept EE, 11 York Road, Maidenhead, Berks SL6 1SQ.

A comprehensive toolkit service ranging from an off-the-shelf toolkit of their own design to individual specialised toolkits to customer's particular requirements and specification are one of the services outlined briefly in the latest Toolrange Ltd catalogue.

A large section on toolkits may be found in the 1982/3 catalogue, together with sections covering over 2,500 tools and production aids.

The catalogue is available free from Toolrange Ltd., Dept EE, Upton Road, Reading RG3 4JA.

Constructional Projects

Two-Tone Train Horn

All items called-up for the *Two-Tone Train Horn* are standard "off-the-shelf" components and should not cause any purchasing problems.

The transistor type BD131 used in the automatic operation circuit is listed by Benning Cross Electronics, Electrovalue, Magenta, Rapid and Watford Electronics.

Car L.E.D. Voltmeter

The transparent case for the *Car L.E.D. Voltmeter* was an old jewellery presentation type case. However, the case can be any suitable type, such as a transparent cassette case, even a small metal box.

The rest of the components for this project are readily available from most of our advertisers.

Big Nine Indicator

No buying problems should be encountered when shopping around for components for the *Big Nine Indicator*.

We have found that the TIS43 unijunction transistor is the most commonly stocked device and is available from most advertisers.

Public Address System

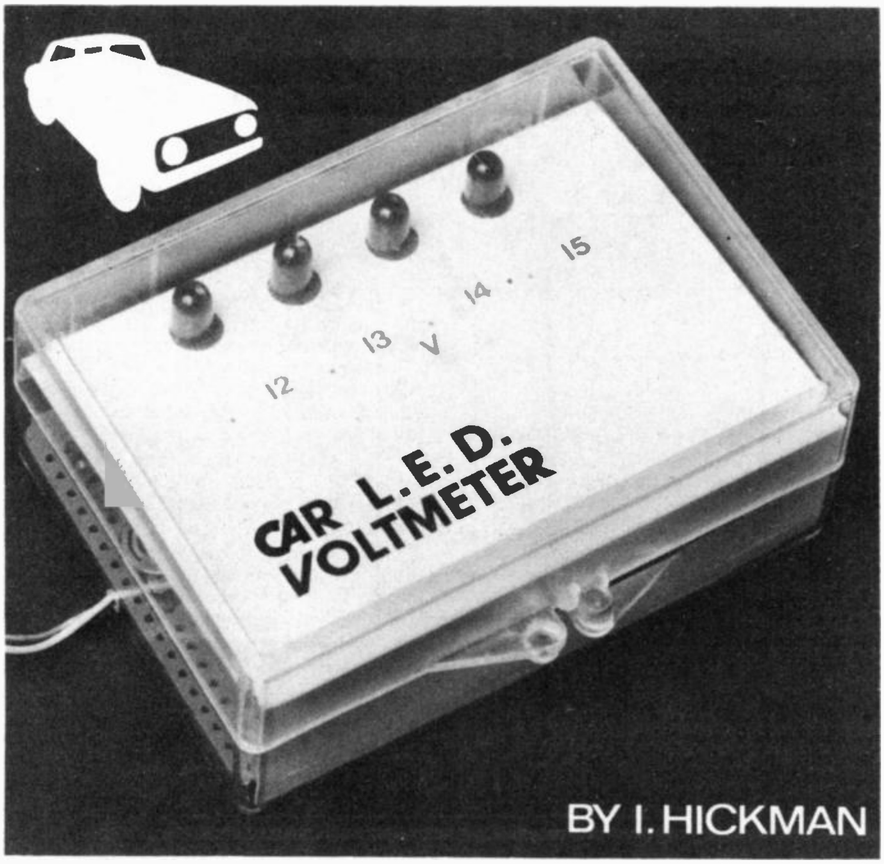
We do not expect any component purchasing problems for the first instalment of the *Public Address System*, although some "specials" will be called up in later parts and be dealt with as required.

The only semiconductor that could prove troublesome is the ZN459 low noise i.c. We are not aware of any alternative for this device, but it is stocked by Watford Electronics.

Lightning Chess Buzzer

All components for the *Lightning Chess Buzzer* are readily available items and should not present any buying problems.

Readers may not wish to use a wooden case for this project and any case may be used here.



CAR L.E.D. VOLTMETER

OLDER readers will remember the golden days of motoring when a car would have an ammeter as well as an ignition light, and sometimes a voltmeter as well! The ammeter, a centre zero type, indicated the current flowing into the battery from the generator when the engine was turning over rapidly, or flowing out of the battery when the engine was idling.

If the engine was turning over very slowly, or actually stopped, a "cut-out" disconnected the generator to prevent it drawing current from the battery. The load on the electrical system, ignition, lights, semaphore style trafficators, horn, windscreen wipers or whatever, was then supplied by the battery and indicated on the ammeter as negative or discharge current. The needle in this case moved to the left of its normal upright position, whilst positive or charging current was indicated by its moving to the right.

The starter current was of course not indicated on the ammeter as it is far too large and was therefore not included in the ammeter circuit.

BATTERY CHECK

One thus had an unambiguous check on the battery, in that a low or zero ammeter charge rate, or worse still a discharge, when driving normally was a clear warning of problems ahead. Either the generator or regulator was faulty or the battery was in such a poor condition that it would not accept charge.

Nowadays a car usually has only an ignition light, which is far less informative. An ammeter can be fitted, but this is little complicated as it means finding a suitable place to break into the battery circuit. Whilst not quite as informative, a voltmeter will still give a lot of useful information about the condition of the battery and charging equipment, and it is much easier to install. It is simply connected across the supply to any equipment, such as the windscreen wiper, which is controlled by the ignition switch. The voltmeter described here uses l.e.d.s (light emitting diodes) rather than a conventional meter with a pointer. It thus needs no dial-light for use after dark, and there is no danger of the meter needle sticking as sometimes happens with conventional meters.

L.E.D. VOLTMETER

Fig. 1 shows the circuit diagram, which is very simple. Resistor R1 and Zener diode D1 form a shunt stabiliser; the voltage at their junction remains at 5·6V (or nearly so) regardless of the battery voltage. The emitters of the four transistors are all returned to this point, whilst the bases of these transistors are connected via 100 kilohm resistors to tappings on a string of resistors (R10 to R14) across the battery supply.

Assuming variable resistor VR1 is set approximately half-way, it will be seen that point *X* is at a potential equal to half the battery voltage, roughly 6V if the engine is not running. Thus TR1 is just starting to conduct and l.e.d. D2 just glows.

As the voltage across the battery rises, due to the generator or alternator charging it, TR2 turns on and lights D3, then TR3 lights D4 also and finally, at about 14·75V, D5 lights.

TEMPERATURE COMPENSATION

Resistors R2 to R5 limit the current through the l.e.d.s, whilst resistors R6 to R9 and diodes D6 to D9 serve three purposes. First, for example, if D6 were shorted, then the voltage at the junction of VR1 and R11 could never exceed 6·3V approximately, that is the 5·6V of the Zener diode plus 0·7V base-emitter voltage of TR1. Hence the other transistors would not turn on as the battery voltage increased. Secondly, by including D6 to D9 and making R6 to R9 as high as 100 kilohms, we achieve a less sharp battery turn-on voltage

COMPONENTS

Resistors

R1-5	1·2kΩ (5 off)
R6-9	100kΩ (4 off)
R10, 14	270Ω (2 off)
R11	22Ω
R12	18Ω
R13	12Ω

All ¼W carbon ±5%

See Shop Talk page 305

Semiconductors

D1	BZY88 C5V6 400mW, 5·6V Zener diode
D2-5	TIL220 0·2 inch red l.e.d. (4 off)
D6-9	1N4148 silicon signal diode (4 off)
TR1-4	BC109C silicon *npn* (4 off)

Miscellaneous

VR1 100Ω miniature horizontal preset

0·1 inch matrix stripboard, 18 strips by 28 holes; transparent plastic case, 75 × 55 × 30mm; 7/0·2 equipment wire; white cardboard (for escutcheon); rub-down lettering.

Approx cost Guidance only £3 excluding case

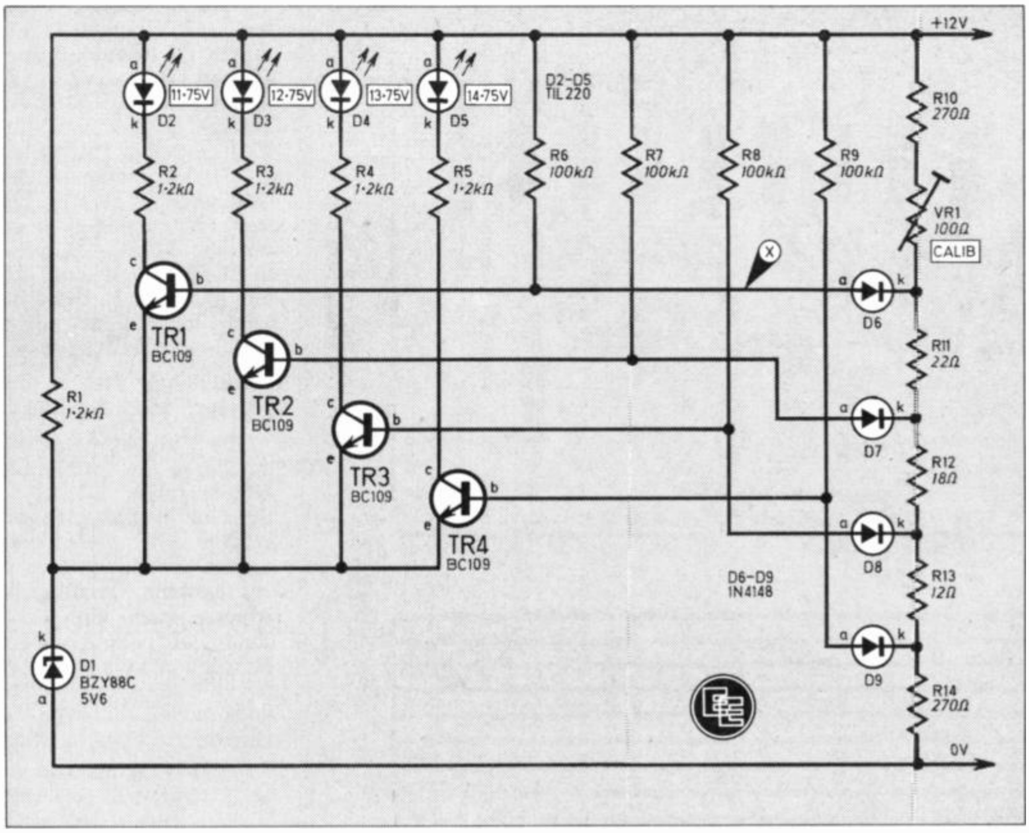


Fig. 1. The complete circuit diagram of the Car L.E.D. Voltmeter. Note that the 12V supply for this circuit is picked up from the car battery supply and that the positive connection must be made to a point after the ignition switch, thus ensuring that there is no drain on the battery with the ignition switched off.

for each l.e.d.; in fact from just glowing dimly to full brightness corresponds to about half a volt change in battery voltage, giving a more progressive indication as one l.e.d. takes over from the previous one. Thirdly, the change of transistor base-emitter voltage with temperature is almost exactly matched by the change of forward voltage of the corresponding diode, preserving accuracy over a wide temperature range.

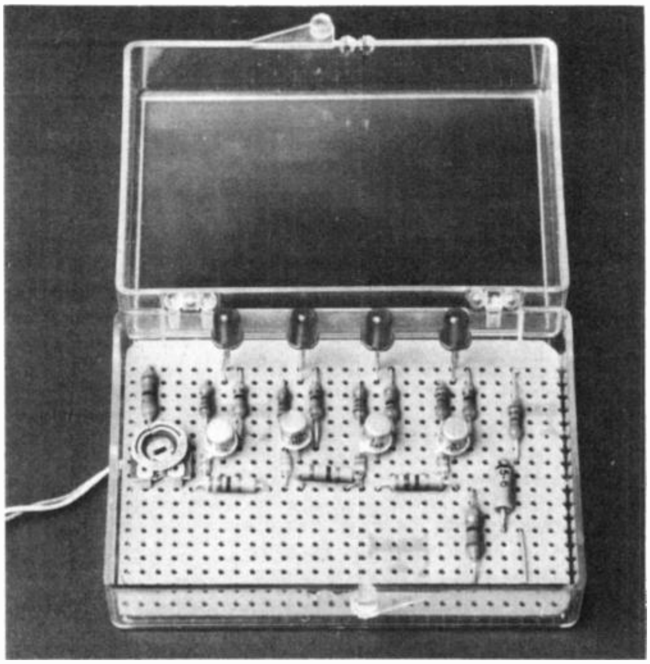
CONSTRUCTION starts here

CIRCUIT BOARD

The prototype voltmeter was constructed on a piece of 0·1 inch matrix stripboard, 18 strips by 28 holes as shown in Fig. 2. Great care should be taken to ensure that all the necessary breaks in the copper strips are properly carried out. It is easy to forget the odd break, and also, particularly if using a twist drill, to leave an odd whisker of copper still bridging the gap at one side. Using a proper Vero stripboard cutter avoids this problem, but a drill is quite adequate if used carefully and the breaks examined with an eyeglass.

Proceed to assemble the components into the board, starting with the resistors, diodes and transistors and finally insert the four l.e.d.s, D2 to D5, so that they stand approximately 20mm above the board. Ensure that the polarities of the l.e.d.s are correctly observed.

The piece of stripboard was chosen to be a snug fit in a transparent plastic box with a hinged lid, approximately 75×55×30mm. A piece of glossy white cardboard was cut out to form an escutcheon (see photo) and holes for the l.e.ds to show through were cut with a two-hole punch as used for file-paper. A scale was marked below the four holes, in half volt intervals from 11·5V to 15V, using rub-down transfers. The scale was positioned so that the four l.e.d.s appear at 11·75V, 12·75V, 13·75V and 14·75V. Finally, a length of light flex was attached to the board and passed through a hole in the side of the case.



View inside the clear plastic case of the voltmeter showing the push-fit of the stripboard assembly.

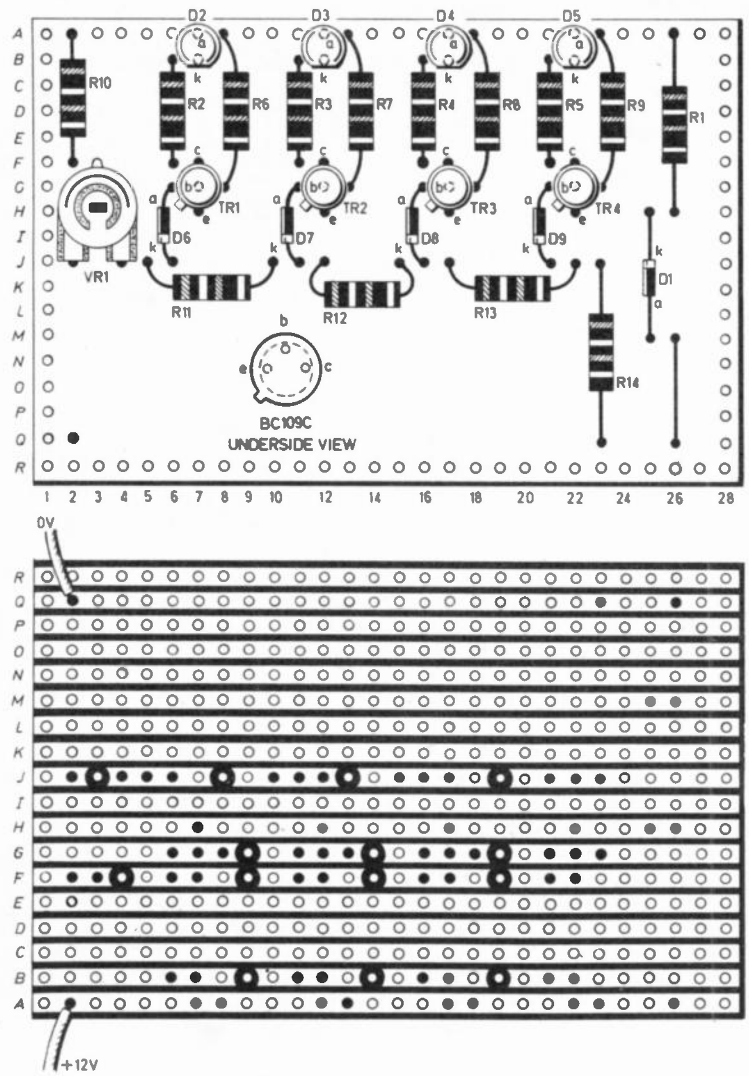


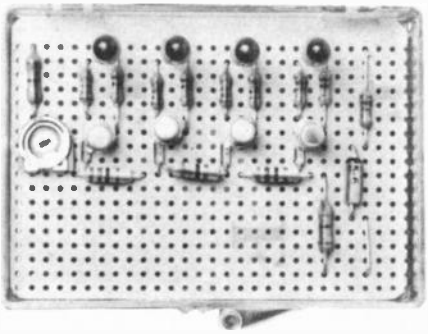
Fig. 2. The stripboard layout for the Voltmeter. L.E.D.s D2 to D5 must be in the positions shown.

SETTING UP

If you have access to a laboratory-style variable output voltage power supply, this is the easiest way to set the circuit up. Simply set the output voltage of the supply to 12·75V and adjust VR1 so that D3 is at half brilliance. D4 and D5 will be extinguished, whilst D2 will be at full brightness for comparison.

Alternatively, the unit can be set up in a vehicle but you will need the usual multimeter, which every electronic hobbyist ought to possess. Connect the L.E.D. Voltmeter between earth (chassis) and a live point "downstream" of the ignition switch. Take great care to observe the correct polarity, to avoid any possibility of damage to the voltmeter. The author has checked that the prototype survives being connected to 12V supply the wrong way round but can't guarantee that this will always be the case.

Close-up of the stripboard assembly. Note the slightly angled corners of the board to fit into the radiused corner of the case.



With the L.E.D. Voltmeter connected and VR1 set to minimum resistance, D2 should light, and possibly D3 and D4 also, with a newish battery in hot weather. Measure the battery voltage with a multimeter and set VR1 so that the indication on the L.E.D. Voltmeter agrees with it. (In cold weather it may be necessary to start the engine to bring the voltage up over 11·5V.) It now only remains to fit the escutcheon, close the plastic box and fit it to the dashboard or any other convenient flat surface, with double sided sticky tape.

USING THE VOLTMETER

The Voltmeter enables one to keep an eye on the voltage of the electrical system under all the various conditions of everyday use. The "normal" voltage will vary depending upon engine speed, the load on the electrical system (headlights, windscreen wipers, etc.) and the temperature. There will also be minor differences between makes of car and even between different cars of the same make and model, but the following is a general guide as to what to expect.

Driving at normal speed, lights, wipers, rear windscreen heater all off: 14·5 to 15V, that is three l.e.d.s on, the fourth just glowing.

Driving at normal speed, lights, heater fan, all on: 13·5 to 14V, that is, two l.e.d.s on, possibly three.

Engine idling: depends very much on idling speed and whether any electrics on; anything from one l.e.d. just glowing to two l.e.d.s on.

Once having installed the L.E.D. Voltmeter, the important thing is to learn to recognise what is normal for your car. Then, if there is a departure from the normal pattern, you will have advance warning that either the generator/alternator or the battery needs attention. ⌑

Finished unit with the scale markings on the cardboard escutcheon clearly visible.

BOOK REVIEWS

ZX81 BASIC BOOK
Author Robin Norman
Price £4·95
Size 216 × 134mm 167 pages
Publisher Newnes Technical Books
ISBN 0 408 01178 5

ANYONE familiar with the ZX81 manual will feel at home with this book. It is written in the same easy to read, light-hearted style as the manual and is even printed using very similar type faces. It is another in the long line of books on the ZX81 which have appeared recently but one which is above average in design and presentation and which would make a useful companion to the manual.

There are thirty chapters in all. The author starts by defining some of the many terms used in computing which beginners often find confusing and which some other books take for granted. Programming is introduced step by step and the author assumes the role of a big brother who is looking over the shoulder of his younger brother. I particularly like the way in which the reader is guided into making mistakes initially so that the consequences of those mistakes can be discussed.

It is encouraging to see flowcharts being used. The importance of flowcharts for writing structured programs cannot be over-emphasised. The book concludes with five appendices. A glossary of terms and sample answers to exercises are both useful inclusions and a 15 program appendix, 12 of which are written for 1K systems, should delight the beginner. All in all, the book is a good buy and fairly priced.

J.W.T.

BASIC ELECTRONICS
Author Course prepared by Malcolm Plant, based on earlier work by Douglas Shorthouse
Price £6·45 soft covers
Size 210 × 135mm, 522 pages, many with photographs and line drawings
Publisher Hodder and Stoughton Schools Council, "Project Technology"
ISBN 0 340 23425 3

THIS is a text book, and as such it is primarily intended for use in a classroom or organised club situation, but nevertheless it would still make a useful addition to the home enthusiast's library.

Basic Electronics is actually published in five parts containing a total of eleven sections and this edition contains the complete set. The course has been designed to meet the needs of wide age and ability ranges and its comprehensive subject matter provides the student with the theory and background information necessary to give a good understanding of electronics. It combines principles with practical applications and includes step by step instructions on how to build 21 useful projects.

True to text book form, this work is set out in logical order, each section accompanied by examples, experiments and questions, the answers of which are given at the end of each section. It's well written and easy to follow and under guidance could form the backbone of an excellent electronics course.

G.P.H.

ELECTRONICS—QUESTIONS AND ANSWERS (Second edition)
Author Ian Hickman
Price £1·95 soft covers
Size 165 × 110mm, 150 pages, many with line illustrations
Publisher Butterworth & Co Ltd, "Newnes Technical Books"
ISBN 0 408 00578 5

ONE of a series of "Questions and Answers" books from Newnes, this one, by respected technical author Ian Hickman, covers most aspects of electronics from first principles to some quite advanced techniques employed in this field, and takes the reader to a useful level of practical knowledge.

The general format for these books is to have a question followed by the answer in clear and concise terms, avoiding the use of complicated mathematical formulae so the beginner and student alike can follow it through.

The questions follow a logical order to guide the reader through the subject, ranging from the most fundamental "what is electronics?" to "how does a laser work?" However, the question/answer format does somewhat limit this book as a ready reference work, making it difficult to refer to a particular theory or principle. But having said that, its primary function is as an introduction to electronics, and judging by the first edition sales of over 25,000 copies, it adequately fulfils this rôle.

Incidentally, Hickman's additions to the second edition include sections on digital techniques, test gear and electronic music.

G.P.H.

LABORATORY MANUAL FOR THE ART OF ELECTRONICS
Authors Paul Horowitz and Ian Robinson
Price £12·00 Hardcover; £4·95 Paperback
Size 255 × 175mm, 144 pages
Publisher Cambridge University Press
ISBN 0 521 24265 7 (Hardcover)
0 521 28510 0 (Paperback)

THIS LABORATORY manual is intended to accompany *The Art of Elecronics* by Horowitz and Hill (Cambridge University Press) which was reviewed in the March 1981 issue of EVERYDAY ELECTRONICS. The manual consists of 23 lab exercises that are used at Harvard University in their Laboratory Electronics course. The instruments and other electronic parts required are listed. The prototyping breadboard referred to for use in setting up the experiments is an in-house variety, but no problem should arise in the employment of other types of breadboards.

The appropriate text in the *Art of Electronics* is indicated at the start of each exercise, as required reading. The exercises start with d.c. circuits and Ohm's law, and proceed through capacitors, diodes, transistors, op-amps, oscillators and power supplies, to logic and so to microprocessors.

The spiral binding permits the book to lie flat on the table or bench; wide margins "leave room for valuable scribblings." A worthy practical back-up for *The Art of Electronics*. Possessors of that fine opus will need no urging to acquire this Lab Manual and thereby further extend its value and teaching power.

F.E.B.

INTRODUCING MICROPROCESSORS
Author Ian R. Sinclair
Price £4·50
Size 215 × 138mm, Paperback, 121 pages
Publisher Keith Dickinson Publishing Ltd
ISBN 0 097266 01 0

ALTHOUGH an excellent introduction to microprocessors, this book does need a fair understanding of the electrical functions involved, or at least plenty of concentration when reading it. As the author says, "The greatest problem which faces anyone who is going to use a microprocessor is knowing where to start; the greatest problem which faces me is how to tell you." Later in the book he adds, "However complex these devices may appear, they consist only of three basic gate types along with large numbers of flip-flops. It's the arrangement of the goods that counts, as Raquel Welch once observed."

Starting with digital circuits that control, compute and make the "mighty chip" so valuable, the theme continues through the microprocessor, the other chips and the registers. Loading and storing the instructions comes next followed by more program operations and finally how to go about programming.

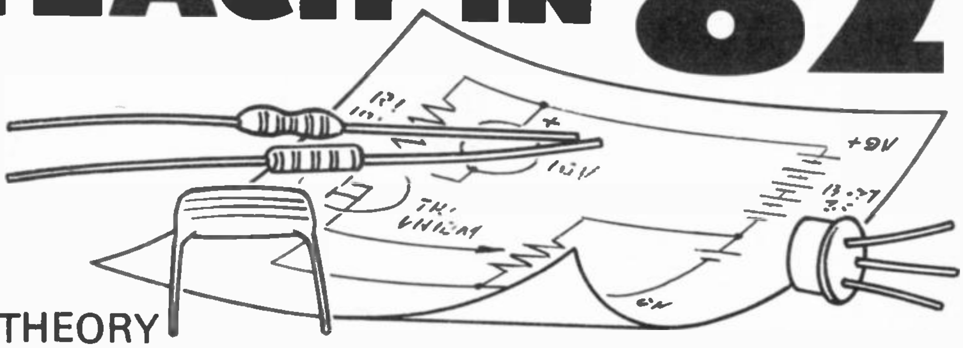
Not an easy-reading book—but a good and careful study will be rewarded with a sound understanding of the basics. If you are prepared to sit down and learn, this is the work for you.

D.J.G.

EE TEACH-IN 82

PART 8

BY O.N. BISHOP



BASIC ELECTRONIC THEORY WITH EXPERIMENTS

OPTOELECTRONICS

THIS month's topic is concerned mainly with devices which convert electrical energy into light energy, or light energy into electrical energy.

ELECTRICITY INTO LIGHT

Devices which convert electrical energy into light energy include filament lamps, fluorescent lamps, neon lamps and the xenon lamps which are used in photographic flash-guns.

In filament lamps the energy of the moving electrons is transferred to the tungsten atoms of the filament. They become excited and eventually release the energy in the form of heat and light.

In neon and xenon tubes, electrons move at high velocity through the rarified gas. As they strike the atoms of the gas they give energy to them. Later this energy is released as light.

The sodium lamps and mercury lamps so commonly used for street lighting work on the same principle. Sodium and mercury are not gases at ordinary temperatures but they are vaporised as the lamp warms up.

Fluorescent lamps work on a slightly different principle. The tube contains mercury vapour and argon. When a current passes, these gases are excited as explained above and give out visible light. They also emit a large quantity of ultraviolet light. The tube is coated on the inside with a fluorescent substance which absorbs the ultraviolet light and re-radiates the energy as visible light.

Developments in solid-state electronics have provided us with yet another device for converting electricity to light, the light-emitting diode, or l.e.d. for short. The way this works was described in Part 3.

Nowadays we have l.e.d.s in many shapes and sizes. They can be made to emit light of several different colours. The commonest ones emit red light, but l.e.d.s which emit yellow, orange or green light are available. A blue light emitting diode has just been developed.

There are also infra-red emitting types such as the TIL38 used in Experiment 8.3.

Light emitting diodes can also be constructed to operate in the manner of a laser. They produce a high-intensity beam of coherent light (usually infra-red) which can travel for great distances without significant loss. This technique is becoming important in telecommunications.

Modulated laser light passing along optical fibre replaces the conventional copper cables of the telephone system. Mention of lasers reminds us that many different types of lasers are used for light production, though we do not have space to go into details here.

DISPLAY MODULE

The first task this month is to build the single digit 7-segment DISPLAY MODULE. The finished assembly is to be mounted just behind the *Minilab* sloping control panel so that the display fits into the rectangular window beneath ME1.

The complete circuit diagram for the module is shown in Fig.8.1. The components have been annotated such that they follow on from all other permanently installed *Minilab* components. The annotations of the experimental components to be plugged into the Verobloc will in turn follow on from these.

The display, X1 has seven segments, (hence its name), each consisting of an l.e.d. Two or more l.e.ds can be lit to form an illuminated numeral. Displays of this kind are commonly used in digital watches, cash registers, calculators, video-recorders and in many other ways. The circuit shows how the display may be controlled by a CMOS i.c. This is designed to perform the following functions:

(1) Accept four inputs which are equivalent to the numerals 0 to 9 in binary coded decimal (b.c.d. see below).

(2) Decode the b.c.d. and provide seven outputs to turn the seven segments of the display on or off.

(3) Transfer the input states to a set of latches, when the 'store' (or latch) input (pin 5) is taken *from low* to *high*.

Binary coded decimal is a way of expressing decimal numbers in binary form. A single decimal digit of b.c.d. has one block of four binary digits. The numeral 0 is represented by 0000, 1 is represented by 001, 5 by 0101, 9 by 1001, and so on. Two-digit decimal numbers are represented by two blocks of four digits. For example 19 is represented by 0001, 1001, even though the true binary equivalent of 19 is 10011. B.c.d. is a *code*, not a strict mathematical way of writing out binary numbers, and it is very convenient in electronic circuits. Usually we represent 1 by a high voltage (+5V or +6V), and 0 by a low voltage (0V). To input 5 into IC1 we make pins 2 and 7 high (4+1=5), and pins 1 and 8 low.

When the lamp test ($\overline{LT}$) input is made low, all segments light. When the blanking input $\overline{BL}$ is made low, all segments are switched off. Normally we hold $\overline{LT}$ and $\overline{BL}$ inputs high. The display also goes blank if the b.c.d. input is greater than nine.

DISPLAY MODULE CONSTRUCTION

The components for the display module are to be mounted on a piece of Veroboard size 10 strips by 24 holes, identical to the piece given free with our March '82 issue.

The layout of the components on the topside of this board and the breaks to be made on the underside with complete wiring up details are shown in Fig. 8.2. A hole needs to be drilled in the *Minilab* Control panel to accommodate a 6BA screw which will hold the module in place. Fixing details for this are also shown in Fig.8.2. The hole needs to be made 10mm left of the TB4 left-fixing screw. A countersunk cross-head type will be neater in appearance.

Make all the necessary breaks along the tracks on the underside of the board using either a small drill bit or a spot face cutter. A wire wrap type socket for X1 was specified so that the height of X1 above the board could be varied to suit. The slot in the board provides lateral adjustment.

DISPLAY MODULE

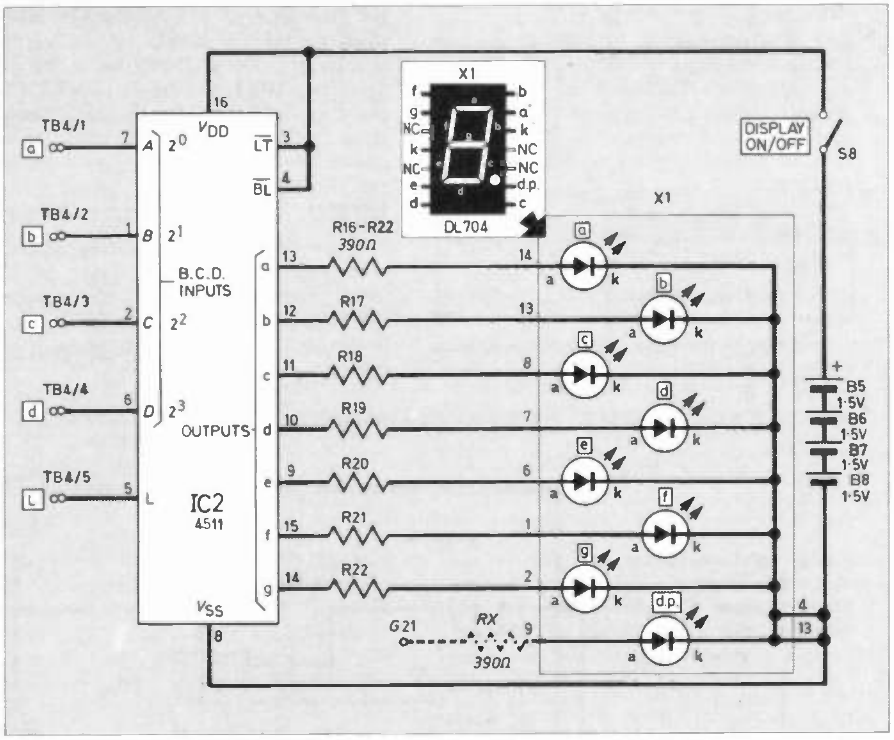
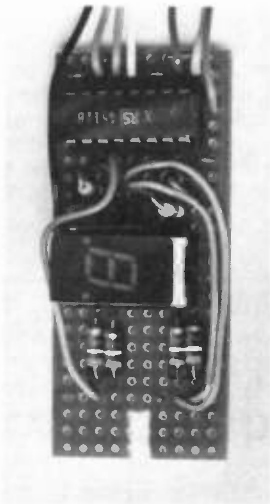
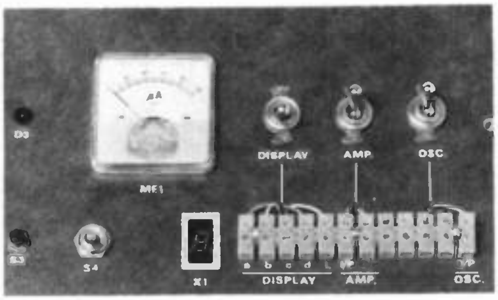


Fig. 8.1. The circuit diagram for the DISPLAY MODULE.





The Minilab Control Panel with the final module fitted.

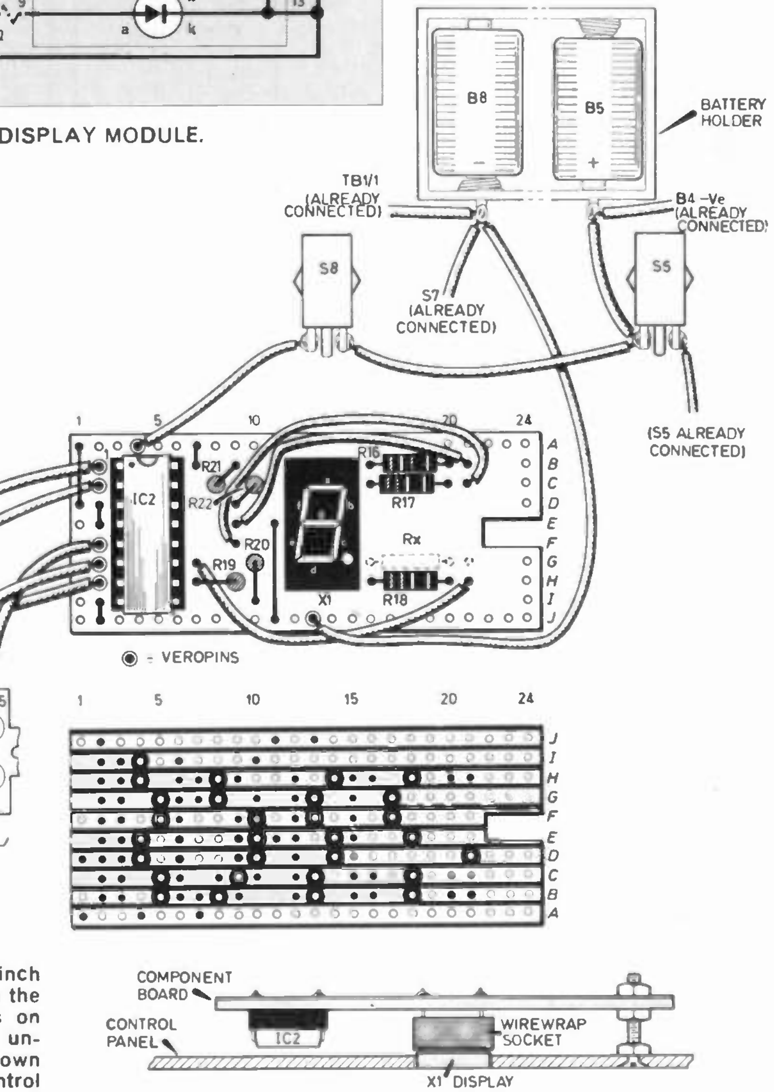
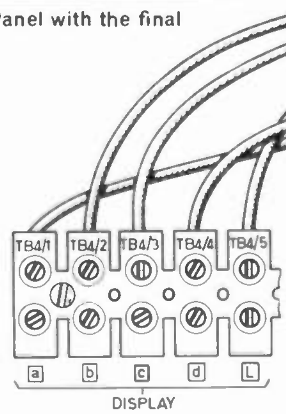



Fig. 8.2. The Module is to be built on a piece of 0·1 inch matrix stripboard and fitted beneath the window in the Control Panel. The layout of the components on the topside of the board, breaks necessary on the underside and complete interwiring details are shown above. The method of fixing the board to the Control Panel is seen below.

Before carrying out any soldering on this board, find the correct position above the board for X1 so that it fits comfortably in the Control panel window. With this done, the remainder of the components may be assembled followed by the flying leads. Do not insert IC2 until all soldering has been completed. Follow the wiring plans and solder in S8, and the connection to B8 -ve. The +6V line to S8 can conveniently be picked up from S5, the oscillator supply line from B5 +ve. Finally insert IC2, fix the module in place and connect the leads to TB4.

EXPERIMENT 8.1
Using the 7-segment display module

The circuit diagram for this experiment is shown in Fig.8.3. The circuit is driven by a series of pulses from the Astable Module (see Part 6). These are counted by a pair of flip-flops, as described in Part 4 (Fig.4.19). There are only three outputs, one (inverted) from the Astable Module and one from each flip-flop. These are fed to the "1", "2", and "4" inputs on IC3. The fourth input ("8") is held permanently low. Hence we get a series of eight input states running from 0000 (decimal 0) to 0111 (decimal 7), which is repeated indefinitely.

The layout of the components on the Verobloc is shown in Fig. 8.4.

When power is applied to all circuit elements, the display should now run through the counting sequence 0 to 7. If the display shows odd-looking characters, you probably have a bad contact between IC2 and the display or the wires to a, b, c and d on TB4 are wrongly connected. Check the soldering of the resistors. It is also possible that one or more of the resistors is incorrectly sited. If you obtain proper numerals, but in the wrong order, possibly including blanks, the input connections to IC2 are wrong.

Remove the wire from *M4* and push it into socket *A4* instead. This makes the store (L) input high; the display no longer follows the changes in the flip-flops but shows the numeral it was displaying when you made this input high. Make the input low again (back to *M4*) and the 0 to 7 sequence is resumed.

The Display Module will be of great use in Part 12 of the series.

To further illustrate the function of the store input, connect the lead from L (TB4/5) to Verobloc position *H1*, a 10kΩ resistor from *J1* to strip *M*, and wire S1 between strip *A* and *G1*. Press S1 at any time during the counting sequence to latch the display. Releasing S1 causes the display to follow the input data again.

LIGHT AND CONDUCTION

The **light-dependent resistor** (l.d.r.) or **photo-conductive cell** does not convert light energy to electrical energy but, since it is used in much the same way as many of the light-to-electricity converters, we will deal with it here. It consists of a disc of semiconducting material (usually cadmium sulphide) with two terminals.

Under low light, or in darkness, it has very high resistance, in the region of 10MΩ. When light shines on it, the energy of light causes electron-hole pairs to be produced. This provides plenty of charge carriers, so the resistance of the material falls. In bright light it may fall as low as 100Ω.

EXPERIMENT 8.2
A light-triggered switch

The circuit for Experiment 8.2 is shown in Fig. 8.5.

The l.d.r. (PCC1) and VR1 form a potential divider. As light level increases, the resistance of PCC1 decreases and V_A rises. Set up the circuit on the Verobloc according to Fig.8.6. Note that R25 is made up of two 100Ω resistors in parallel. Cover the l.d.r. with a piece of black cloth or thick cardboard. Turn VR1 until D1 l.e.d. comes on. Then carefully turn VR1 back until the l.e.d. *just* does *not* go off again. A few trials will find the correct position.

When VR1 is finally adjusted the l.e.d. is on. Remove the cover from the l.d.r. What happens to the l.e.d. If you have set VR1 correctly, it should go off. If it does, cover the l.d.r. again. Does the l.e.d. come on?

EXPERIMENT 8.1

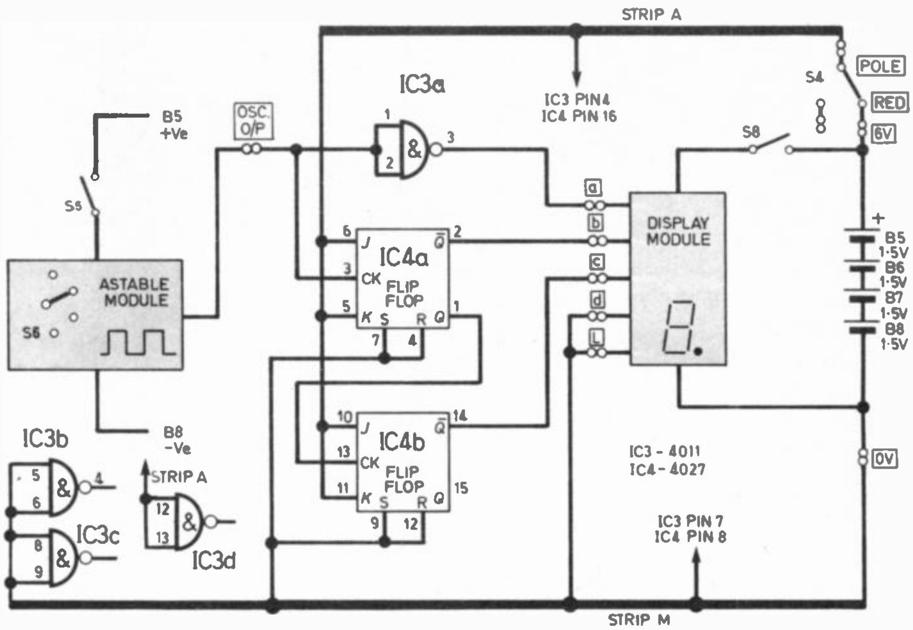


Fig. 8.3. A simple counting circuit to demonstrate the operation of the DISPLAY MODULE, Expt. 8.1.

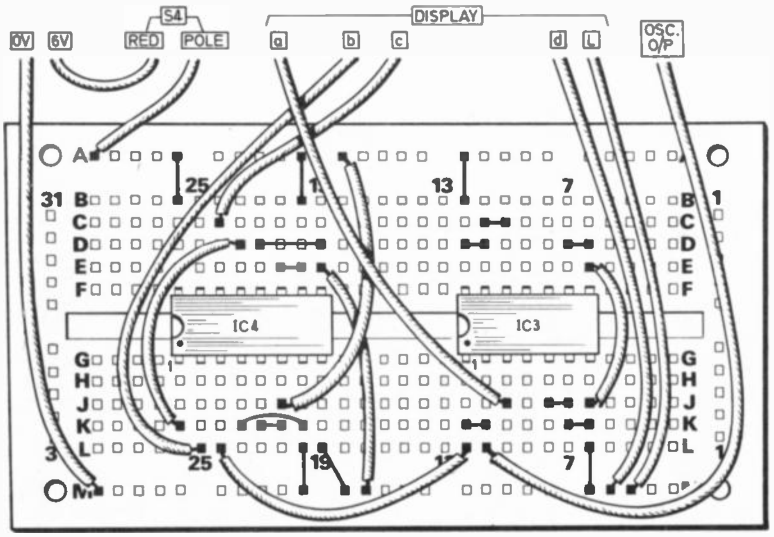


Fig. 8. 4. The layout of the components on the Verobloc for Expt. 8.1.

In darkness V_A is low, TR4 is off, making V_C high, which causes TR5 to be turned on. Current is flowing through R25, so V_D is about 1V (assuming the current is 20mA). V_B must be higher than V_D by the emitter-base forward voltage drop, which is 0·6V, so V_B must be 1·6V. By adjusting VR1 we make V_A match V_B. No base current flows to TR4.

When the light falling on PCC1 is slightly increased, V_A rises *slightly* above 1·6V. Base current flows and TR4 begins to turn on, V_C begins to fall and TR5 begins to turn off. As TR5 turns off, the current through D1, R24, TR5 and R25 is reduced. This reduces the p.d. across R25 and V_D falls. V_B *must* stay 0·6V higher than V_D but, since V_D has fallen, V_B must fall by an equal amount.

The increasing difference between V_A (=1·6V) and V_B (falling below 1·6V) leads to an increasing base current to TR4, turning it further on. Thus a slight increase in light brings about a sharp triggering action, turning D1 on abruptly.

Once the l.e.d. is off, no current flows through R25; V_D=0V and so V_B=0·6V. To turn the l.e.d. on again, V_A must be made *lower than* 0·6V. There is a gap between 0·6V and 1·6V where changes in V_A have no effect. Thus, very small changes in light level do not affect the circuit.

If the circuit is set to turn on the l.e.d. at sunrise, a small reduction in the light caused by a cloud passing over the sun does not turn the l.e.d. off again.

This circuit is useful for giving a sharp "snap" action. It is a good example of the use of positive feedback. A circuit which has this kind of action is generally known as a **Schmitt trigger.**

It is interesting to investigate the effect of altering the value of R25 to 100Ω or 560Ω. This affects the difference between the switch-on level and the switch-off level.

EXPERIMENT 8.2

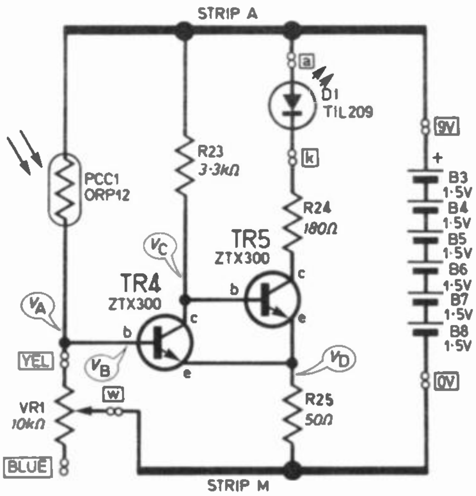


Fig. 8.5. Circuit for a light-triggered switch using a Schmitt trigger arrangement. The layout.

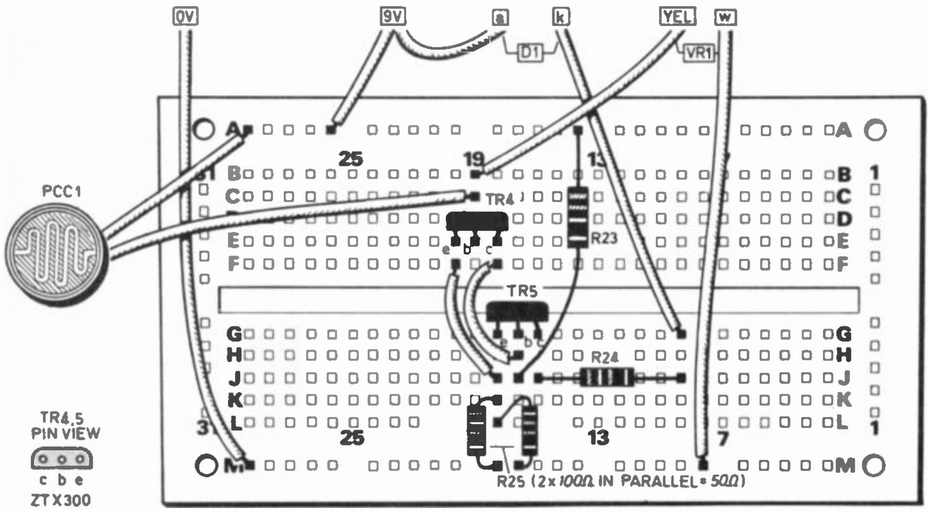


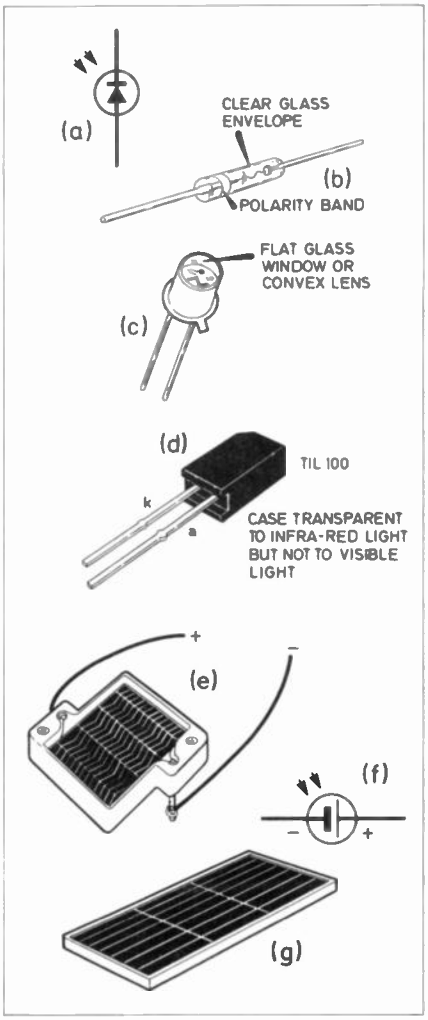
Fig. 8.6. The component layout on the Verobloc for the circuit in Fig. 8.5.

LIGHT TO ELECTRICITY

A photodiode, examples of some types and circuit symbol are shown in Fig. 8.7 generates an e.m.f. when light falls on it. It is an example of a **photo-voltaic cell.** The energy from the light causes the production of electron-hole pairs at the *pn* junction. Since these are in the field of the imaginary cell at the depletion region, the holes and electrons move in opposite directions and cannot re-combine. This gives rise to an additional e.m.f. across the junction. This is proportional to the amount of light falling on it.

The silicon **photoelectric cell** (solar cell) operates in a manner similar to the photodiode, but is designed to have a large area

Fig. 8.7. (a) Circuit Symbol for a photodiode (b) and (c) two package styles for light sensitive types (d) package for an infra-red photodiode (e) and (g) two array geometries from the many solar cell types available (f) circuit symbol for a photovoltaic cell—solar cell.



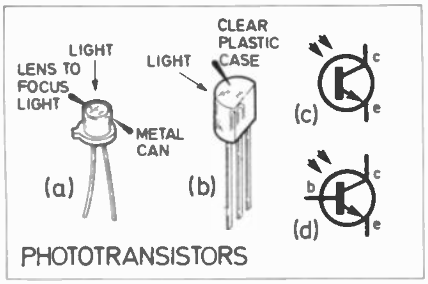


Fig. 8.8. Two common packages for phototransistors and circuit symbols for types with and without a base connection.

for receiving light and a very low resistance, so allowing the additional e.m.f. to produce the maximum amount of current.

A **phototransistor** (Fig. 8.8) need not have a base connection. The action of light at the collector-base junction generates an increased e.m.f. which causes the equivalent of a base current to flow from the collector to the base. Transistor action amplifies this small current, resulting in a relatively large collector current.

EXPERIMENT 8.3
Infra-red communication

We can use the radiation from an infra-red l.e.d. to carry a signal to a photodiode, (see Fig. 8.9). The transmitter uses a Darlington pair (see last month's article) to vary the brightness of the infra-red l.e.d. D4 in accordance with the waveform of the signal. Here we apply a square-wave signal at 100Hz, 1kHz and 10kHz (available from the Astable Module). This is controlled by S1, allowing Morse Code signals to be sent.

The beam is picked up by a photodiode D5. This is reverse-biased. Variations in the amount of radiation reaching D5 cause variations in the potential at *A*. These are amplified by the Amplifier Module and heard in the Minilab speaker, LS1.

For a demonstration, you can set up both transmitter and receiver on the same Verobloc. The loudspeaker should emit a note whenever S1 is pressed. To check that this is really an infra-red transmission, place a piece of card between D4 and D5 to interrupt the beam. The tone in LS1 should cease when this is done.

It is better to have the transmitter on a separate board and to increase the distance between D4 and D5. The circuit works up to a distance of 1 metre.

A greater distance can be covered if you use reflectors and have lenses to focus the beam. If there is a lot of stray infra-red radiation in the room, it may swamp the transmission. Switch off any filament lamps near the workbench.

To transmit across a brightly lit room (or outdoors) put a shield of black paper around D5 so that it can receive radiation only from the direction of D4.

Try to pick up the signals from the controller of an infra-red remote-control TV set. Try to improve transmission by using various lens systems. A lens of large diameter would catch a large amount of radiation from D4 and direct it all to D5. Try using mirrors to send the beam round corners.

Unfortunately, a microphone does not provide a large enough signal to work the transmitter directly. If you make another

EXPERIMENT 8.3

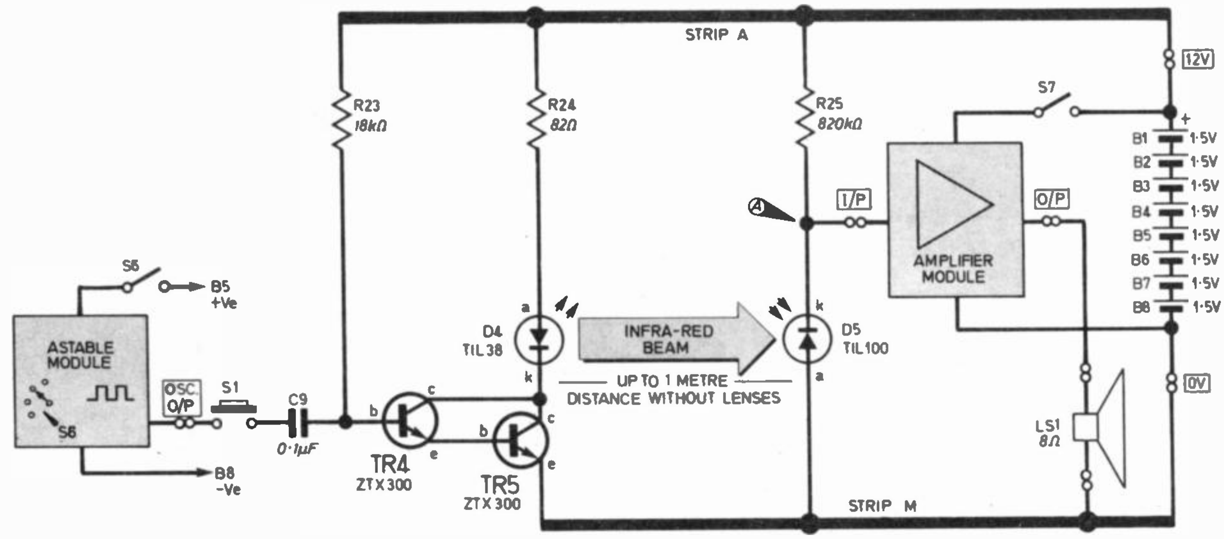


Fig. 8.9. Circuit diagram for a simple infra-red communication system. The experiment uses two *Minilab* modules.

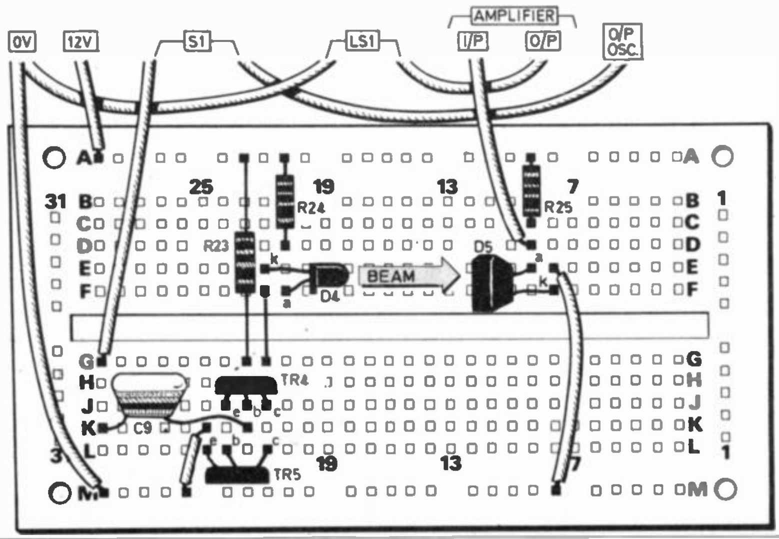


Fig. 8.10. The layout of the components on the Verobloc for the circuit in Fig. 8.9.

Answers to Part 7

7.1. Collector.
7.2. Common base connection.
7.3. Multiply the two individual gains together.
7.4. C6, C7.
7.5. They are specially manufactured to have low noise.
7.6. Negative.
7.7 To adjust output to 0V when both inputs are equal.
7.8. −3·5V.
7.9. −1·1V.
7.10. *(In question 7.10, R16 should read R17, R17 should read R18.)* 0·01 × 1006800/6800=1·48V.

Amplifier Module, you can use this to amplify the signal from the microphone. Connect the output of the amplifier to location *H30*, Fig. 8.10.

A radio set or tape-recorder can be used as a source of signals if it has an earphone socket. Run two wires from the plug; one goes to location *H30*, Fig. 8.10, the other goes to the 0V line.

LIQUID CRYSTAL DISPLAYS

Liquid crystal displays (l.c.d.) are taking the place of l.e.ds in most kinds of digital display. They need so little current that they can be driven for months from one or two tiny button-cells. They can be seen clearly in bright light, in fact the brighter the light the more easily you can see them. The reverse applies to l.e.d. displays!

Liquid crystal displays do not convert electricity to light. The display is viewed by daylight, room lighting or a built-in lamp, and areas of the display are made to appear light or dark to form the characters displayed.

There is a thin layer of liquid sandwiched between two transparent sheets. The inside surface of the rear sheet is coated with a transparent conductive layer (the back plate) and there is a reflector behind it. The inside surface of the front sheet has a design printed on it in transparent conductive material.

If there is no p.d. between a segment and the back plane, the molecules in that region of the liquid are arranged in a random way. Light enters the l.c.d. and is polarised. It passes through the sandwich, is reflected, passes back again and out to the viewer. The display appears clear in that region.

If there is a p.d. between a segment and the back plane, the field arranges the molecules of that region in a regular array which rotates the plane of polarisation of light as it passes through. The light is reflected and there is more rotation on the way back.

QUESTION TIME

8.1. What is the b.c.d. for the decimal number 139?
8.2. If in Fig 8.1 the inputs to pins 7 and 6 were +6V, and to pins 1 and 2 were 0V (other inputs as shown), what would be the outputs from pins 9 to 15?
8.3. In what way does the action of an l.d.r. differ from that of a photodiode?
8.4. What would be the effect of connecting the emitters of TR4 and TR5 (Fig. 8.5) directly to the 0V line?
8.5. What would be the effect of exchanging PCC1 and VR1 in the circuit of (Fig 8.5)?
8.6. What is another name for an l.d.r?
8.7. Which part of the circuit in Fig. 8.5 provides the positive feedback?

By the time it reaches the polarising film again, the light is polarised right angles to its original direction and it cannot pass through the polarising film. The display appears black in that region.

To be continued

COUNTER INTELLIGENCE

By PAUL YOUNG

Spoilt set

We have always stocked in addition to components, a range of technical books. Over the years we have cut out the less popular ones, but there is one kind that always sells steadily, and that is the *Teaching Books.* Unfortunately, we are now having problems with these.

Most of these consist of a set, usually five books, which could, originally, be purchased separately. This was obviously helpful to the impecunious constructor. But now, on the basis of the dictum that the cost involved in selling one book is the same as five, the publishers will only supply complete sets, so the poor old retailer, if he supplies one book from the set, is eventually left with several incomplete sets.

Mind you, I don't think the perfect teaching book has yet been written. Does the raw beginner really want to know about electrons revolving around nuclei, complete with little diagrams? After all, none of us really know what electricity is, so why not tell the reader "it is a force" with one end positive and one negative, then proceed to show him experiments that he can duplicate, to demonstrate what this force can do, given the right circumstances.

Computer Shopping

Has it ever occurred to you that with the rapid progress made in computers, it could change our whole way of life? The French are already replacing all their telephone directories with minicomputers. If it is successful, it is the thin end of the wedge. You could replace your encyclopedia with a computer and also your component catalogue.

The time cannot be far distant, when, one of our readers who wants a transistor simply taps out the parameters on his home computer, and immediately on his screen would appear a list of all stockists and prices. If our hypothetical reader is a designer, he might be able to type out the specification of a component he needs, without even knowing if it exists, and there on the screen would be the answer.

Anti-Radar Invention

We in this country, are fortunate in having scientists with brilliant original minds. I was reminded of this quite recently when I read of the death of Professor Derek Jackson. He was responsible for testing out our reply to German radar in 1942.

I expect to all but the most senior of our readers the word "Radar" means the electronic gadgetry they have at major airports to prevent aircraft from bumping into each other while airborne, In 1940 you might say it was used in the reverse way.

Imagine you are being attacked by formations of enemy bombers; you have a limited number of fighters and their duration of flight is only a little over an hour, therefore your problem is to guide your fighters right onto the bombers as quickly as possible. If you think for a moment of the size of the sky, you have to admit to having an enormous problem to deal with. It was Sir Robert Watson Watt's invention that solved it.

Where ever the German bombers appeared, there were several squadrons of *Spitfires* and *Hurricanes* waiting for them, vectored into position by radar. The Germans couldn't make it out, and when the going became really rough, the Luftwaffe Commanders told their pilots "dont worry, they are down to their last 50 *Spitfires*". But when they kept on appearing day after day, these remarks were received rather sceptically by the German aircrew, and they would say sarcastically "there are those last 50 *Spitfires* again".

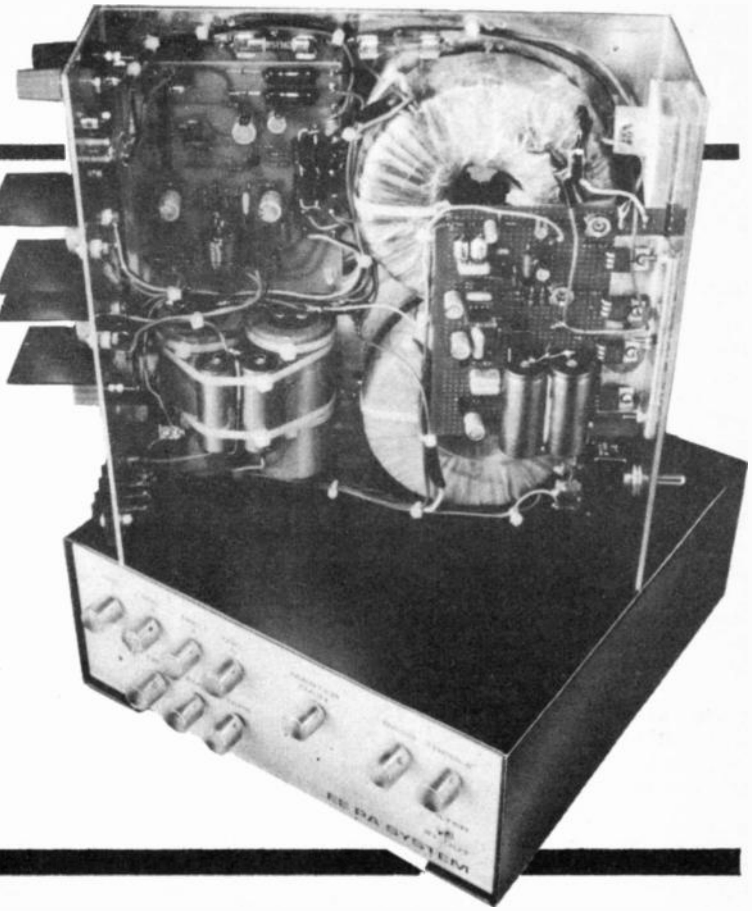
However, by 1942, the tide had turned in our favour, and our bombers were penetrating deep into Germany. But The German radar was now being used successfully against them. Eventually, Professor R. V. Jones came up with an answer, which was, if you want to hide a pebble you place it on a pebbly beach.

He decided that if thousands of small strips of metal coated paper were released into the sky by the bombers, they would cause a similar number of reflections on the German radar screens, most of them being spurious. Professor Jackson, as head of Airborne Radar in the RAF, was responsible for testing the theory out. It was, of course, very successful, and given the code name "Window". It enabled many of our aircraft to return home safely.

P.S. If any readers would like to learn more about the Radar of World War II, and the two remarkable men I have mentioned, I strongly recommend that they read the book by Professor R. V. Jones entitled, *Most Secret War* published by Hamish Mamilton.

PUBLIC ADDRESS SYSTEM

PART 1
By E.A.Rule



This amplifier was born as a result of attending a number of local village fêtes and hearing the awful sound quality that was coming from the average sound system used on these occasions.

The amplifier to be described has a performance equal to and better than many professional PA amplifiers and also has a number of optional design features. It is constructed as two units, one contains the control and pre-amplifier circuits and the other the power amplifier and dual purpose power supplies.

FEATURES

Inputs are provided for four microphones, disc, tape, and auxillary. Microphone priority over other inputs is provided. There are also Bass and Treble controls, a music/speech filter and a peak reading VU meter. Full mixing of all inputs is provided.

The power amplifier will deliver a minimum of 50 watts into either 8 ohm loads or 100 volt lines and can be operated from either the 240 volt mains or a 12 volt car battery.

Power MOSFETS are used in the output stage and enable a reliable wider bandwidth and lower distortion to be obtained than is possible with bipolar devices. Bi-FET op-amps are used in the early stages and enable an improved performance to be obtained due to their much improved slew rate over the more common types. Special low noise op-amps are used for the microphone inputs enabling a basic sensitivity of 70 microvolts with a signal to noise ratio of −58dB to be obtained.

Construction is straight forward and no special tools are required. All the components are generally available and no special test equipment is required for setting up.

POWER MOSFETS

The use of power MOSFETs may be new to some constructors so a few words about these devices may be helpful.

Bi-polar transistors have until recently been used in almost all the semiconductor amplifiers available until the introduction around 1978 of the Hitachi power MOSFETS.

Bi-polar transistors require a wide area of safe operation to obtain reliability and also a wide gain/bandwidth so that large amounts of negative feedback can be used at high audio frequencies to keep the harmonic and other distortion to an acceptable level. They also have a positive temperature coefficient which means that they are very prone to thermal runaway and careful design is required to avoid this. They also suffer from "storage effects" due to being minority carrier devices and at high audio frequencies this can cause a most objectional distortion that could well account for the so-called "transistor sound".

Because of all these problems a considerable amount of money and research went into looking for a better device and the power MOSFET developed by Hitachi Ltd of Tokyo, Japan, is one answer.

Their advantages over conventional transistors are:

- *good high frequency response because of their fast carrier speed.
- *no storage effect.
- *negative temperature coefficient so no risk of thermal runaway.
- *no secondary breakdown.
- *high input impedance and high gain.
- *no special protection circuits required.

The power amplifier section uses a complementary pair of these Hitachi power FETs and each device has a maximum dissipation rating of 100 watts. When used in an output stage delivering 50 watts, each device is only called upon to dissipate 25 watts, just ticking over in fact!

This makes for a very reliable output stage, more so, when you consider that they are also rated at 120 volts drain-to-source breakdown voltage and a drain current of 7 amps. You could run this amplifier at full power all day into a short circuit and you would not damage these devices (try that with bi-polars if you dare), mind you the power supply circuits may complain a bit!

No protection circuits are required (as are needed with bi-polar circuits) so another source of distortion is eliminated, as well as the risk of the amplifier "shutting down" during peaks of power output.

GENERAL CONSTRUCTION

As already mentioned, the PA amplifier is constructed in two units. This has the advantage of being easier to construct, keeps transformer magnetic fields away from sensitive microphone inputs, and gives the option of constructing more than one power amplifier section for extra "slave" amplifiers if more output power is required (see section on options later in series).

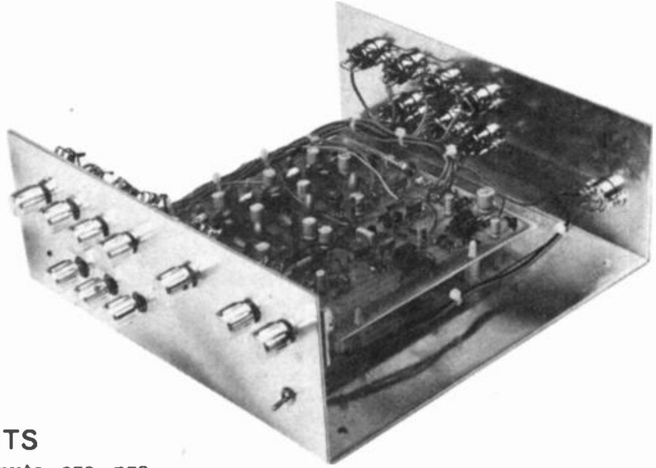
The front panel of the control unit has 11 controls fitted: four microphone gain controls and also one each for disc, tape, and auxiliary; a master gain control, bass and treble controls, a speech/music filter switch, and a l.e.d. "on" indicator completes the picture. On the rear panel of the control unit are all the input sockets (5-pin DIN 180 degree) and power supply socket (5-pin DIN 240 degree).

The power amplifier front panel has a mains/off/battery switch and a peak reading VU meter.

The rear of the power amplifier is fitted with a mains input socket, battery supply terminals, 8 ohm and 100 volt line output terminals, earth terminal and the heat sinks for the MOSFET output stage. The control unit power take off and audio input socket is also on this panel (another 5-pin DIN 240 degree).

The size of each unit is 245×100×290mm overall.

CONTROL UNIT



The complete circuit of the control unit section is shown in Fig. 1.1.

MICROPHONE INPUTS

Four microphone inputs are provided and as each of these are indentical only one will be described in detail.

Input connection is via a standard 5-pin DIN socket SK1 and the connections are arranged to accept either balanced or unbalanced microphone lines. This input is connected to one end of VR1 (MIC.1 GAIN) and its wiper goes to the input of IC1 (ZN459) via tantalum capacitor C1 (10μF). A tantalum *must* be used in this position otherwise leakage currents could cause noisy operation of VR1 due to the very high gain and sensitivity of this circuit.

The output from IC1 (pin 7) goes to the other end of VR1 via R3 and C5 (also a tantalum) R4 maintains the circuit at earth potential.

MIC GAIN CONTROL

The microphone gain is controlled by varying the amount of negative feedback and this method has a number of advantages over other methods. At the maximum gain position of VR1 the basic sensitivity is less than 100 microvolts and at the minimum gain position inputs as high as 10 volts will not overload the input.

The actual sensitivity of the input will depend on the impedance of the signal source connected to the input and details of this are given in Table 1.1. The use of negative fedback also ensures optimum frequency response

SPECIFICATION

POWER AMPLIFIER ONLY

Power output, continuous sine wave		55 watts into 8 ohms
Power bandwidth, −1dB		20Hz to 100kHz
Frequency response, 0·5dB		20Hz to 50kHz
Rise time		2 μsec
Slewrate		26 V/μsec
Damping factor, 8 ohm output	20Hz to 1kHz	better than 200
	20kHz	better than 50
Stability		unconditional
Sensitivity for 50 watts		80mV
Input impedance		100 kilohms
Power output from 100 volt line, 166 ohm load		60 watts
Frequency response, −3dB		30Hz to 12kHz
Regulation		2·4dB
V U Meter accuracy, 0dB=50 watts		within 2dB
The following figures relate to POWER AMPLIFIER plus CONTROL UNIT		
Harmonic distortion, at rated power output		less than 0·1% 30Hz to 20kHz
Intermodulation distortion, two tone, 15/16kHz, 28 volts peak output		less than 0·05%
Sensitivities	Microphone	70μV PD (see Table 1.1)
	Disc	3·5mV PD.
	Tape & Aux.	120mV PD.
Input impedance	Microphone	200 ohms
	Disc	47 kilohms
	Tape & Aux.	50/100 kilohms
Frequency response, ± 0·5dB		
	Microphone	30Hz to 22kHz
	Disc	R.I.A.A.
	Tape & Aux	20Hz to 30kHz
Signal-to-noise ratios,	A weighted	
	Microphone	−58dB
	Disc	−65dB
	Tape & Aux	−73dB
Tone controls	Bass, 100Hz	± 10dB
	Treble, 10kHz	± 10dB
Music/speech filter, −3dB		280Hz and 6·5kHz (12dB/octave)
Sub-sonic, disc input only		−3dB at 20Hz
		−8dB at 10Hz
		−17dB at 5Hz
Outputs	Control unit	80mV
	Tape	100mV

These figures were measured on the prototype

COMPONENTS approximate cost £49 excluding case & p.c.b.

and signal to noise ratio at *all* gain settings.

Another advantage of this system is that should the gain be set high and the microphone become disconnected, instead of a high hiss and/or hum coming from the loudspeakers, the input gain will *automatically* drop to a

TABLE 1.1: INPUT SENSITIVITY

Source impedance, ohms.	200Ω	600Ω	1kΩ	10kΩ	100kΩ	1MΩ
Source E.M.F. millivolts	0·14	0·28	0·42	3·5	35·0	350·0

$$\text{E.M.F. input} = 0{\cdot}07 \times \frac{\text{source impedance} + 200\Omega}{200\Omega}$$

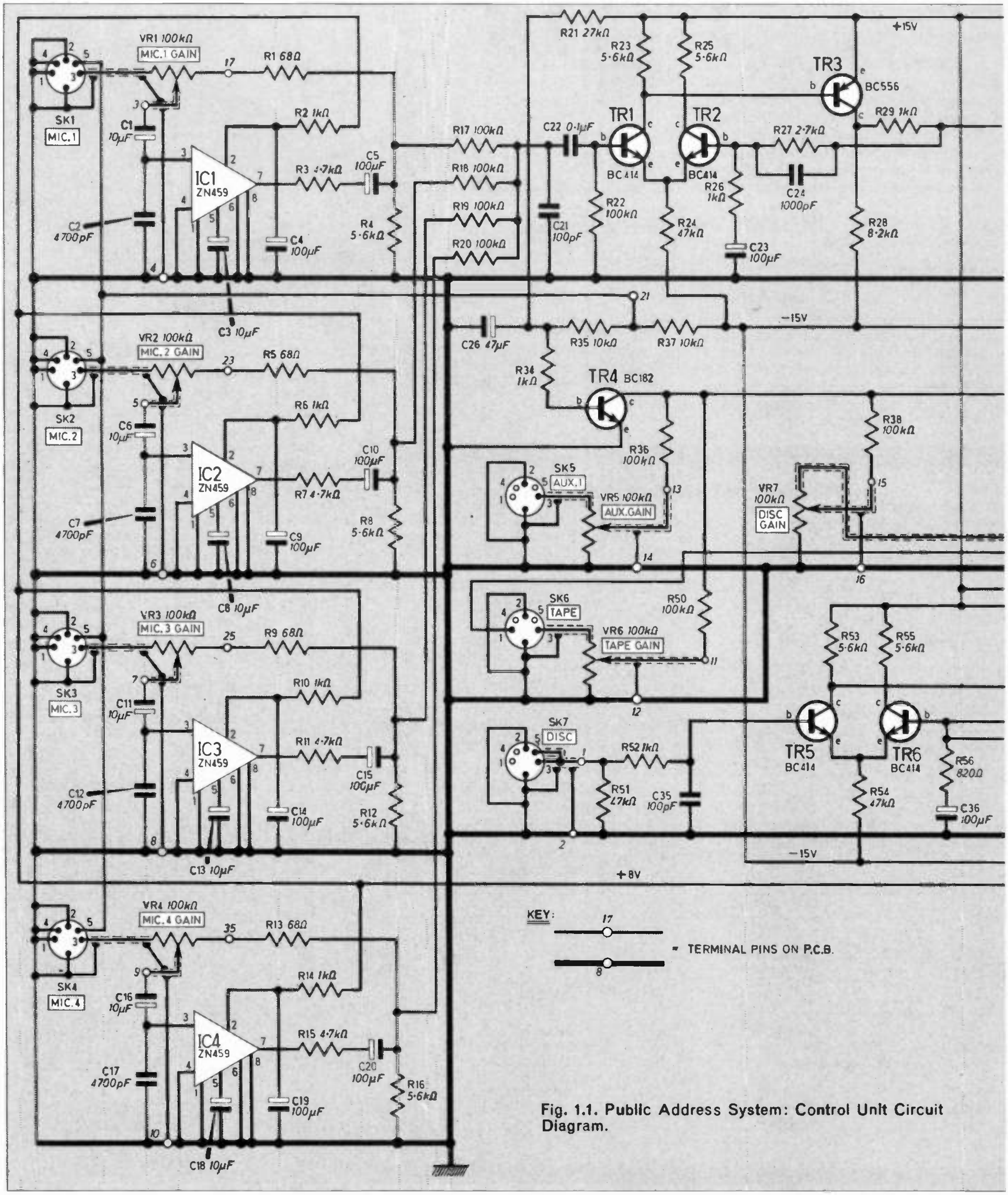


Fig. 1.1. Public Address System: Control Unit Circuit Diagram.

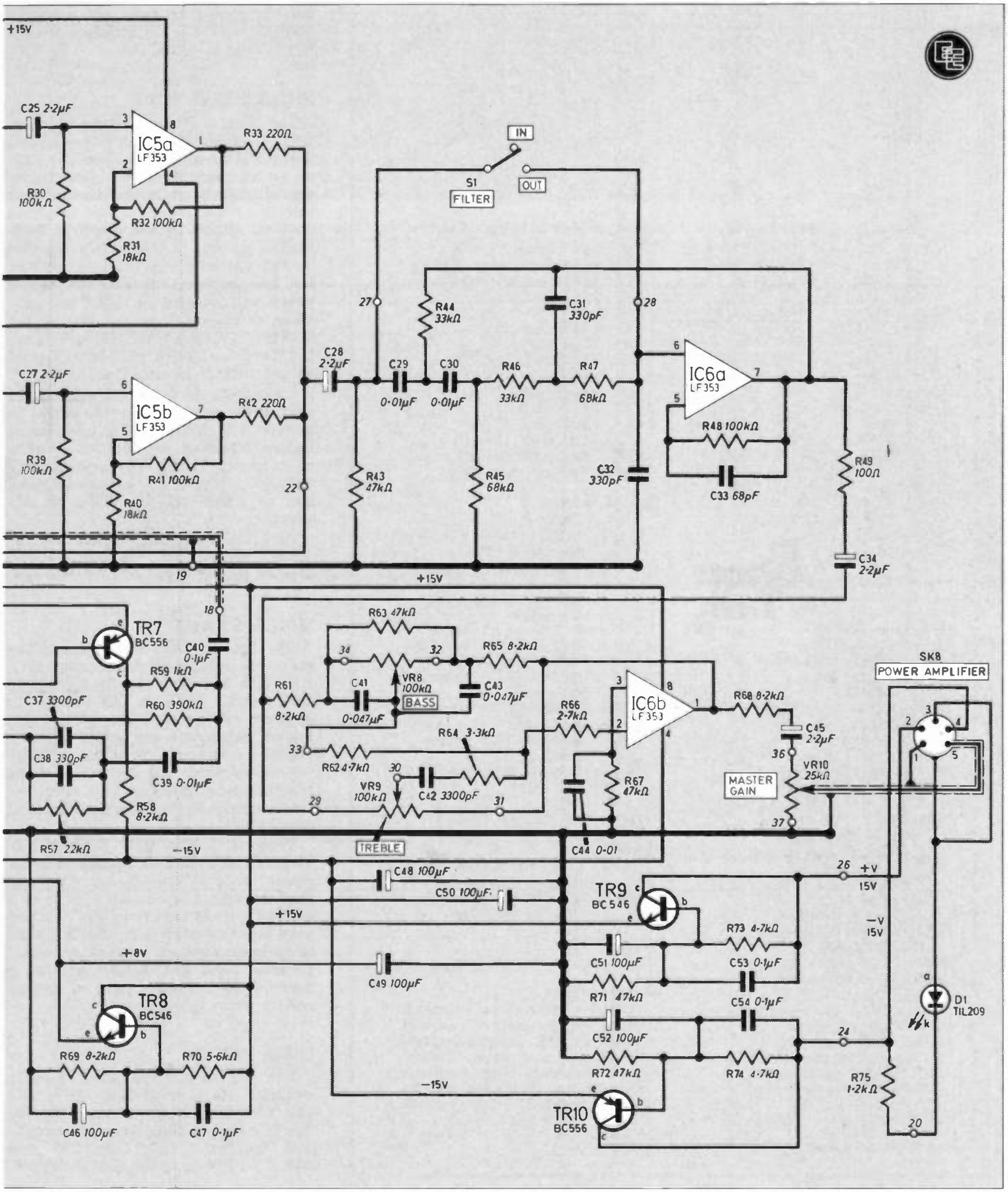
low sensitivity level and ensure a minimum noise condition.

At maximum gain and with an open circuit input the noise level is −60dB. Bearing in mind the basic sensitivity of less than 100 microvolts, this is an astounding signal to noise ratio for an open circuit input. One can just imagine the amount of hum and noise which would result under similar conditions with a conventional gain control system.

The very wide range of input voltages which can be handled also means that these microphone inputs can be used for any other type of input signal that requires a flat frequency response, radio or tape for example.

POTENTIOMETER LAW

The potentiometer used for VR1 (VR2, VR3 and VR4) should ideally have an inverse-log law, but as these



COMPONENTS

Resistors

R1 68Ω
R2 1kΩ
R3 4·7kΩ
R4 5·6kΩ
R5 68Ω
R6 1kΩ
R7 4·7kΩ
R8 5·6kΩ
R9 68Ω
R10 1kΩ
R11 4·7kΩ
R12 5·6kΩ
R13 68Ω
R14 1kΩ
R15 4·7kΩ
R16 5·6kΩ
R17 100kΩ
R18 100kΩ
R19 100kΩ
R20 100kΩ
R21 27kΩ
R22 100kΩ
R23 5·6kΩ
R24 47kΩ
R25 5·6kΩ
R26 1kΩ
R27 2·7kΩ
R28 8·2kΩ
R29 1kΩ
R30 100kΩ
R31 18kΩ
R32 100kΩ
R33 220Ω
R34 1kΩ
R35 10kΩ
R36 100kΩ
R37 10kΩ
R38 100kΩ
R39 100kΩ
R40 18kΩ
R41 100kΩ
R42 220Ω
R43 47kΩ
R44 33kΩ
R45 68kΩ
R46 33kΩ
R47 68kΩ
R48 100kΩ
R49 100Ω
R50 100kΩ
R51 47kΩ
R52 1kΩ
R53 5·6kΩ
R54 47kΩ
R55 5·6kΩ
R56 820Ω
R57 22kΩ
R58 8·2kΩ
R59 1kΩ
R60 390kΩ
R61 8·2kΩ
R62 4·7kΩ
R63 47kΩ
R64 3·3kΩ
R65 8·2kΩ
R66 2·7kΩ
R67 47kΩ
R68 8·2kΩ
R69 8·2kΩ
R70 5·6kΩ
R71 4·7kΩ
R72 47kΩ
R73 4·7kΩ
R74 4·7kΩ
R75 1·2kΩ
All ¼W high stab. carbon film 5%

See Shop Talk page 305

Potentiometers

VR1 100kΩ
VR2 100kΩ
VR3 100kΩ
VR4 100kΩ
(VR1–VR4: inverse log. or linear)
VR5 100kΩ
VR6 100kΩ
VR7 100kΩ
(VR5–VR7: log.)
VR8 100kΩ
VR9 100kΩ
(VR8–VR9: linear)
VR10 25kΩ log.

Capacitors

C1 10µF tantalum 16V
C2 4,700 pF polystyrene 5%
C3 10µF elect. 16V
C4 100µF elect. 16V
C5 100µF tantalum 6·3V
C6 10µF tantalum 16V
C7 4,700pF polystyrene 5%
C8 10µF elect. 16V
C9 100µF elect. 16V
C10 100µF tantalum 6·3V
C11 10µF tantalum 16V
C12 4,700pF polystyrene 5%
C13 10µF elect. 16V
C14 100µF elect. 16V
C15 100µF tantalum 6·3V
C16 10µF tantalum 16V
C17 4,700pF polystyrene 5%
C18 10µF elect. 16V
C19 100µF elect. 16V
C20 100µF tantalum 6·3V
C21 100pF polystyrene 10%
C22 0·1µF polystyrene 10%
C23 100µF elect. 16V
C24 1,000pF 5%
C25 2·2µF elect. 16V
C26 47µF elect. 16V
C27 2·2µF elect. 16V
C28 2·2µF elect. 16V
C29 0·01µF polyester 10%
C30 0·01µF polyester 10%
C31 330pF polystyrene 5%
C32 330pF polystyrene 5%
C33 68pF polystyrene 5%
C34 2·2µF elect. 16V
C35 100pF polystyrene 10%
C36 100µF elect. 16V
C37 3,300pF polystyrene 2%
C38 330pF polystyrene 5%
C39 0·01µF polystyrene 2%
C40 0·1µF polyester 10%
C41 0·047µF polyester 10%
C42 3300pF polystyrene 5%
C43 0·047µF polyester 10%
C44 0·01µF polyester 10%
C45 2·2µF elect. 16V
C46 100µF elect. 16V
C47 0·1µF polyester 10%
C48 100µF elect. 16V
C49 100µF elect. 16V
C50 100µF elect. 16V
C51 100µF elect. 16V
C52 100µF elect. 16V
C53 0·1µF polyester 10%
C54 0·1µF polyester 10%

Semiconductors

IC1-4 ZN459 (4 off)
IC5, 6 LF353n (TL072cp) bi fet op-amp (2 off)
TR1-2 BC414 (BC384) very low noise transistor (2 off)
TR3 BC556b (BC212) *pnp* transistor
TR4 BC182 *npn* transistor
TR5, 6 BC414 (BC384) very low noise transistor (2 off)
TR7 BC556b (BC212) *pnp* transistor
TR8 BC546b (BC182) *npn* transistor
TR9 BC546b (BC182) *npn* transistor
TR10 BC556b (BC212) *pnp* transistor

D1 TIL209 l.e.d. (red)

Sockets

SK1-7 5-way 180 degree d.i.n. chassis mounting (7 off)
SK8 5-way 240 degree d.i.n. chassis mounting

Switch

S1 s.p.s.t. miniature toggle

Miscellaneous

Printed circuit board, "control Unit". P.C.B. stand-offs (4 off). Terminal pins. Sheet aluminium for chassis and cover. Screws, nuts, washers, wire, screened lead. Knobs, 15mm o.d. aluminium to suit 0·25 in pot. spindle (10 off). Cable ties.

devices are not easy to come by without special ordering, a linear law can be used. The only difference found in operation will be that the inverse log law potentiometer gives a more even distribution of gain with rotation of the potentiometer whereas the linear law tends to let the gain come up at a quicker rate towards the maximum gain end of the potentiometer. This has not proved to have any practical disadvantage and no difficulties have been found in actual use.

PHASE REVERSAL

The resistor R1 needs some explanation. If it is left out of the circuit there will be a tendency for the gain to go through zero and then to increase slightly at the minimum gain setting of VR1. This is due to phase reversal effects in the negative feedback loop and is completely avoided by the use of a low value resistor at the low gain end of VR1. Its actual value will depend on the "hop on" value of resistance at the end of the actual track used in the potentiometer but the value shown (68 ohms) should be satisfactory in most cases.

Unless the input is being used for very high signal inputs the effect is not likely to be noticed in practice as the reduction in gain at this point is in excess of 100dB. The capacitor C2 (4700pF) is used to bypass r.f. and has no effect on the audio signals present.

All the foregoing applies to the other three mic. circuits, based around IC2, IC3 and IC4 respectively.

MIXER STAGE

The outputs from each microphone stage are combined via resistors R17, R18, R19 and R20 and then fed into TR1 via C22 (0·1µF). C21 (100pF) is another r.f. bypass filter. (These r.f. bypass capacitors are important and failure to fit them could result in interference from CB and other radio transmissions coming out over the loudspeakers at the most inconvenient moment!)

Transistors TR1, TR2 (BC414) and TR3 (BC556) form a voltage amplification stage to provide extra gain so that the signal input into IC5a is at a similar level to that from the AUX and TAPE inputs. Negative feedback is used to optimise frequency response, signal to noise ratio and distoritiion. C24 is used in the feedback path to further reduce the response to r.f.

DISC INPUT

The DISC input is fed into a separate amplifier stage comprising TR5, TR6 and TR7. This stage is equalised for the RIAA recording curve by negative feedback. C37, C38, C39 and R56, R57, R60 form the feedback path.

R51 provides the correct input impedance for magnetic cartridges and R52, C35 form an r.f. filter.

The DISC GAIN control, VR7, is fitted in the output of the disc amplifier. This potentiometer and C40 form a low frequency filter to comply with the IEC 65 recommendation for a filter on RIAA inputs to provide a −3dB response at 20Hz. The purpose of this filter is to prevent warped records producing a large low frequency output which could introduce intermodulation distortion in the later stages of an amplifier system.

AUX AND TAPE

The gain of the AUX and TAPE inputs is controlled by VR5, VR6.

The sliders of the AUX GAIN, TAPE GAIN and DISC GAIN feed into IC5b via combining resistors R36, R38 and R50. As the outputs from each half of IC5 are combined via R33 and R42, we are able to fully mix any input combination required without restrictions. Tape output is taken from the output of IC5b and is not affected by the tone control or filter circuits.

BANDPASS FILTER

The output signals from IC5a and IC5b (LF353) pass on to the filter stage which uses IC6a (LF353). This is a bandpass filter which is designed to limit the overall frequency response when the amplifier is used with horn loudspeakers, or other systems where a full frequency range is not required.

The high pass section of this filter consists of C29, C30 and R44, R45 and the low pass section, R46, R47 and C31, C32. The values used provide a 12dB per octave fall in response with the −3dB points at 250Hz and 6kHz respectively.

This frequency range will provide high quality speech and reasonable quality music when the system is used outdoors or with horn loudspeakers and enables all the available audio power to be condensed into this limited frequency range. The filter can be switched in or out of circuit by S1.

TONE CONTROL

The other half of IC6 is used for tone control. The output from the filter stage goes to the input of the tone control circuits consisting of R61, R63, R65, VR8, C41, C43 and R62 for BASS; and VR9, C42 and R64 for TREBLE.

A negative feedback circuit of the Baxandall type is used to obtain the required response curves and to keep harmonic distortion to a minimum. Resistors R63 and R64 limit the maximum amount of boost obtained at very high and very low frequencies. Without these components fitted the response (at maximum settings) would continue to rise at frequencies outside the audio range resulting in possible overload in later stages. The range of control obtained within the audio band is not affected.

The output from the tone control stage passes to VR10, the MASTER GAIN control and then out to a DIN 5-pin 240 degree socket SK8.

(The use of 240 degree sockets to interconnect the control unit to the main amplifier is to avoid microphones or other units being plugged into the power sockets by mistake, an error which could prove expensive.)

POWER SUPPLIES

The power supplies for the Control Unit come from the Power Amplifier Unit via SK8; 15V positive at pin 2 and 15V negative at pin 4. Extra electronic decoupling is provided in the Control Unit. The positive and negative supplies are decoupled by TR9 and TR10 respectively. TR8 further decouples the positive supply for the microphone circuits.

This extensive use of electronic decoupling ensures that the supplies are completely hum free which in turn enables the very maximum signal to noise ratios to be obtained on all inputs.

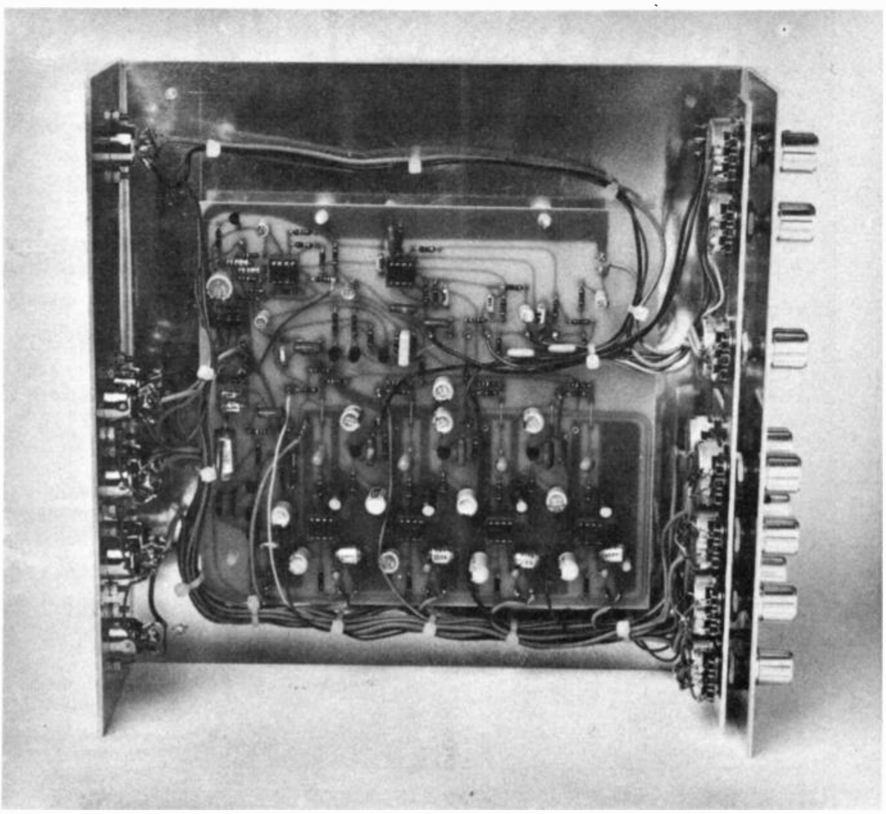
This aim is also aided by the separate construction of the Power Amplifier and Power Supply Unit which avoids either high power audio or power supply induction currents being induced into the very sensitive high gain inputs.

A point worth bearing in mind is that to achieve a signal to noise ratio of 58dB with an input of 70 microvolts means that any induced signal or noise must be less than 0·08 microvolts!!

MICROPHONE PRIORITY

One final part of the control unit which has not been mentioned so far is the microphone priority circuit. At the input of the second half of IC5 we have connected to the junction of R36, R38, R50 and C27 the collector of TR4 (BC182). This transistor is biased via R21, R35, R37 so that it is normally "off". The junction of R35, R37 goes to pin 5 on the microphone input socket and if this pin is earthed it changes the biasing conditions so that TR1 conducts (becomes switched on). This then effectively puts a short across the input of IC5 and mutes any signal present.

This muting only applies to the AUXILLIARY, TAPE and DISC inputs leaving the microphone circuits operating normally, a feature which enables any special announcements to override the other inputs. Capacitor C26 provides a few milliseconds delay and avoids clicks being heard when the mute circuit is activated. (Microphones can be obtained with a suitable switch already fitted, although a separate switch could be wired to the input socket if required.)



CONSTRUCTION starts here

The photographs show the general form of the construction. The U-shaped chassis is easily fashioned from a sheet of aluminium. Full details will be given in Part 2. In the meanwhile, work can proceed with preparation of the circuit board.

All components other than potentiometers, sockets, l.e.d. and switch S1 are mounted on a printed circuit board. A full size pattern of the underside of this p.c.b. is given in Fig. 1.2. The placement of components on the top side is shown in Fig. 1.3.

Assembly of the printed circuit board should start with the terminal pins which are inserted from the track side of the p.c.b. and lightly hammered into place so that they are a firm fit but not over-tight. The p.c.b. should be supported from behind to avoid damage to the board. After fitting, the pins are soldered into place.

The suggested order of assembly is resistors, small capacitors, transistors, and electrolytics. In other words, the smaller components first, as this will enable the components to be inserted and the p.c.b. turned over onto a foam pad which will hold the components in place while they are soldered in. Be very careful to mount all electrolytics and semiconductors the correct way round as indicated on the p.c.b.

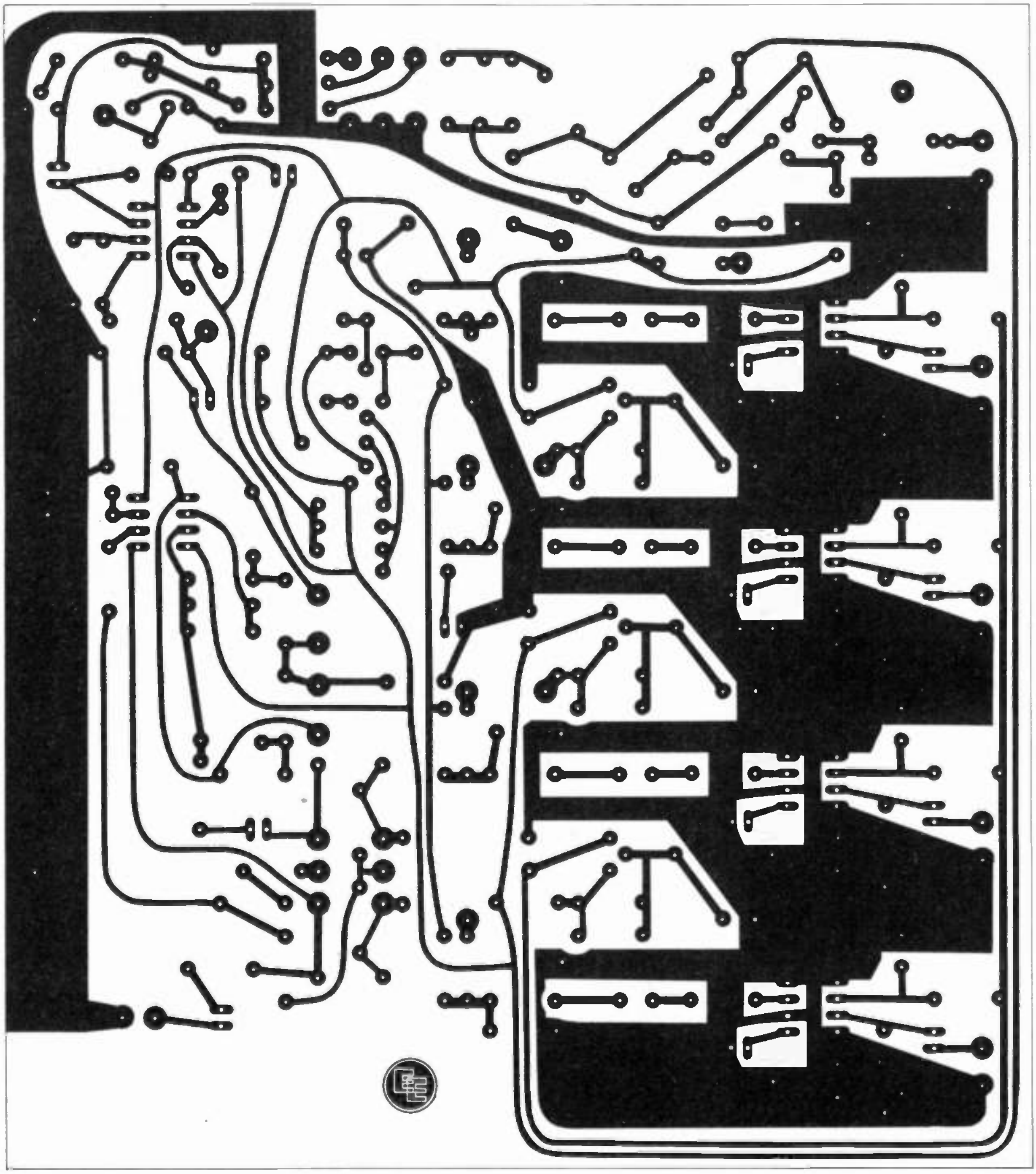


Fig. 1.2. Public Address System: Control Unit printed circuit board, actual size.

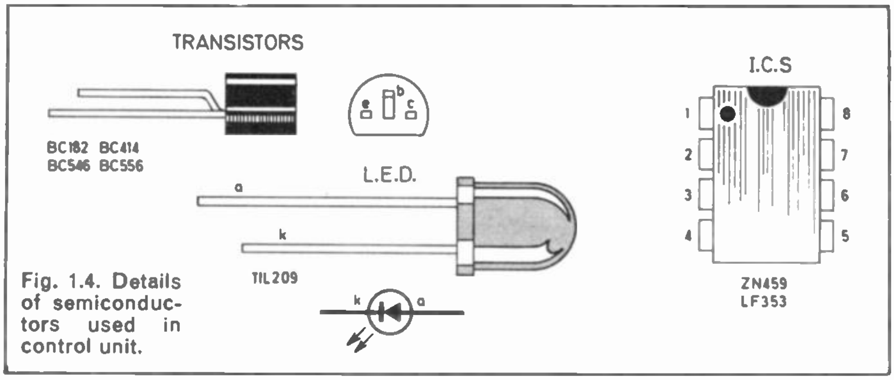


Fig. 1.4. Details of semiconductors used in control unit.

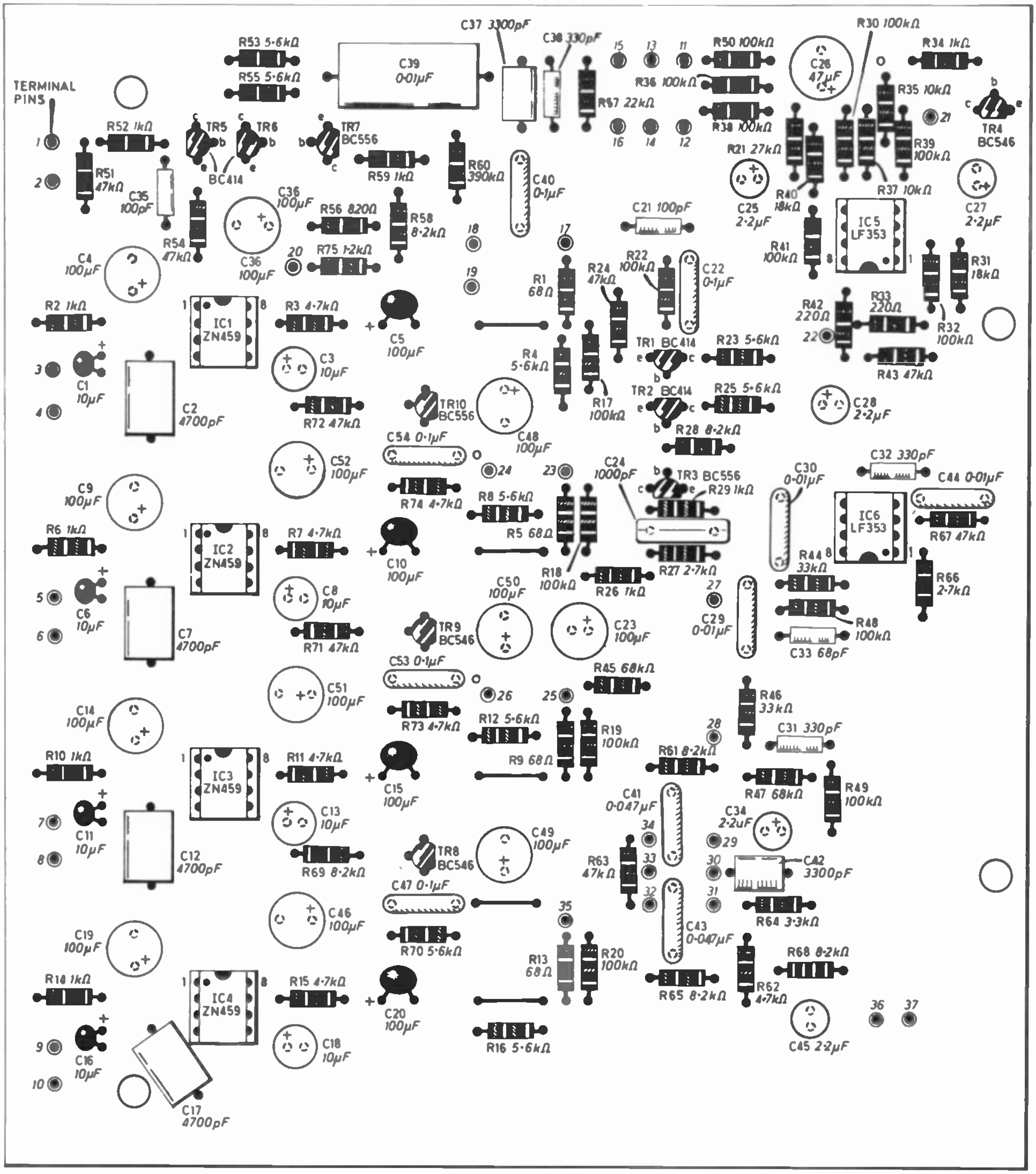
layout; in particular watch the polarity of diodes and the position of pin 1 on the i.c.s. Sockets may be used for the i.c.s as this will be an aid to rapid servicing in the field in the event of failure.

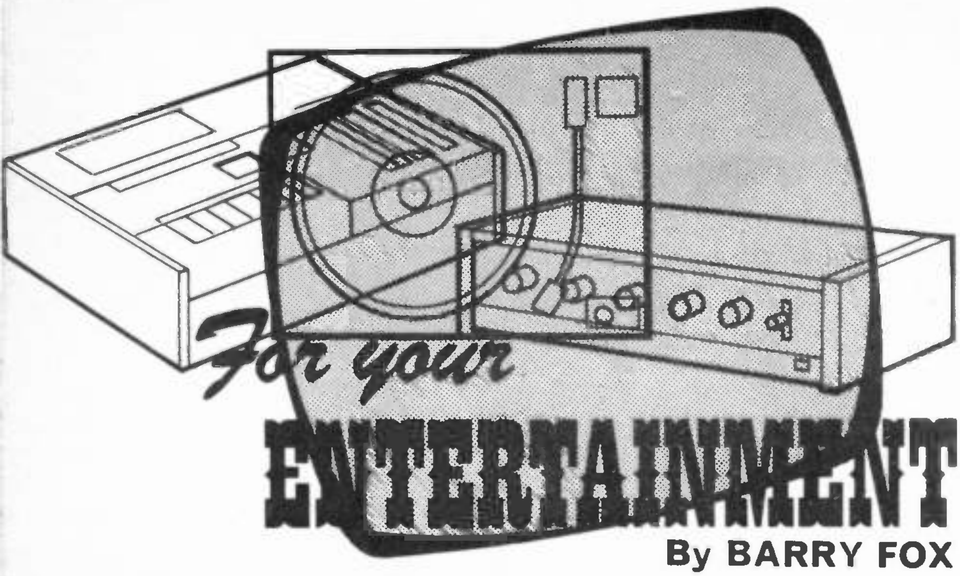
The leads of some semiconductors may need to be pre-formed and details of these devices are given in Fig. 1.4.

Finally, check the whole board carefully to ensure that all soldered joints are sound and that there are no solder "bridges" between tracks and components.

To be continued

Fig. 1.3. Public Address System: Control Unit printed circuit board, topside with components in position.





For your ENTERTAINMENT

By BARRY FOX

Learning Morse

Recently I had to find out the answer to a curiously awkward question. How do Japanese communicate in Morse code?

The more you think about the question, the more difficult it is to answer. And then you start thinking about other questions. Like how do the Japanese communicate by telex or telegram?

In the West we use a limited number of letters in an alphabet to build up words which have a phonetic meaning. Western text is simply a written record of the *sounds* of speech. Because there are a limited number of letters it's easy to transmit these letters in a simple digital code, either dot-and-dash Morse or the pulse codes used for telex.

In the Far East, language is based on Chinese ideographic or pictographic characters. These are intricate geometrical shapes like miniature drawings. And these characters directly convey visual meaning. The character for a tree, for instance, looks like a tree and the character for a wood looks like two trees.

All the Far Eastern countries, including Japan, have adopted the basic set of Chinese characters. This is why a Japanese citizen can read a Chinese newspaper. But different countries have adopted different ways of representing these pictorial characters in speech.

They use different sounds and intonations, just as Westerners from different countries use different words to describe the same object, like "tree", "arbre" and "Baum" for a tree in a field. This is why Japanese and Chinese citizens can't talk to each other, even though they can communicate on paper.

Obviously, if a language uses a different pictorial character for every object or concept in the world, the number of individual characters becomes enormous. To confuse the issue further, the Japanese modify some of their pictorial characters with additional characters which have a phonetic rather than pictorial meaning.

The basic pictorial characters are called *kanji* and the modified symbols are called *kana*. There are tens of thousands of kanjis and 150 kana.

An official Japanese government edict says that only 1850 kanji can be used in official documents. But 2500 appear in newspapers and a well educated Japanese will need to know at least 5,000.

Clearly it would be quite impossible to translate these into a Morse or telex code, because each word would have to contain an unmanageable number of digits. So coded transmission of Japanese seems impossible. But in fact they do manage it.

Romaji

There exists a Romanised version of the Japanese language called *Romaji*. This uses the Western alphabet to make a written record of the sound of a Chinese character as spoken by a Japanese citizen!

This is how Westerners can use a few Japanese phrases, like *A-ri-ga-toh* (thank you) or *Sayonara* (goodbye) without being able to read the picture symbols for those words.

Railway stations, for instance, have the name of the station written both in picture symbols and a Western word which is the phonetic equivalent of how the local Japanese would speak the station name.

It's also why the Japanese confuse the letters "l" and "r". There's a Japanese hieroglyphic for "r" but not "l".

This Romanisation is the key to coded communication. When a Japanese company sends a cable or telex to its British subsidiary, the telex is either in pidgin English or phonetic Japanese.

According to colleague columnist Pat Hawker, who is, of course, an enthusiastic amateur radio operator, this is exactly how the Japanese manage the even more daunting task of communicating in Morse. They simply write the message in phonetic Japanese using the English alphabet, and then tap out the Western letters in Morse.

Not surprisingly, this caused awful headaches in the last war. It's bad enough learning to operate a Morse code station at around 25 or 30 words a minute when you are simultaneously translating dots and dashes into your own native language. But when the coded language is the phonetic equivalent of something as obscure as Japanese picture text, then the task becomes daunting.

In fact communication between Japan and the West is one of the biggest problems faced by everyone involved in East-West trade. It's so easy to mis-understand what is really meant behind spoken words translated by an interpreter. As a result more and more Japanese businessmen and engineers are learning English.

Also most of the major Japanese electronic companies are now investing heavily in research into automated translation. The initial aim is for a keyboard operator to type one language into a keyboard. A computer will then search its memory for corresponding phrases and print out a translation text.

The next generation of translation machines will offer a direct speech link. The operator will speak into a microphone and circuitry will translate the spoken word into computer data. This will then be used for the memory search and the translated data output sent either to a printer or speech synthesis circuit which will produce a virtually spoken translation

See Facts!

Last Christmas *Ceefax*, the BBC's teletext service, came up with a novel idea. On a few pages well outside the normal magazine (circa page 700 on BBC1) they pumped out computer programmes. The idea, apparently, was that owners of home computers would interface them with a TV set and use the teletext data to programme their computer.

On Christmas day a new and topically festive programme of data was transmitted. It promised to make a home computer produce sounds, and so let it play carols. But the caption text which the computer was programmed to throw up on the screen was delightfully honest. "The programme has a bug in it somewhere but I can't detect it right now."

If the BBC *Ceefax* people are working on interesting projects like this, couldn't the BBC publicity people make more effort to tell the press and public.

Sadly, this typifies the BBC's rather ambivalent attitude towards teletext. There's been an infuriating tendency on the part of the BBC to talk about *Ceefax*, rather than teletext, on the surely misguided assumption that the public fully understands that *Ceefax* is the BBC's teletext service, and *Oracle* is the IBA's teletext service.

For several years now there has been a display of teletext in the main lobby of the BBC TV Centre at Wood Lane. The display is labelled *Ceefax*, rather than teletext, and on almost every occasion that I've been through the lobby over recent years, the television set at the centre of the display has been switched to normal programme viewing, rather than teletext.

The display placards are now getting very scruffy. The headline sign has lost some of its letters and describes *Ceefax* as a "levision dial-a-page service" (sic).

Even the receiver itself was faulty last time I saw it. When switched to teletext it threw up lines of gobbledegook in the middle of displayed page of text. Perhaps no-one at the BBC had noticed.

BOOK REVIEWS

BEGINNER'S GUIDE TO ELECTRONICS
(Fourth edition)
Author Owen Bishop, BSc
Price £3·60 Paperback
Size 185 × 120mm, 240 pages
Publisher Newnes Technical Books
ISBN 0 408 004134

THE 1964 1st edition of this popular introduction to electronics was written by Terence L. Squires and it is surprising that his name has been omitted from this latest 4th edition. Obviously the time has come for a major revision and Mr Owen Bishop has performed a good job in updating the text and writing additional chapters so that this latest edition fairly reflects the present state of technology.

This book takes a brief but informed look at the many branches of electronics and helps the beginner to approach the subject easily. From molecules and electrons, conductors and insulators, resistors and current flows (the "stuff" of which electronics consists), then moving on through various circuit components including optoelectronic devices such as light emitting diodes (l.e.d.s), phototransistors and solar cells.

Integrated circuits take quite some understanding and a full eighteen pages are spent doing just that; from then on its all downhill with a detailed look at each of the basic electronic circuits illustrated, then it takes a quick look at test equipment before stepping gently into computer electronics, microwaves, medical electronics and radio and television.

The final two chapters cover recording and industrial electronics, two massive subjects that can only be given a cursory introductory coverage. A well illustrated and informative book that allows knowledge to be absorbed without recourse to other resources. The amazingly complex can always be broken down into more manageable units to study and learn. This book has achieved just that—but simply.

D.J.G.

ELECTRONIC PROJECTS USING SOLAR CELLS
By Owen Bishop, **ISBN** 0 85934 057 0
50 SIMPLE L.E.D. CIRCUITS BOOK 2*
By R. N. Soar, **ISBN** 0 85934 062 7
AUDIO PROJECTS
By F. G. Rayer, **ISBN** 0 85934 065 1
AN INTRODUCTION TO RADIO DXing
By R. A. Penfold, **ISBN** 0 85934 066 X
ELECTRONIC TIMER PROJECTS
By F. G. Rayer, **ISBN** 0 85934 068 6
ELECTRONIC PROJECTS FOR CARS AND BOATS
By R. A. Penfold, **ISBN** 0 85934 069 4
MODEL RAILWAY PROJECTS
By R. A. Penfold, **ISBN** 0 85934 070 8
C B PROJECTS
By R. A. Penfold, **ISBN** 0 85934 071 6
Price £1·95 each except those marked thus * at £1·35 each all with soft covers
Size 180 × 110mm, between 57 and 110 pages
Publisher Bernard Babani (Publishing) Ltd

WE HAVE here a selection of the more recent titles in the Babani "Radio and Electronics" books and for those of you not already familiar with this series, now numbering over 90 titles, I think you will probably be conversant with the work of the authors as most of those represented here are regular contributors to the pages of EVERYDAY ELECTRONICS.

All these books follow a similar pattern in that their main objective is to provide constructional information on a number of related projects, ranging from simple novelties to quite complex and useful circuits.

An exception here, perhaps, is "An Introduction to Radio DXing" which covers in some detail the exciting hobby of receiving distant and difficult radio stations, but again, this book also includes some projects to build a number of interesting accessories to extend the range of equipment used in radio DXing.

Amongst the more topical and interesting titles in this batch are Owen Bishop's "Electronic Projects Using Solar Cells" which contains over 30 circuits all operating a low voltages to enable them to be powered from two or three solar cells, and R. A. Penfold's "CB Projects" describing such add-on goodies as a speech processor and interference filters for 27MHz f.m. citizens band radio reception for the enthusiast to build himself.

However, all eight books represent a varied source of circuits for the home constructor and are worth a look.

G.P.H.

PRINCIPLES OF TRANSISTOR CIRCUITS
(Sixth edition)
Author S. W. Amos, BSc, CEng, MIEE
Price £12·50 cased, £6·95 soft covers
Size 220 × 145mm, 331 pages, many with line illustrations
Publisher Butterworths
ISBN 0 408 01106 8 (0 408 00599 8 soft covers)

THIS book, now in its sixth edition, was first published in 1959 and is still as valuable today to the student and enthusiast alike as its predecessors have been. In this, the first revision since 1975, Mr Amos keeps pace with advancing technology by including a much revised section on digital techniques to reflect the most significant development in electronics today, that is the increasing use of integrated circuits. Other sections to benefit from the update are those on a.m. detectors and the account of regulated power supplies, expanded to give up-to-date circuits.

The information contained within this edition gives the student a wealth of details, both theoretical and practical, to introduce him to the design of amplifiers, receivers and digital circuits.

It is interesting to note that this book has been selected as a standard course book in many colleges teaching electronics to beyond A-level, but that is not to say that the home constructor won't also find it a welcome addition to his shelves.

G.P.H.

TELEVISION AND RADIO 1982
Editor Eric Croston
Price £2·90 Paperback
Size 194mm × 230mm, 224 pages
Publisher Independent Broadcasting Authority
ISBN 0 900485 418

HAVING had the pleasure of reviewing the annual *Television & Radio* yearbook three times out of the last four its become almost impossible to find any superlatives for this excellently produced book that have not already been used.

With a great sigh of relief, I am at last able to offer a rebuke. When you think that the IBA swamped us with a mass of publicity about how "the event of the year" was the biggest outside broadcast ever mounted in their history, particularly in terms of cost and numbers of personnel, it only warrants a brief mention!

In fact, the "royal occasion" only justified one colour and one black and white photograph, one caption and one small paragraph. Surely, the reader would be fascinated to read about all the problems that were overcome to present such an excellent coverage on the day?

With sections on drama, sport, children's television, learning and science, religion, and the latest on Local Radio, the book is still masterly produced and excellent value for money. Although, on a personal note, I find this year's edition is tending to verge on the "picture book" approach.

D.G.B.

BOOKS in BRIEF

Digital Logic Design by B. Holdsworth (Butterworths). Cased £17·95, Limp £9·95. An excellent well-presented book for any serious student of digital electronics. Deals with all aspects of digital circuitry including Boolean Algebra, Combinational Logic, Flip-flops, Counters, Clock and Event driven circuits. Final chapter devoted to explaining the internal workings of a microprocessor.

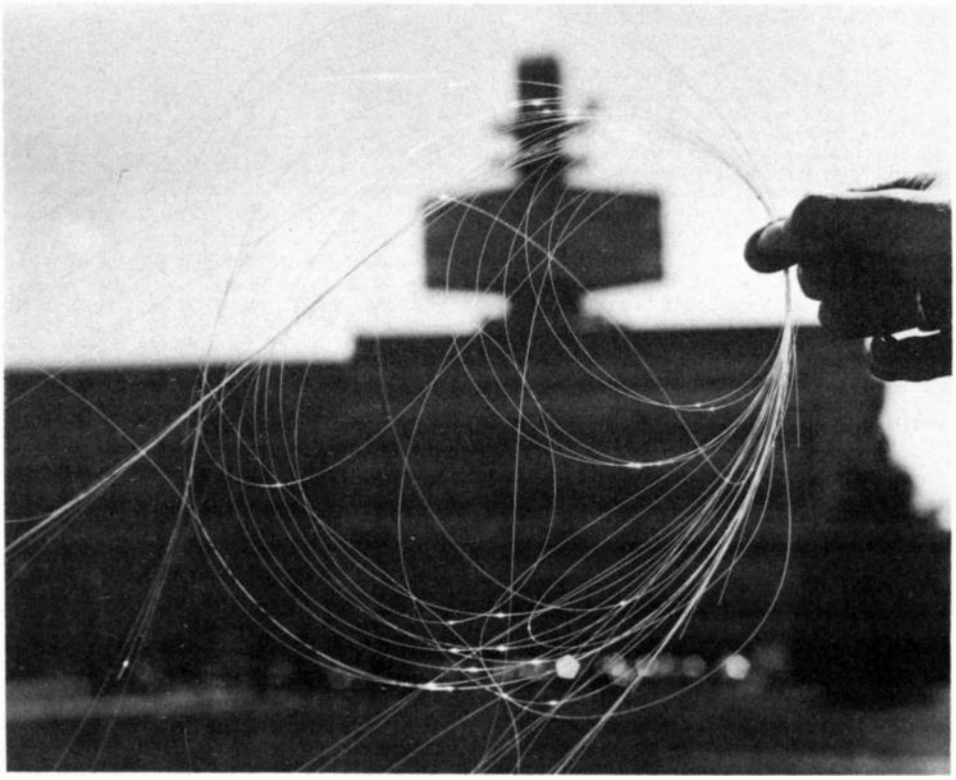
Everyday News

HIGHWAY OF THE FUTURE

Tomorrow's communication "highways" in Britain, carrying thousands of phone calls, plus computer data and TV pictures, between the nation's towns will be hair-thin strands of glass.

These tiny threads are optical fibres, made from the world's purest glass—a block 20km (13 mile) thick would be as transparent as a window pane.

Phone calls are sent along the fibre as rapid on-off pulses of light. At Telecom's research laboratories scientists have sent pulses of light over more than 100km of fibre—twice as far as they achieved in 1981.



Clive Sinclair's ZX81 personal computers are reported to be coming off the Timex production line in Dundee at the rate of one every ten seconds. Two thirds of production is exported.

Mercury Go-Ahead

Project Mercury is all set to go ahead as a competitor to British Telecom, having been granted a 25-year licence.

The consortium of Cable & Wireless, BP and Barclays Merchant Bank will lay 1,000km of optical fibre along railway tracks linking British cities. Capacity will be 8,000 simultaneous telephone calls.

The service should start operating next year.

NO IDEA

SEAMA, a newly formed Small Electrical Appliance Marketing Association, is threatening to pull out of IDEA and go it alone.

At a recent press conference given in London, SEAMA chairman Bill Bastin of Moulinex said: "As a result of general disenchantment with IDEA in its current form, SEAMA is now actively looking at alternative exhibition solutions for its members in 1983."

The LaserVision Disc System from Philips is finally about to reach UK customers at the end of May.

Players and discs will initially be on sale in Greater London and surrounding Home Counties through a restricted number of outlets including High Street multiples, independent retailers and specialist rentals.

Million-to-One

The first VLSI package containing the equivalent of one million transistors will be here by the year 2000 according to Professor James D. Meindl of Stanford University.

Interconnecting these will provide up to 1,000 million devices in a single piece of equipment. Golly!

Digital Caution

At an IERE colloquium on digital recording, Peter Fellgett, head of cybernetics department, Reading University, warned that digital audio quality as often over-exaggerated, often inferior to the best analogue recordings. He cautioned the industry against setting standards too early before all the possibilities have been fully examined.

Computer School

The London Computer Summer School offers everyone over the age of 13 a chance to combine learning about microcomputers with a summer holiday on a country estate just outside London. A series of weekly courses are being held between July 10 and September 11 at Middlesex Polytechnic. Both residential and day courses are available.

Giving hands-on experience, the courses are offered at elementary, intermediate and advanced levels. All tuition and practice is in BASIC, with the elementary course enabling beginners to write simple programs in BASIC.

A brochure describing the programme and application forms are available from The London Computer Summer School, Mortimer House, 37/41 Mortimer Street, London W1N 7RJ.

New Complex for Sony

The new Sony Broadcast 47,000sq ft building complex in Basingstoke, comprises a central location for the systems engineering, customer service, quality assurance, spare parts, warehousing and distribution departments for their operations in the professional broadcast market.

Special areas enable all video and audio products to be quality tested prior to despatch to customers. The service department deals with all local maintenance as well as providing a base for field service operations.

The systems engineering area contains its own workshops, wiring shop, drawing office and stores, and there is a large area for the construction of Outside Broadcast vehicles. At present they are completing orders for OB vehicles to Jordan, the Oyo State in Nigeria, the Seychelles and Oman.

—ANALYSIS

RIGHT CONNECTION

Veteran hobbyists can still remember the days when every electronic component was fitted with screw terminals. Transformers, coils, valve-holders and even capacitors and resistors. When the pentode valve appeared it, too, had a screw terminal on the top of the glass envelope or on the side of the base.

Using "hook-up" wire with slide-back insulation you could wire up a complete radio without touching a soldering iron. Very simple, but not very reliable what with oxidisation and the terminals loosening through temperature cycling and vibration.

Like everything else the humble connection has since made enormous technical progress. It remains the most critical element in terms of equipment reliability, economy in assembly and ease of servicing. And it is big business with a UK market for electronic plugs and sockets of all types estimated at £120 million a year.

The big breakthrough was the printed circuit board which allowed a complete radio (and today a complete mini-computer) to have all its component interconnections soldered in a single pass over the bath of a soldering machine. This was followed by the IC and, later, the LSI with at first hundreds and now thousands of interconnections within the encapsulation of the device itself.

There have been two important developments in external connections. One is the insulation displacement connector (IDC). It uses flat multiple-way cable of, for example, 20 conductors which can be connected to a 20-way socket in a single clamping operation without stripping the insulation, realiable contact being made through piercing the insulation. Clearly very labour saving.

The other is the flexible printed circuit, ideal where multiple connection needs making to moving parts. In a high-speed computer printer, for example, such a connector will need to flex as many as 400 million times without break age over the life of the machine.

In data processing systems the trend is to use i.c. sockets on the p.c.b.s to help trouble-shooting and easy replacement. On present projections the world's electronics industry is expected to gobble up 2,500 billion i.c. sockets in 1986, each having up to 40 contacts. Preparing for the rush the latest automated machines can manufacture these sockets at the rate of 6,000 contacts per minute!

But professional electronic engineers in the initial stages of their designs still use simple aids like Veroboard and hand-soldering. Just like you and me.

Brian G. Peck

This year's "All-Electronics/ECIF Show" will be officially opened on Tuesday, April 20, by Mr John Herrin, Chairman and Managing Director of Welwyn Electronics and current Chairman of The Electronic Components Industry Federation (ECIF).

This year's exhibition will run from April 20 to April 22 and the venue is the new Barbican Exhibition Centre in the City of London.

UNITED SATELLITES

British Aerospace, Marconi and British Telecom plan to form a joint company, United Satellites, to provide Britain's first national broadcasting and telecommunications satellite system.

Welcoming the Home Secretary's announcement of the Government's policy on direct broadcasting by satellite in Britain, the new consortium confirmed that they are planning a British satellite system for the mid-1980s.

Nun Better

The Notre Dame Convent School in Cobham, Surrey, is to start teaching Computer Studies, and has bought Sharp MZ80-B microcomputers from Newbury Micro Systems for this purpose.

"If computers are to be the tools of tomorrow's world, then we'll not have one, we'll have three" was the enthusiastic attitude of the school's headmistress, Sister Mary Agnes.

Wrist TV

The Japanese Agency for Industrial Science and Technology is forecasting 1995 as the year for TV worn on the wrist. But it is rumoured in the trade that an unspecified Japanese company will have one ready for marketing within the next two years, handled in the UK by Trafalgar Watches currently importing speaking watches.

RADIO WORLD

By Pat Hawker, G3VA

Regulating Radio

Radio broadcasting stations that operate in breach of the International Radio Regulations and sometimes also in breach of national legislation have become so common in Europe that it is often inappropriate to call them "pirates". Indeed in Italy where the legislation has become blurred, it is more common to call them "private" stations.

We have already drawn attention to the 1000kW erp V.H.F./F.M./stereo station, located almost 4000 metres above sea level, on the Italian side of Mont Blanc, putting out programmes that are receivable over large parts of France and Switzerland. It took three years to build, is remotely controlled, with the electrical power supplied by diesel-electric generators. Under the present Italian legislation such a "private" station is not a "pirate" but it does breach the International regulations.

ITU Radio Regulations insist that broadcasting stations should not in principle employ more power than is necessary to maintain economically an effective service within the frontiers of the country concerned, however with so much international broadcasting on medium and long waves such regulations are widely broken. But until now the V.H.F. band has been reasonably free of this problem.

In France there have been recent legal battles over the deliberate jamming of unauthorised broadcasting stations. Some of these stations are "political" while others are seeking to attract audiences with programme material that are most unlikely to be transmitted by authorised broadcasters even in this permissive age.

Dutch Pirates

Pirate stations have long been a feature of the Dutch radio scene and have now reached the stage where something over 40 per cent of all listening is to these stations. One reason for the popularity is said to be that these stations transmit more musical programmes with Dutch lyrics than the Hilversum stations where English pop lyrics predominate, with French and German lagging behind and apparently few Dutch songs.

The pirates are also cornering the audience for "golden oldies" and their programming is said to be "easy on the ear". But there are other Dutch "pirates" including the "action" stations, for example those that play a role in coordinating political demonstrations.

When, in December, Poland was virtually cut off from the international scene, the national television news, complete with newsreaders in military uniforms, was seen on screens throughout the world. How was this done?

The answer was the large defence aerials on the Danish island Bornholm in the Baltic. Danish television was allowed to use these aerials and to bring the pictures via a microwave link across Sweden to Copenhagen. They then had to be converted from SECAM to PAL before the pictures were offered to television services in many countries.

Several European countries, to counter the growing number of unauthorised pirate or private stations, are now in process of setting up local radio stations along the lines of those in the UK. For listeners it gives more choice, even if for engineers there is the ever increasing problem of finding suitable frequencies.

In the UK it will be some years before the VHF/FM Band 2 expands to the extent foreseen in the latest Radio Regulations but a start has been made in releasing frequencies between about 102 to 104MHz.

Vandal Challenge

Car radio aerials have long been a target for vandalism, and it takes some pluck to introduce on to the market an aerial claimed to be "virtually indestructable". This is one of several claims made for a new range introduced by Blaupunkt—though I am not sure whether this is meant to cover normal wear and tear or includes deliberate sabotage.

At least it cannot easily, if at all, be snapped off. Made of a 45cm length of fibre glass rod it has two spirals of copper wire wound in opposite directions. It is not telescopic but highly resilient at the base and is coated with polyamide.

Perhaps with such designs there will be fewer wire coat hangers pressed into service as car aerials!

Broadcast Links

In the UK it is not often possible to obtain permission to use h.f. communications equipment for other than the amateur radio service. In some countries where distances are longer and the telecommunications service less well developed this is not the case.

An unusual application for the Drake TR7 transceiver has been reported to me by Dave Harris who is the Engineering Deputy Director of Radio Botswana. This s.s.b. equipment has been used as part of a low-cost broadcast news "feed" to enable the Gaborone station to carry reports from the more remote parts of Botswana.

Although basically an amateur communications rather than broadcast equipment this has proved capable of providing better speech quality than the telephone system—and has since been further improved by fitting a wider (4kHz) filter. The equipment works from 12V vehicle batteries in conjunction with an Australian-developed form of broadband dipole. For this type of application it opens the way to local news reports at costs within the budget of Third World broadcasters.

The BBC use high-power s.s.b. point-to-point relays to feed programmes to some distant overseas bases but these are now being superseded by satellite circuits. The Foreign and Commonwealth Office has recently ordered a 10-metre dish receive-only terminal to be installed on Masirah Island off the coast of Oman specifically to bring BBC overseas programmes via an *Intelsat V* satellite to the FCO relay base on the island, including a number of extremely high power transmitters.

Radio Regs

British amateurs received a shock during February when the Home Office published in *The London Gazette* a new "schedule" of frequencies, power limits etc. Publication in this way constitutes full notice to licence holders of a change to their licences.

Unfortunately, as the authorities later admitted, the long 4-page schedule, contained a number of important errors. For example, it reduced maximum power on 3·5MHz to the much lower limitation enforced on 1·8MHz, and also swept away all differences between Class A and Class B licences.

The Home Office agreed to look at the question again, this time in consultation with the Radio Society of Great Britain. A new "new schedule" will probably have been published by the time my notes appear. Let us hope they get it right this time—and that any changes are fair and necessary.

A number of people have been suggesting changes to the amateur licence recently. For this reason it is worth quoting some extracts from the International Radio Regulations, since all national licences are supposed to conform with these.

"Any person seeking a licence to operate the apparatus of an amateur station shall prove that he is able to send correctly by hand and to receive correctly by ear, texts in Morse code signals. The administrations concerned may, however, waive this requirement in the case of stations making use exclusively of frequencies above 30MHz. . . . Administrations shall take such measures as they judge necessary to verify the operational and technical qualifications of any person wishing to operate the apparatus of an amateur station."

Basically, the International Radio Regulations defines the "Amateur Service" as "a service of self-training, intercommunication and technical investigations carried on by amateurs, that is, by duly authorised persons interested in radio technique solely with a personal aim and without pecuniary interest." Which must make amateur radio one of the very few hobbies ever to have been defined in an international treaty signed by well over a hundred nations.

Everyday ELECTRONICS

JUNE FEATURES

Motorists- don't forget!

SEAT BELT REMINDER

Flashing lights illuminate a small "Belts" sign. Operates when ignition is switched on and runs for about 15 seconds.

Mobile to base

C.B. POWER SUPPLY

Allows a mobile transceiver to be used as a mains powered base station.

Eyes Down! **ZX81** *users*

MICROCOMPUTER KEYBOARD SOUNDER

No need to look up at screen whenever a key on the ZX81 is pressed.
A tone is generated from this add-on unit every time one of the ZX81's touch keys is actuated. A different tone is generated when the shift key is actuated.

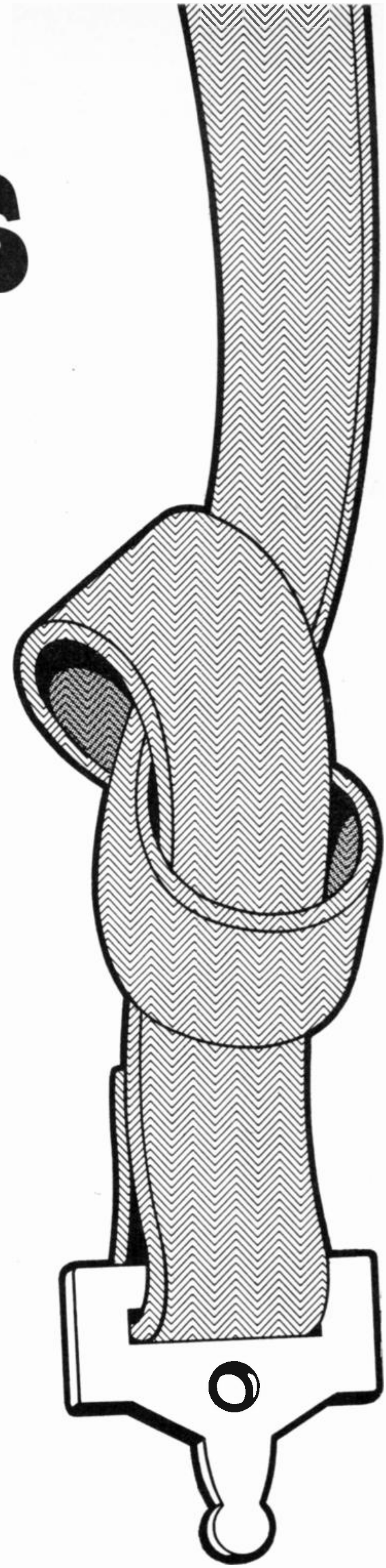
EE

PUBLIC ADDRESS SYSTEM Part 2

Part 2 of this series deals with the Control Unit construction and introduces the Power Amplifier.

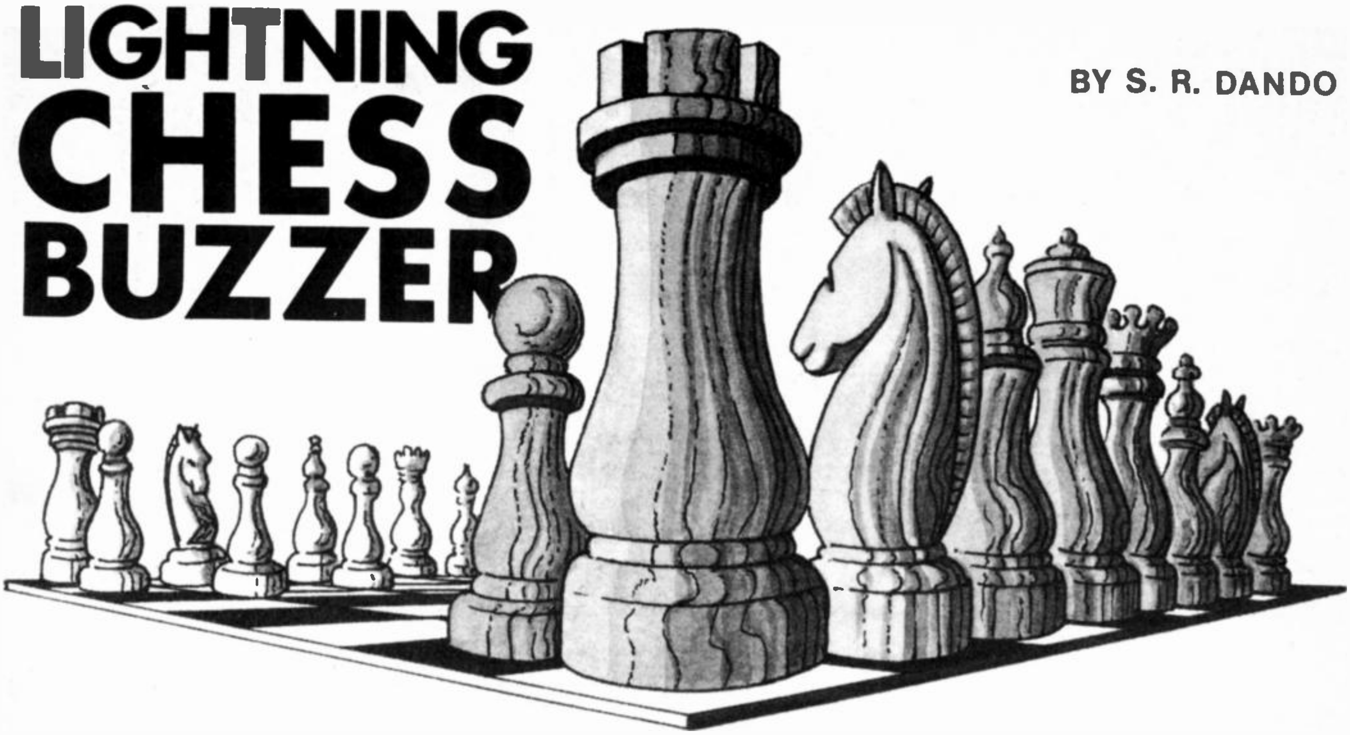
All this and more

JUNE 1982 ISSUE ON SALE FRIDAY, MAY 14



LIGHTNING CHESS BUZZER

BY S. R. DANDO



MOST towns and villages have a chess club and many schools have chess teams in leagues or play chess as an extra-curricular activity. Chess tournaments are arranged which can last for several days when each player has to complete two or three games.

Lightning chess has become popular because tournaments can be arranged and completed in an afternoon or evening. In this variation of chess each player has a fixed time to think of a move before a bell or buzzer operates for approximately two seconds. The player must then make his or her move.

The cycle is then repeated with the players opponent having the same time interval before he or she has to move a piece. At this speed of play "check" does not have to be said, and the player loses if he or she fails to make a move before the buzz ends.

The time interval is usually ten seconds at the commencement of play and after several minutes it is reduced to five seconds. The interval between moves has been fixed to give two, five, eight, ten or fifteen seconds and the duty cycle is fixed at two seconds. These values can be changed if the constructor wishes to use the buzzer in any game where a fixed interval of time is required between moves.

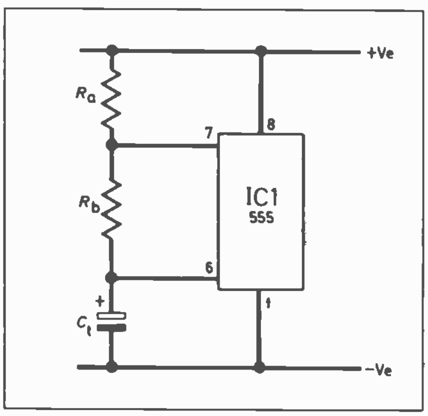


Fig. 1. Selecting the timing values for the Lightning Chess Buzzer.

Table 1: Timing Values

R_a (ohms)	R_b (ohms)	C_t (μF)	Charge time (secs)	Discharge (secs)
1kΩ	27kΩ + 1·5kΩ	100	2	2
43kΩ + 1kΩ	27kΩ + 1·5kΩ	100	5	2
43kΩ + 43kΩ + 1kΩ	27kΩ + 1·5kΩ	100	8	2
43kΩ + 43kΩ + 27kΩ + 1kΩ	27kΩ + 1·5kΩ	100	10	2
180kΩ + 5·6kΩ + 1kΩ	27kΩ + 1·5kΩ	100	15	2

TIMING

The timing of the unit can be selected by referring to Fig. 1 and table 1. Capacitor C_t charges up to two thirds of the supply voltage and then discharges via R_b. When the voltage drops to one third of the supply voltage C_t starts to charge up again. This operation is repeated.

The time intervals for the charge t_1 and discharge t_2 can be calculated using the formulae:

$$t_2 = 0{\cdot}7 \times R_b \times C_t$$

$$t_1 = 0{\cdot}7(R_a + R_b)C_t$$

If we wish to have a duty cycle of two seconds and use a value of $C_t = 100\mu F = 100/1{,}000{,}000\ F$

$$t_2 = 0{\cdot}7 \times R_b \times C_t$$

$$\text{Therefore } 2\text{ sec} = \frac{0{\cdot}7 \times R_b \times 100}{1{,}000{,}000}$$

$$R_b = \frac{20{,}000}{0{\cdot}7} = 28{,}571\Omega$$

The nearest preferred value for R_b is, 27kΩ + 1·5kΩ = 28·5kΩ. This value for R_b gives a value for t_2 of 1·995 seconds. Hence the values for R7 and R8 are 27kΩ and 1·5kΩ respectively (see Fig. 2). We can then use this value for R_b to calculate R_a values for given time intervals for the fixed duty cycle of two seconds.

Table 1 lists the values of C_t, R_a and R_b used in the timing circuit.

CIRCUIT

The complete circuit for the Lightning Chess Buzzer is shown in Fig. 2. Two 555 timer i.c.s are used connected as oscillators. IC1 is used to produce the time interval and IC2 is set to produce the frequency of the tone required.

Resistors R1 to R6 form the switched timing range. The output from IC1 is inverted by transistor TR1 enabling the oscillations of IC2 only when IC1 output is low, this corresponds to the discharge time of 2 seconds.

SUPPLIES

The circuit can be operated from 5V to 18V but in practice a 9V battery was found to be convenient. Volume was adequate with this supply voltage. Care should be taken to use capacitors with working voltages as close to the supply voltage as possible but their working voltage must be greater or equal to the supply voltage.

CONSTRUCTION starts here

ASSEMBLY

Most of the components are mounted on a piece of 0·1 inch pitch stripboard, 16 strips by 30 holes. Drill the mounting holes and make the breaks in the copper strips as indicated in Fig. 3 before soldering the components and wires into position.

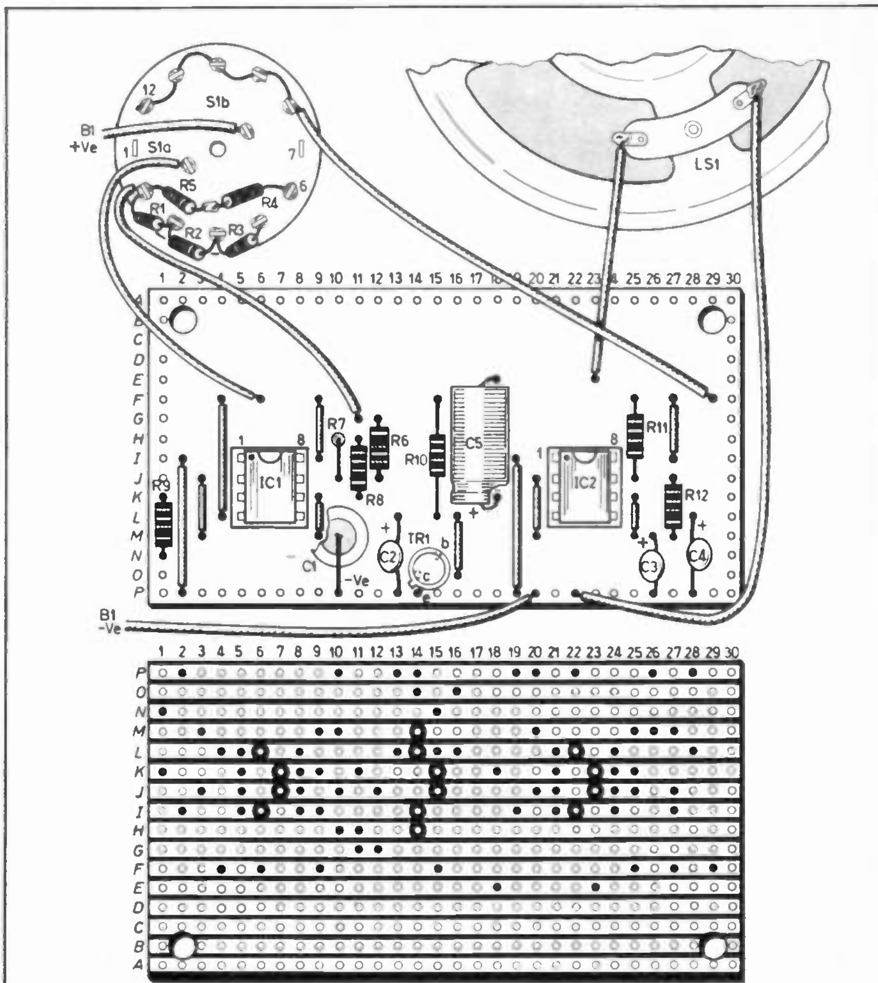


Fig. 3. Circuit board component layout and interwiring details.

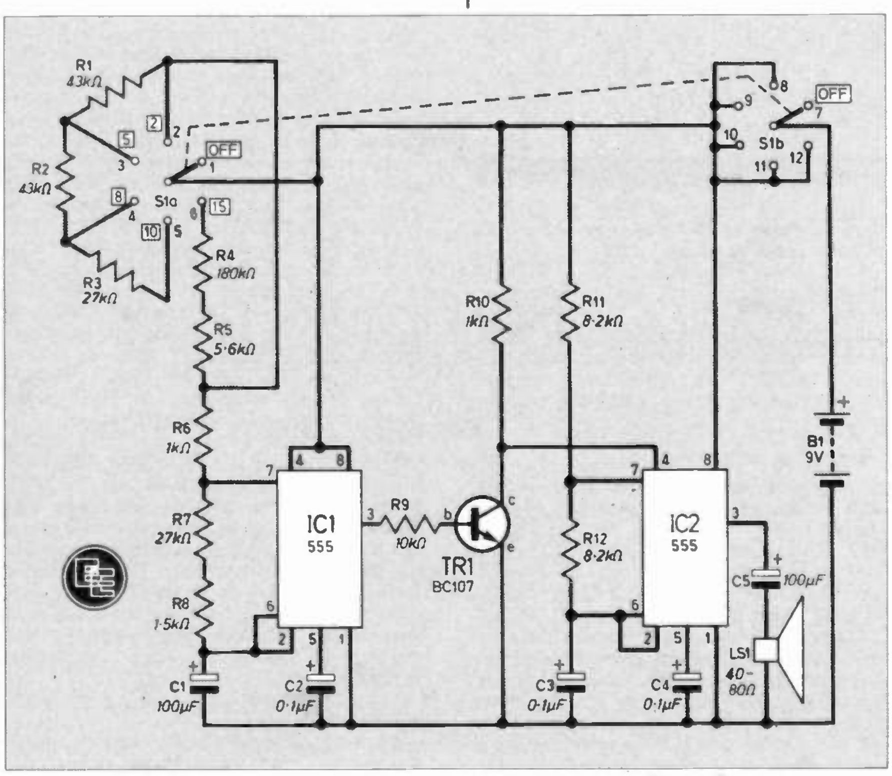


Fig. 2. The complete circuit diagram for the Lightning Chess Buzzer.

COMPONENTS

Resistors

R1	43kΩ	R7	27kΩ
R2	43kΩ	R8	1·5kΩ
R3	27kΩ	R9	10kΩ
R4	180kΩ	R10	1kΩ
R5	5·6kΩ	R11	8·2kΩ
R6	1kΩ	R12	8·2kΩ

All ¼W carbon ± 5%

Capacitors

C1, C5 100µF 25V elect. (2 off)
C2, 3, 4 0·1µF 35V tantalum (3 off)

Semiconductors

TR1 BC107 *npn* silicon
IC1, IC2 NE555 timer i.c. (2 off)

Switches

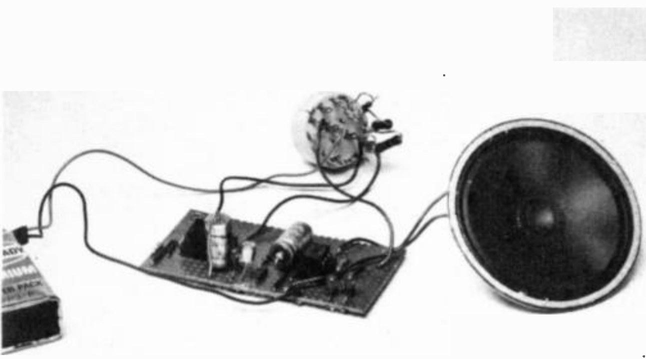
S1 2-pole 6-way rotary switch

Miscellaneous

B1 9V type PP3
LS1 40 to 80ohm miniature loudspeaker

Wood or plastics case, approx. 115 × 100 × 65mm; 0·1 inch matrix stripboard, 16 strips by 30 holes; Speaker covering; interconnecting wire; battery connector.

Guidance only Approx. cost **£4·50**



The completed buzzer prior to insertion in a suitable case.

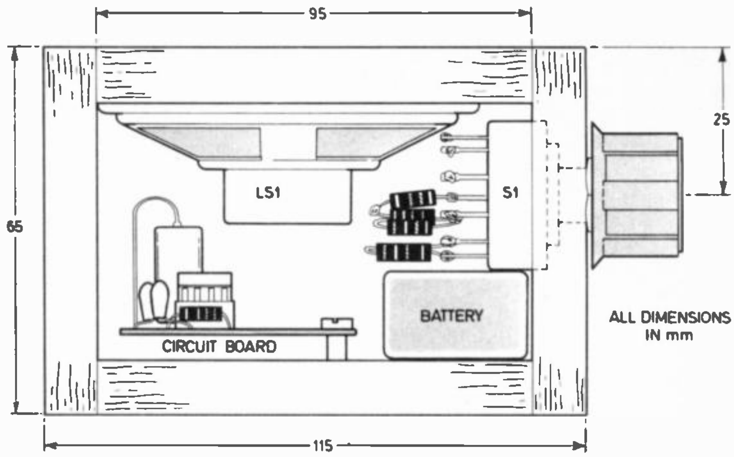


Fig. 4. End view of the wooden case showing component position. The timing switch S1 has been recessed in one side panel.

Care must be taken to position the range resistors correctly on the rotary switch S1 (Fig. 3). Five positions of S1b are linked together with wire. This can be done by removing the insulation from a length of wire and feeding the bared wire through S1b tags 2 to 6 before soldering.

CASE

To keep the cost down the prototype was built in a small wooden box but a small plastic box could be used.

Small holes were drilled in the top of the case before the speaker was fixed in place with glue or four small supporting nails. The holes should be drilled from the outside inwards to keep the surface smooth.

When a hole has been drilled for the central shaft of "timing" switch S1, the wood on the inside of the case should be chipped away to a depth so that the switch fits in place and sufficient fixing thread appears on the outside to take the locking nut, Fig. 4.

Finished unit with suggested lettering around timing switch S1.

A transfer type system was used for the lettering on the box and the completed unit was varnished. ⌑

SOUND EIGHTY TWO
EXHIBITION REPORT

IMAGINE an hotel of 1,150 bedrooms, 35 public rooms, 2 ballrooms, 14 meeting rooms, an exhibition hall, not to mention the many bars and a restaurant or two. Now imagine that it is your job to choose and install the various sound systems, background music, entertainment amplification, fire warning circuits, announcement facilities and so on.—Where would you begin?

SOUND EIGHTY TWO

Sound Eighty Two was the annual exhibition and seminars of the Association of Sound and Communications Engineers, held at the Cunard International Hotel, Hammersmith, London. It is the professionals show; but this is not to say there aren't a lot of ideas for us to gleen.

Of the thirty-nine companies exhibiting the most popular stands seemed at first to be the loudspeaker manufacturers, but later this changed and it was the microphone exhibitors who were crowded out. Finally, it was realised that the friendly atmosphere was being created by the stand and show organisers milling around looking at each other's wares.

The Queen Mary Suite on the first floor of the Cunard Hotel, Hammersmith, was divided in two for this exhibition. The "Port Side" and "Midships" section housed the main exhibition, whilst the "Starboard Side" accommodated the lecture theatre setting.

LISTENING POST

The lobby and Bar area was in use both as reception and exhibition layout, and it was here that the Listening Post system of Rediffusion Reditronics, who developed the system in association with the Countryside Commission, was demonstrated.

Listening Post is a free standing or wall mounted cassette player that provides information or commentary, either through a loudspeaker, a plastics tube and earpiece, or a stethoscope device for noisy situations. It is proving popular in museums, art galleries and wildlife sanctuaries. Larger installations use a central multitrack tape player to feed the visitors Listening Post.

AMPLIFIERS

Ambient noise sensing amplifiers was a theme of Modular Communications, where the level of background noise controls the output level of the amplifier enabling the announcements to be clearly heard. Another theme was an aerial splitter feeding f.m. radios, with switched tuning, known as Bedroom Radios and installed in many small hospitals and student hostels.

Plug-in crossover modules that provide an inexpensively simple bi-amping and tri-amping facility were demonstrated by Peavey Electronics (UK), the world's largest manufacturer of portable sound equipment. Also on show were the high quality Black Widow range of loudspeakers, graphic equalisers, mixers and the new Automatch transformer.

From practice amplifiers to 100 watt 5 channel mixer amplifiers and 2×12+ horn pairs capable of handling 260 watts gives a good idea of the Raven amplifiers available from the Cheshire Communications stand; their display included the latest Coles Electroacoustics microphone for the professional entertainer and this mic could be the answer to many a tape recording fanatic.

MICROPHONES

Various stands had radio microphones to give freedom of movement to actor, priest or president. One novel idea was a loudspeaker with a telescopic aerial appearing out of the top. The internal receiver and amplifier drive the loudspeaker that can be set up anywhere without the need (or cost) of long connecting leads. Radio-microphones require a special licence and must be of approved design.

Grampian designed microphones are now produced and serviced by Pegra Engineering and they had on show both omni-directional and cardioid microphones as well as semi-cardioid and "figure-of-eight" ribbon microphones.

Well known performers such as Charles Aznavour/Crystal Gayle/Rod Stewart/Dionne Warwick/Eddie Rabitt/ and Marie Osmond all use Shure microphones and their extensive range covers every sound situation—their catalogue is fact-packed too. From scientific sound level microphones to surface mounted Lo-profile microphones that look more like mice with long tails (used at conferences and in churches to pick up reflected sound coming from the table surface), and, of course, the whole range of entertainment microphones.

INFRAPORT

A long time was spent on the Hayden stand as they had so many new items on show. The infra-red distribution of sound within rooms has proved useful to many people and even used in schools for the deaf where the system works both ways, the teachers communicate with the children, who can speak back, and they can hear their own voices which help their development.

A device known as a Infraport system would have looked more at home in a hospital and was a trolley with a tray top containing a matrix of infra-red l.e.d.s. In the centre section was a stethoscope attachment that could be used by a doctor to listen to a patient whilst students in his charge hear (on their own Infraport receivers) the same sound as the doctor, who then explains what they have heard and moves on. In the past it would have meant every student having to listen to the sound through the doctor's stethoscope.

The Sennheiser Infraport systems are also available on multi-channel distribution to come with multi-translation at conferences, and it was interesting to note that the "hard-of-hearing" could use the system safely at home to enjoy television sound.

RECORDERS

Also demonstrated on the Hayden stand was the first EPROM program controlled professional tape recorder we had seen in operation; it only arrived from Germany the night before and so we experienced a hesitant demonstration of its function.

It was a joy to see this machine working with its "hands off" facility to ease editing. Auto forward reverse slowing over each pause between notes or syllables and when the edit button is pressed after stopping "on the spot" the machine runs the tape on to the cutter aligns the exact spot—all that is left is for the cutter to be pressed, and edit.

Broadcast quality tape recorders were here too. The Nagra range of portables using 6·25mm tape are the workhorses for quality interviews, sound film sync. recording, and their miniature professional tape recorder has to be seen to be believed.

The London Science Museum are installing rack mounted cartridge message repeaters to feed their many "information" points and the Sarner Audio Visual stand were demonstrating these machines.

SEMINARS

The first seminar that we attended, entitled "The Automatic Solution to Sound Pickup by many Microphones" was given by Dave Ashdown of the Knowles Company. A curious title that attracted us because we always thought that microphones were designed to pick up sound.

It soon became obvious that the systems under discussion involved council chambers and the like where there is a general background of noise. Each speaker is heard clearly because the other microphones are switched off until they input sound louder than the preset background noise level, this ensures that even a softly spoken person will be heard.

The unfortunate part of this show for me was the jarring way the internal PA announcements were made. But following its advice we attended a most interesting seminar on "Microphone Placement" by Ken Dibble. His interesting and informative talk on the problems of choosing the right mic and putting them in the best position for various musical instruments could well be an idea for a series of sound publications.

A Question Time was the final session of the day, spoilt by a verbose member of the public trying to prove he knew more than the panel members.

One interesting point that did manage to get across was the Tone Control vs Equalisation argument. The renters seem happy with tone controls but the designers were unhappy that hirers could wind up the bass and cause a lot of heavy wear on the loudspeaker cones, and anyway if the tone controls are set for music, then announcements sound poor or vice-versa.

LAST CALL

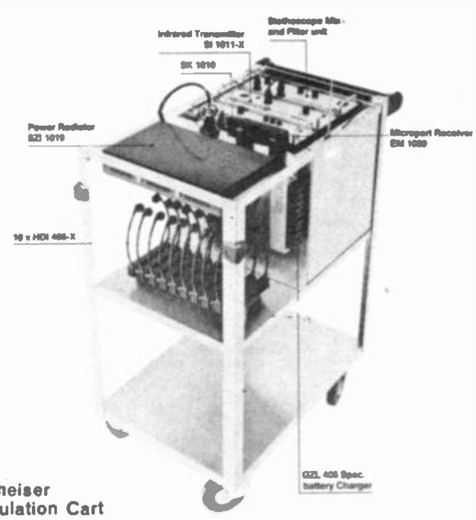
Back in the main exhibition area one of the last ports of call was a visit to the Eagle stand where their horn re-entrant speakers and the cordless headphone were featured. The headphone system involves a winding of four wires around the room, hall or factory, each listener wears headphones that contain a pick up coil, amplifier and small batteries; it enhances the sound quality and is easily installed. (A Home Office licence is required for this type of system).

The last to assist with information before the show closed was M. E. Millbank, and their range of equipment seems to cover every kind of PA situation. From Automatic "Spot" Announcement machines for use in railway stations, factories and airports, to an auto room call for hotels to set off a "pleasant interrupted tone" which has to be cancelled by the guest. If it doesn't wake the guest the system alerts staff and a printout describes the room number for investigation.

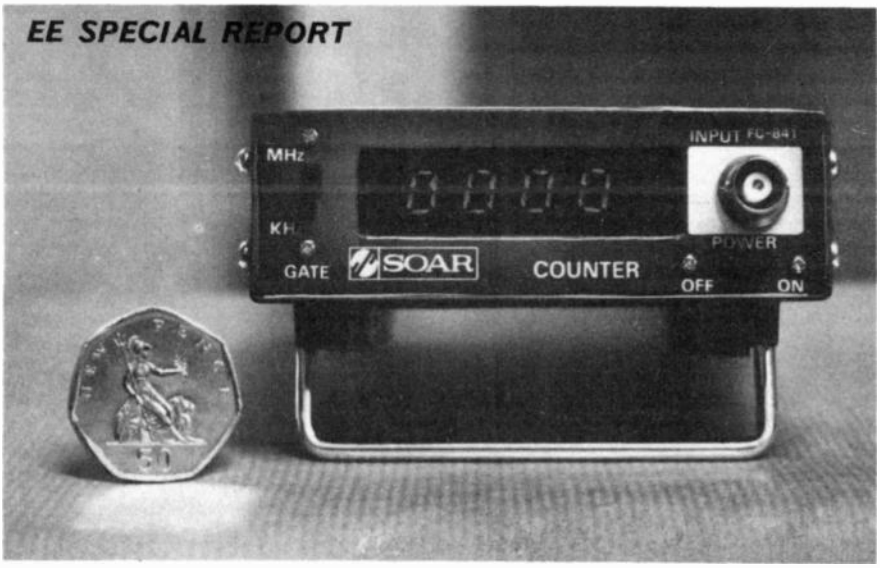
Studio 4119 and 4038 mics. from Coles Electroacoustics

Shure Pro Master Power Console

Toa Electric RX-6 Professional Mixer



Sennheiser Ausculation Cart



SOAR FREQUENCY COUNTER

ACCURATE digital frequency measurement has, until recently, remained almost exclusively within the realms of the professional laboratory and workshop. Until recently that is, because Holdings Photo Audio Centre in Blackburn have taken the initiative to import a neat little d.f.m. from Japan and made it available for under £50.

The meter in question is the SOAR FC-841 Frequency Counter and its specification is, to say the least, quite impressive for a unit small enough to rest on one hand. Small in size it may be but short on applications it's not, and the enthusiast can now own a d.f.m. with a frequency range covering audio to r.f. and hence can be used for such diverse purposes as checking the speed of a tape recorder or setting up a radio transmitter. And you won't need a pilot's licence or an electronics degree to operate it!

The controls are uncomplicated, with an on/off switch, a range switch to change between the two ranges (kHz and MHz, reading directly from the display in both cases) and a b.n.c. input socket.

SPECIFICATION

Frequency range:
10Hz-65MHz (45MHz on battery)*

Accuracy:
±10Hz, ±0·0002%

Resolution:
10Hz/10kHz

Sensitivity:
Better than 30mV (60mV on battery)*

Display:
4 digits, 7 digit accuracy on MHz range

Maximum input:
20V peak-to-peak

Input:
1MΩ+ stray capacitance via b.n.c. socket

Power supply:
4 × 1·5V AA size batteries or via external 8 to 11V d.c. mains adaptor through a 2·1mm power-in socket in back panel

Controls:
On/off switch, range switch

*Where performance is slightly derated on battery power, figures shown in parentheses.

DISPLAY

The display consists of four 0·3 inch seven segment l.e.d.s with the decimal point between the middle two digits.

The kHz range can therefore measure up to 99·99kHz, the resolution being ±10Hz as the last digit represents multiples of 10Hz. For frequencies above 100kHz, the meter must be switched to the MHz range and will now measure up to 65MHz, with a resolution of ±10kHz.

However, in order to achieve a higher resolution measurement with high frequencies, the meter can be switched back to the kHz range to display the next three digits (four are actually displayed, but the first digit now corresponds to the last digit displayed on the MHz reading) giving seven digit accuracy with the same resolution as the kHz range, ±10Hz.

If all that sounds a little confusing, it becomes much clearer with an example, so say the first reading was 10·25MHz and the meter was switched to kHz and reads 46·25. The precise "4" on this reading is a replacement for the approximate "5" in the first reading so the actual frequency is 10·24625MHz ±10Hz.

It should be noted that *all* counters have a tendency to read high rather than low on the last digit, so the frequency in the previous example is probably between 10·24624 and 10·24625MHz.

ON TEST

When it came to checking the accuracy of this meter, the test gear at our disposal proved to be of insufficient specification to do the SOAR any justice, so a series of tests were carried out to determine the consistancy of measurement from 10Hz up to 10MHz.

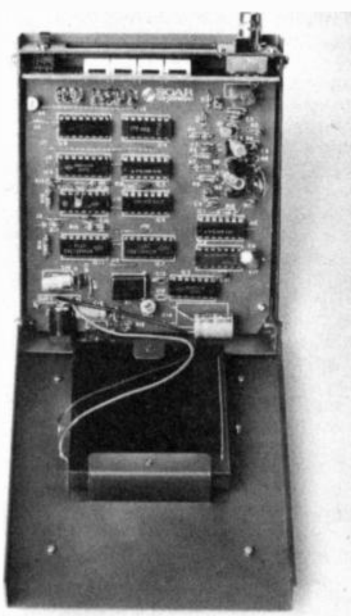
To do this, an accurate 10MHz crystal oscillator was built along with a 20-stage binary divider to repeatedly divide the input by two, thus creating a total of 21 test frequencies, each one exactly half the preceding one, from 10MHz down to 9·53Hz. (This is equal to 10MHz divided by 2^{20}.)

It is pleasing to note that the meter passed with remarkable accuracy, producing a linear relationship throughout this range.

A slight inconsistency was noted in the readings for 10Hz and 20Hz, but it was still within the specified accuracy of ±1 digit, so no black marks for that one.

This level of accuracy (and the distributors guarantee the figure of ±10Hz, ±0·0002 per cent) make the SOAR d.f.m. an attractive buy, comparable with meters costing many times more.

View inside the Soar frequency counter showing the single p.c.b. construction.



Meter with its input lead and power unit.

The meter is supplied in a robust steel case, only 120 x 100 x 32mm, with tilt-up front feet. The b.n.c. input lead, terminated with a pair of crocodile clips, is also included in the purchase price of £48 for the battery powered version or £52 if the mains adaptor is required.

An optional prescaler to expand the frequency range to 600MHz is also available for £23. All prices include VAT, but please add £1 for postage.

The operator's manual supplied with the SOAR contains the usual strange but rather quaint Japanese/English translation, but is quite clear and concise, and as the meter is simple to use, there should be no problems in this department.

The SOAR FC-841 is available, with a 6 month guarantee, from Holdings Photo Audio Centre, Dept. EE, Mincing Lane, Darwin Street, Blackburn, BB2 2AF.

WALES4CYMRU

Sianel Pedwar Cymru

At an estimated cost of £20 million over 500,000 Welsh speaking people will be able to receive over 22 hours per week of Welsh language broadcasting when the new television service S4C goes on the air next November.

BBC, IBA and HTV have helped in establishing the new Independent Welsh Fourth Channel Authority.

All programmes will be interspersed with most locally produced Welsh language advertisements.

The launch of the Welsh Fourth Channel Authority—Sianel Pedwar Cymru—appropriately on Saint David's Day, marked an historic change in the pattern of future broadcasting in Wales.

At last, after many years of campaigning, Welsh speakers will have a channel which will give priority to the use and development of the Welsh language. In addition to that, S4C will also provide a service for English speakers in Wales including coverage of local events.

S4C will come on the air in the first week of November. All Welsh programmes will move from existing channels to the new station.

S4C's first international "Superstars", Wil Cwac Cwac and Super Ted meet the girls.

Programmes

There will be 22 hours weekly in Welsh. S4C will commission programmes from the BBC, HTV and the Independent Producers. There will be some 40 hours weekly in English selected from Channel Four output.

They have no facilities to make programmes themselves. It will have only a small continuity suite. Programmes on HTV and BBC will now be in English only.

There will be advertising on S4C and the responsibility and the revenue for this will belong to HTV.

The Independent Broadcasting Authority has three main duties towards the new service. It will be responsible for the control of advertisements, for funding, and for transmitting the service.

The IBA and the Welsh Authority agreed the sum of £20 million to fund the service up to the end of March 1983. This finance forms part of the subscriptions payable by the ITV companies and is supported by the Government's adjustment of the levy payable to the Exchequer.

Productions

Already, over 30 independent producers have been commissioned to prepare programmes, contributing over 4 hours of Welsh language shows each week.

Most of the independent producers are Welsh-speaking, and many have based themselves in rural Wales where they hope to reflect the local culture.

English versions are also to be produced, and already the children's character "Super Ted" (the Welsh answer to Superman) is set to become an international hit with sales to America.

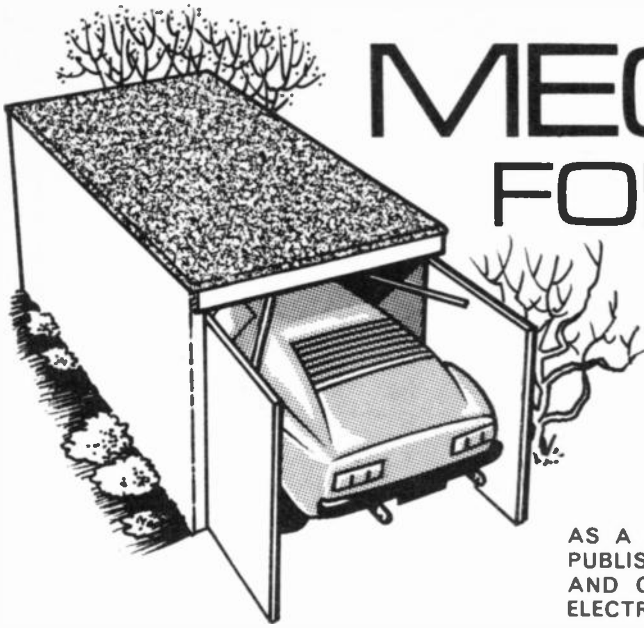
Technical Centre

The presentation centre for S4C is located within the Authority's premises at Sophia Close, Cardiff. It connects via cable with the BBC and HTV in Cardiff and with Channel Four, allowing for live or direct injection from these remote sources.

The majority of programmes, however, will originate from the centre. For this purpose, S4C has adopted the 1in helical scan C-format video tape recorder as its standard.

The centre will be equipped with six VTR machines to provide transmission sources and acquisition of programmes from remote sources.

At the heart of the system will be a 30 input Z80 microprocessor controlled presentation mixer bringing together local programme sources with remote inputs rendered locally synchronous by digital frame stores. Continuity will be in vision provided by two broadcast colour cameras. The presentation will be supported and enhanced by a digital still stores facility in addition to a graphics and character generator.



MECHANISM FOR SIDE HUNG GARAGE DOORS

BY J. HART

AS A SEQUEL TO THE AUTOMATED UP-AND-OVER GARAGE DOOR PUBLISHED EARLIER THIS YEAR, WE HAVE A NOVEL SYSTEM TO OPEN AND CLOSE THE SIDE HUNG TYPE DOORS, UTILISING THE SAME ELECTRONIC CONTROL UNITS AS BEFORE.

In the January and February 1982 issues, a description was given of a remote control system for up-and-over garage doors. However many readers will have the traditional side hung pattern and there is no reason for them not to benefit from the convenience and luxury of electronic control. An electric motor provides the power as before but a different operating principle must be adopted, relying on a chain driven traveller running on rails, with operating rods to move the doors.

Before starting on the construction, some simple geometry is necessary to determine the length of rails required and the position of a microswitch operated by the traveller to signal "door open".

With standard four-foot doors, a length of some 1·8 metres is needed to enable the operating rods to fully open them. Consideration should also be given to mounting the unit; in the author's installation, a bracket, made from a short length of angle iron, was fitted inside the garage above the centre of the door opening to which the motor plate with rails was bolted and steel straps attached to the garage ceiling support the other end of the rails.

RAILS AND TRAVELLER

Suitable 40×40mm angle iron for the rails was obtained from an old iron bedstead. Dexion type angle is not satisfactory as it tends to flex and twist. The rails, which must be straight and parallel, are bolted 25mm apart with a short iron strap at one end and the motor mounting plate 190×160mm at the other.

The microswitch (S8) is fixed at the motor end of the rails with a single bolt so that it can rotated to provide some degree of adjustment. This switch is the DOOR FULLY OPEN switch. The traveller is a critical component in the system and is made up from two flat steel or aluminium sheets 50×90mm with a piece of steel strip sandwiched between them. This must be of sufficient thickness to ensure a clearance to the rails so that it can slide freely (see section through traveller in Fig. 1). Holes are drilled on the centre line for the attachment of the chain and for an M8 bolt, 60mm long which acts as a pivot for the two operating rods. The running edges of the rails should be thoroughly cleaned and lightly smeared with grease before the traveller is mounted.

MOTOR DRIVE

A 240V a.c. reversible motor with gearbox is required and a model designed for opening and closing stage curtains, having a torque of 14·5 kgs and a shaft speed of 19 r.p.m. was purchased. A local cycle shop supplied the chain which is of 0·5in pitch and is normally available in 114 link lengths, so that three will be needed, together with two 21 tooth sprockets. With this size of sprocket, a closing or opening cycle will take about 18 seconds.

One sprocket was mounted on the gearbox shaft using a collar and grubscrew and the other turns freely on a shaft, centralised with spacers and supported on brackets bolted to the rail flanges. The motor is positioned so that the sprocket is centralised between the rails and is then bolted to the mounting plate. The chain is threaded over the sprockets and attached to the traveller with a small shackle and rigging screw of the type used on sailing dinghies; the rigging screw being used to tension the chain.

A simple folded aluminium cover was made to protect the motor and this was fixed to the motor mounting plate with small self-tapping screws.

COMPONENTS

Mechanical Components

Rails	40 × 40 × 2mm thick angle iron, 1·3m long, 2 off, see text for details. *(item 1)*
Operating rods	25 × 25mm softwood, 1·8m long, 2 off. *(item 2)*
Traveller	50 × 90mm steel or aluminium plate, 2 off; 90 × 25 × 2·5mm thick steel plate, 1 off. *(item 3)*
Chain	0·5 inch pitch, approximately 4m long. *(item 4)*
Sprockets	Bicycle type, 21 teeth, 2 off. *(item 5)*
Motor plate	190 × 160 × 2mm steel or aluminium plate. *(item 6)*
Motor cover	160 × 450 × 1mm aluminium sheet. *(item 7)*
Spring strip	200 × 13mm spring steel *(item 8)*

Electro-mechanical Components

Motor	Citenco 240Va.c. reversible motor and gearbox, output speed 19 r.p.m., torque 14·5kgs. *(item 9)*
Solenoid	240Va.c. type, optional if lock is required. *(item 10)*
Switches	Microswitch, S7 and 8, 2 off *(item 11)*

Miscellaneous

Assorted nuts, bolts, screws, washers, small shackle and rigging screw (for securing chain to traveller), various small brackets and plates (for fixing operating rods), spindle and spacers (for rear sprocket).

All item numbers given in parentheses refer to the encircled numbers shown on Fig. 1.

OPERATING RODS

For convenience, the rods were made of 25×25mm softwood and were stained or painted to match the doors, the metal fittings were then bolted on. At one end, a simple pin fitting is used to engage with a drilled bracket screwed to each door and at the other end, shaped plates drilled for the traveller bolt allow the rods to pivot as the doors move.

There can be a complication here as the doors are sometimes rebated where they meet, and to avoid jamming on closing, one door must shut a fraction of a second before the other. To achieve this action the bracket for the rebated door is bolted to that door at the end of a spring steel strip (on the prototype, a flexible hacksaw blade was used) which will allow about 50mm deflection. The length of this operating rod is shortened by the same amount (50mm) so that the rebated door will close first with the spring then deflecting as the other door follows through to the final closed position. Above this door another microswitch (S7) is fitted to signal DOOR FULLY CLOSED.

A separate door to the garage allows access to be gained and the pins of the operating rods to be disconnected from the door brackets in the event of a failure of the system. If there is no separate access then a hole should be drilled in one door to permit the operating rod to be disconnected by lifting with a small screwdriver.

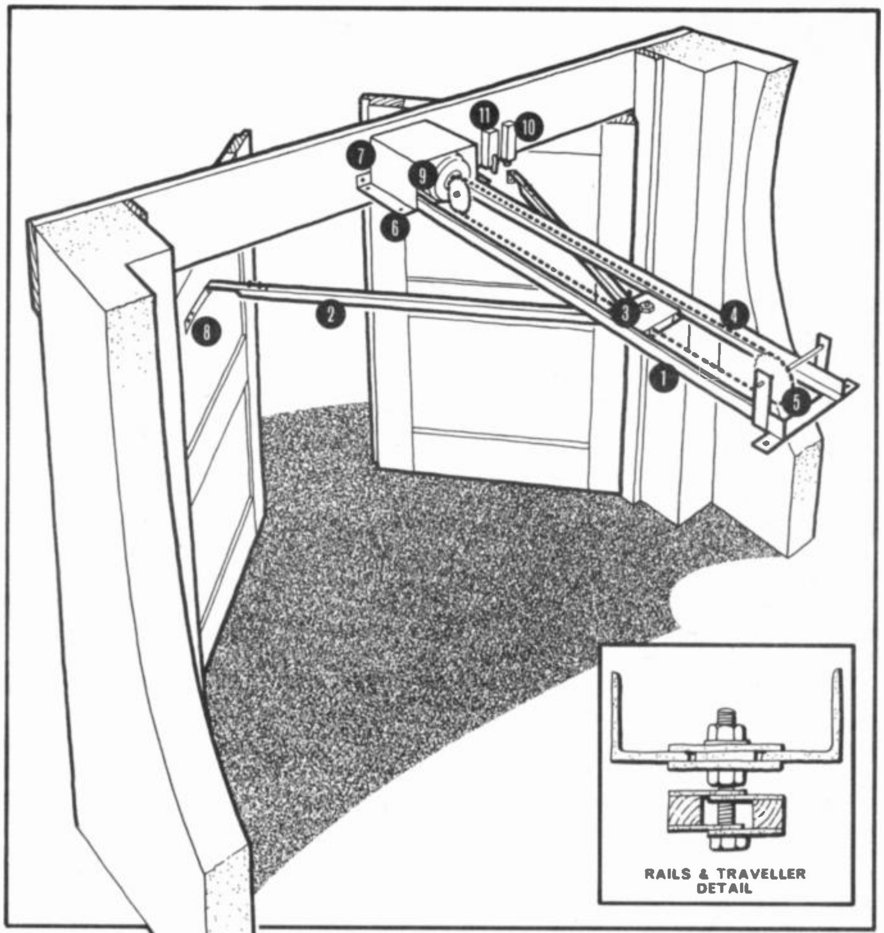


Fig. 1. Cut-away drawing of the garage showing the mechanical assembly of the opening device. See the components list for a breakdown of the numbered items. Inset shows a section through the traveller.

CONTROL

The control unit described in the previous article is suitable to control the motor; an important and necessary feature of which is the built-in delay between motor reversals. The motor leads should be connected to TB2/3, 4, 5 and 6 and the microswitches S8, DOOR FULLY OPEN, and S7, DOOR FULLY CLOSED, to TB1/7 and 8 and TB1/8 and 9 respectively, taking care with those wires carrying mains potentials. A 240V a.c. solenoid is fitted adjacent to the DOOR FULLY CLOSED microswitch to engage with a large eyebolt with connections made to TB2/3, 4 and 5 on the control unit.

All component designation numbers and terminal block references given here refer to the original system, the wiring diagram being Fig. 13, page 120, in the February issue.

No overload obstruction switches are used as it was considered that having waterproof microswitches on each door with flexing leads and long operating levers would not be entirely reliable, particularly when the obstruction would in most cases be an awkwardly shaped car. For this reason, TB1/3 and 4 must be linked.

One possibility would be a photoelectric circuit mounted near the ultrasonic receiver, projecting a beam diagonally across the door opening with reflection from a small mirror fitted on the edge of the far door, but the feasibility of this approach will have to await further experimentation. ⌑

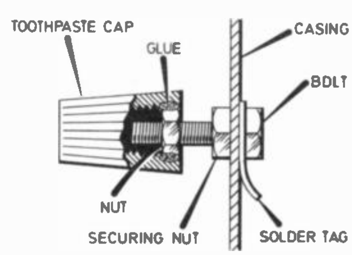
Readers' Bright Ideas; any idea that is published will be awarded payment according to its merit. The ideas have not been proved by us.

SCREW TERMINAL

I have devised a simple home-made screw terminal that I think may be of interest to other constructors.

A nut is glued inside the cap of a toothpaste tube which forms an insulated cap to screw on a bolt, nut and solder tag arrangement as seen in the drawing. This is only suitable for mounting on plastic cases in its presented form.

P. Brooksbank,
Garforth, Leeds



BIG 9 INDICATOR

BY F.G. RAYER

BY ADDING the numbers 7, 8 and 9, as well as Zero, this random indicator opens out further possibilities for games normally played with a conventional 1 to 6 die, and introduces new interest. Random selection of a number occurs each time the operating button is pressed, and players do this in turn, instead of shaking and tossing the die.

CIRCUIT DESCRIPTION

The circuit is shown in Fig. 1. Pulses are generated by unijunction transistor TR1 so long as the "Run" switch S1 is closed. Capacitor C1 charges through R1, until at a particular emitter potential TR1 discharges, producing the pulse at base 1. Pulses arise too rapidly of course for the player to have any chance of deliberate selection.

Potentiometer VR1 is not absolutely essential, but does have the advantage that conditions can be easily set to suit a range of unijunction transistors at TR1, and also to allow working from a 5V power supply, or 4·5V battery. If the total resistance from B1 to negative is either much too high, or much too low, pulses will not operate the counter IC1. So adjustment of VR1 takes care of this.

DECADE COUNTER

IC1 is a decade counter with binary output along 11, 8, 9 and 12. These points provide input to the decoder-driver IC2. This i.c. switches into circuit the correct segments of X1, the DL747 l.e.d. numeral, to produce the figure. Resistors R4 to R10 limit current to about 8mA per segment.

COMPONENTS

Resistors
R1 100kΩ
R2 470Ω
R3 180Ω
R4-10 220Ω (7 off)
All ¼W ±5%

See Shop Talk page 305

Potentiometer
VR1 470Ω miniature preset

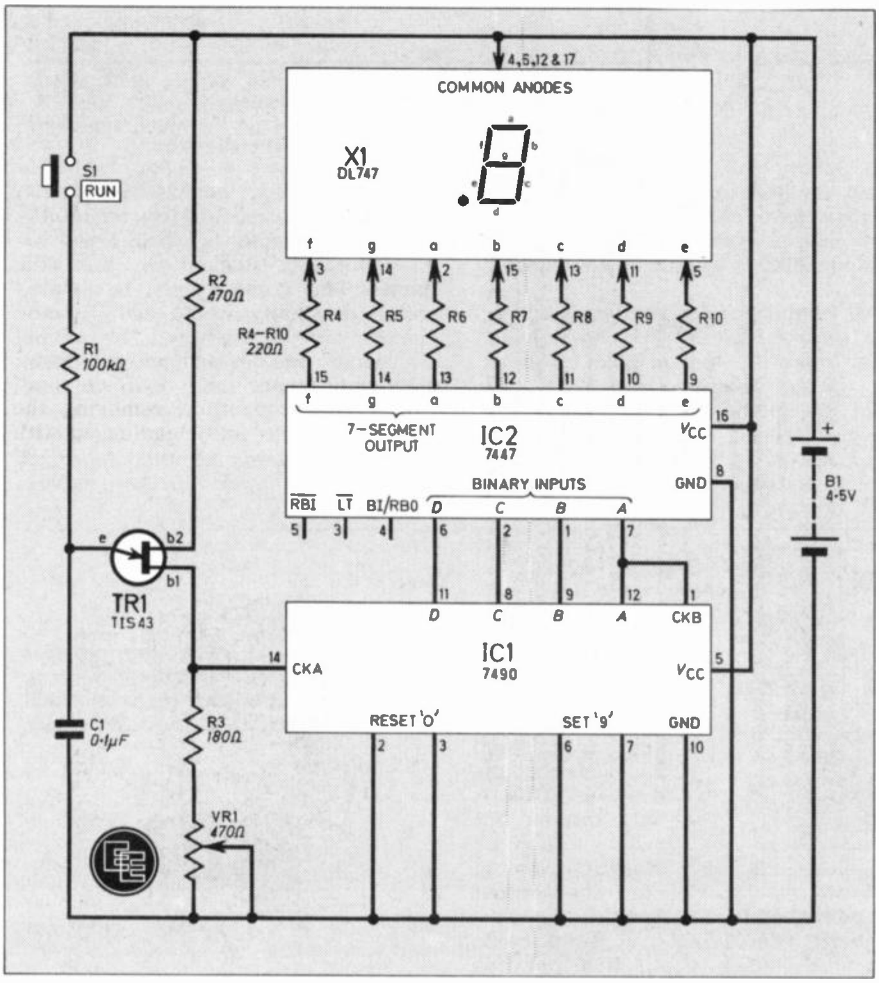
Capacitors
C1 0·1μF disc ceramic

Semiconductors
TR1 UT46, TIS43 or E5567 unijunction transistor
IC1 7490/FLJ161 decade counter 14-pin d.i.l.
IC2 7447 decoder-driver 16-pin d.i.l.

Miscellaneous
X1 DL747 common anode 7-segment l.e.d. display
B1 4·5V battery
S1 miniature push switch
Case, Verobox 70 × 50 × 25mm
Veroboard 15 strips × 26 holes.
Wire (see text). 14-pin d.i.l. holder, 16-pin d.i.l. holder.

Approx. cost Guidance only £5·50

Fig. 1. Circuit diagram of the Big 9 Indicator



CONSTRUCTION

Components are constructed on a piece of 0·1in stripboard, 15 strips by 26 holes. Some interconnections are made by link wires on the top and underside of the board. These link wires, the breaks in the copper strips and the placement of components are all clearly shown in Fig. 2(a) and (b).

To fit the plastics case, which measures 70 x 50 x 25mm, it will be necessary to file the corners off the board to clear the mouldings which take the case screws.

Before inserting the DL747 display X1, clear away the copper strip where the pins emerge, except for A, Fig. 2. Support this device by soldering at A, and for the four positive line connections, which are to the adjacent strips as shown. Have the numeral as far from the board as the length of pin allows, and make sure the identifying spot or mark (*not* decimal point) is at the top.

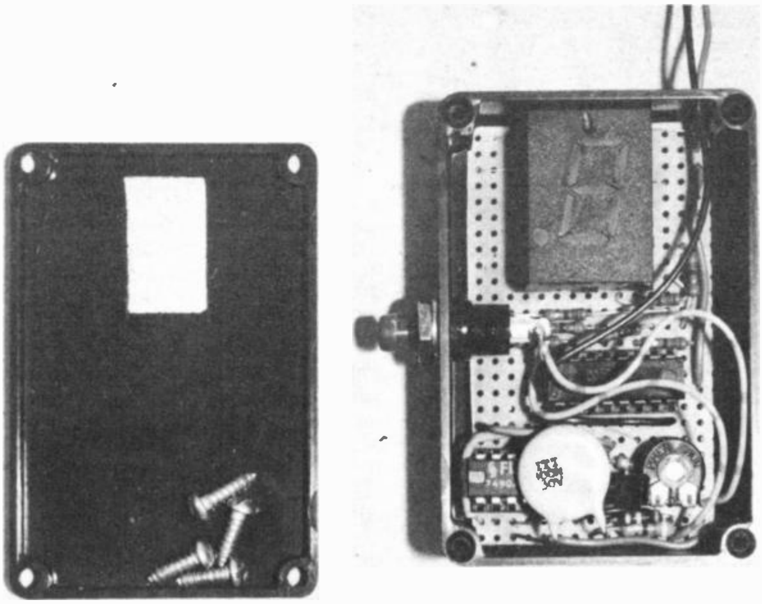
Holders are used for IC1 and IC2. Resistors need to be of the small, fractional wattage type, to save space. C1 is a low voltage disc ceramic capacitor, which can rest flat on top of IC1.

CIRCUIT POINTS

Cut breaks in the copper strips under the rows of pins for IC1 and IC2, and in all other positions. This is most easily done systematically as work progresses. As example, between 14 of IC1 and R4, between 13 of IC1 and R6, and so on, across the board, finally between R8 and the positive line.

Where several leads are close together, as near IC1, thin insulated wire is required. Also use this for the positive line from 5 of IC1, and solder on two flexible wires for S1.

Positive and negative leads run through a small hole in the case so that the indicator can be run from a 5V power supply. It will also operate from a 3-cell (4·5V) battery. Current taken is about 95mA. Take care to use the correct polarity of connection.



The completed Big 9 Indicator.

CHECKING AND ADJUSTMENTS

Carefully examine the board for omitted breaks, or fragments of copper or solder between conductors. These can cause an incorrect display or other troubles.

With VR1 set at about middle position, and S1 closed, the numeral should change rapidly, and stop at some figure when S1 is released. Check that all numbers display correctly. If not, look for shorts or omitted connections around the display and IC2. If the number does not change with S1 closed, adjust VR1 to clear this.

If no setting of VR1 produces the wanted result, TR1 may not be oscillating. This is easily checked by taking headphones, or similar means of testing, to b1, where a rapid buzz should be heard. If this is absent, check around TR1, S1, R1, C1 and R2.

The push switch S1 fits in a hole in the side of the case, and is easily manipulated in this position. The case cover fits with four self-tapping screws. A hole is cut in the cover, over the numeral, by drilling small holes closely together, removing the unwanted piece, and cleaning up with a small file. ☒

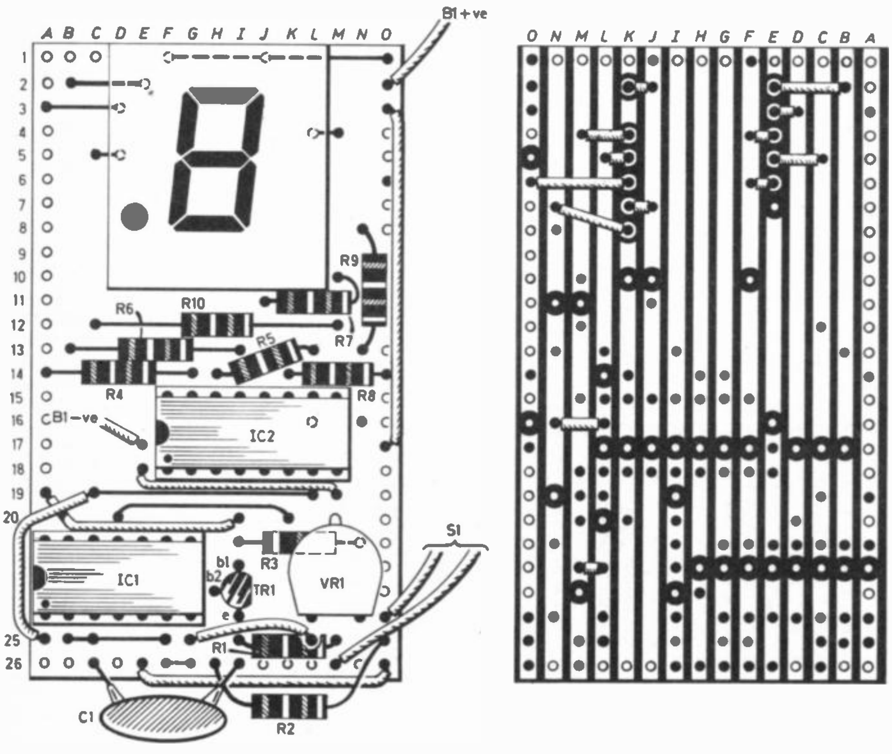
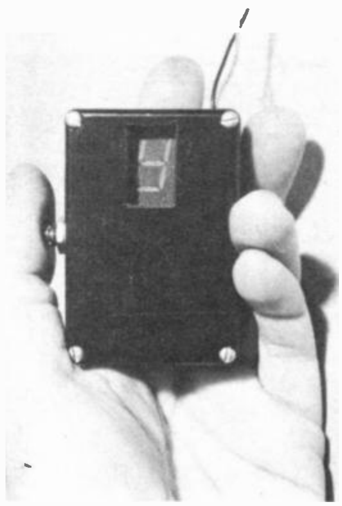


Fig. 2. The unit is assembled on a piece of stripboard. (a) shows the top side with all components in position, (b) shows the underside of the stripboard. Note carefully all the breaks that have to be made in the copper strips. The wiring from the display pins is taken directly to the copper strips. Plastic sleeving should be used for display wiring and *all* underside links.



DOWN TO EARTH

BY GEORGE HYLTON

Positive Feedback

POSITIVE FEEDBACK must have looked to early radio engineers like a great and glorious free gift which would answer all their problems. So it did, up to a point. But today those problems hardly exist. All the same, positive feedback still has its uses.

Radio valves used to be very expensive. A simple triode cost a sizable portion of a week's wages.

This gave radio engineers a problem. How could the sensitivity and selectivity of a receiver be increased without increasing the number of valves?

Positive feedback did both these things, at one stroke. Only, it wasn't called positive feedback in those days, but reaction, regeneration, or retro-action.

All these names suggest a process involving some sort of repetition, and this indeed was how positive feedback was regarded. The basic idea was to make the same valve amplify twice. To do this, you took some of its output and fed it back to its input, so that the signals were amplified a second time.

Op-Amp Model

The operational amplifier hadn't been invented. If you had suggested, in the *twenties*, that a device containing a dozen active amplifying units and giving an audio gain of 1000 or more could one day be obtainable for the price of a few cigarettes, people would probably have thought you insane.

Down To Earth

We do have operational amplifiers so let's make use of one to illustrate the principle of positive feedback.

Our particular op-amp (Fig. 1) is a very modest affair, giving a voltage amplification (A) of only 10. Even this is quite good compared with the earliest valves.

If we take some of the output and feed it back (via resistances Y and X) to the non-inverting input, this feed-back output is amplified a second time and reappears in enlarged form at the output.

Suppose we feed back one twentieth part of the output. If the original signal input was 1V, the original output (with $A=10$) was 10V. One twentieth of this (0·5V) is now fed back, and because of the way op. amps work this 0·5V is added to the original 1V input, giving a new input of 1·5V.

The gain has effectively been increased from 10 to 15, it seems. In fact, it has been increased more than this, because some of the new 15V output is now fed back, giving a "new new" input of 1·75V and a "new new" output of 17·5V.

The process doesn't stop there, but continues. I can tell you that the gain you end up with is 20, because I know the formula:

$$\text{NEW GAIN} = A/(1-AF)$$

Here A is the "real" gain (in our case, 10) and F is the fraction of output fed back (in our case 1/20).

Putting in our figures gives: NEW GAIN= 10/(½), and since there are 20 halves in 10 this comes to 20. If more of the output is fed back the effect is to reduce the fraction by which A has to be divided and this means an increase in effective gain.

If the fraction fed back is such that the sum comes to 10/(1/10), the new gain is 100. For 10/(1/100) it is 1000; for 10/(1/1000), 10,000 and so on. The limit comes when the original gain of 10 has to be divided by 0, because the answer is infinity.

Infinite gain is of no practical use, because it means that any input signal, however small, is amplified until it gives the maximum possible output. Since there is always an input, in the form of unwanted noise, the amplifier always gives maximum output.

In the case of Fig. 1 this means that the op—amp "latches up", sticking on, say, maximum possible positive output, whether there is an input or not. In the case of the positive feedback circuits used in early radios, infinite gain meant that the circuit burst into oscillation. Since, in those days, sets were fitted with long wire aerials, oscillation turned a receiver into a transmitter which sent annoying "howls" to the neighbours, so it was frowned upon.

The art of using "reaction" in radio receivers was to design a circuit which could be set just short of oscillation, giving a very greatly increased gain. Since the feedback path included a tuned circuit selectivity was also increased because more signals were fed back at the tuned frequency than at any other.

Limitations

With the circuit set just short of oscillation any tiny increase either in the amount fed back or in the real gain pushed the circuit over the brink. Changes in mains voltage, temperature, and in physical conditions near the receiver such as bringing one's hand to the controls could all affect the circuit in this way.

In a word, the advantages of positive feedback have to be paid for in terms of operating difficulties. As valves became cheaper and the required selectivity could be obtained by building "superhet" receivers with several tuned circuits in their intermediate frequency stages "reaction" quietly faded from the scene, except in radios built by electronics enthusiasts.

Positive Feedback

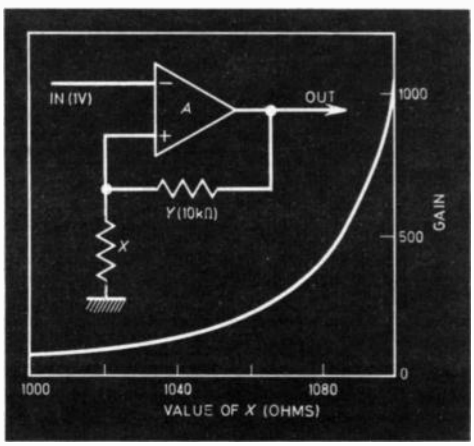
Positive feedback, however, continued to be used for other purposes, not by itself but in conjunction with negative feedback. This may seem odd, since negative feedback cancels positive.

However, it does not do so if the positive feedback path differs from the negative in frequency response. This leaves open the possibility of circuits where some positive feedback is obtained at some frequencies.

This gives the designer control over frequency response and many "active filters" use positive feedback in this way, as response-shaping not gain-raising. Gain is cheap, today.

A familiar example of mixed feedback is the Wien Bridge audio oscillator (Fig. 2). Here the positive feedback gives a slight preference to the one frequency at which capacitances C have the same reactance as their associated resistances R.

By setting the potentiometer VR1 so that the circuit just oscillates this frequency is generated as a pure sine wave. In other words, the positive feedback is used to transform a circuit which is only slightly selective into one so sharply selective that it picks out the noise in the amplifier on that one frequency and amplifies it to give a large output.



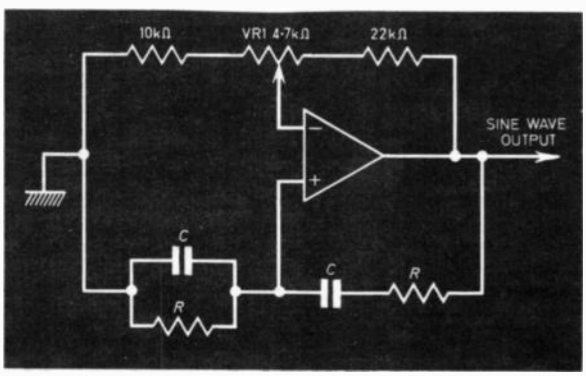
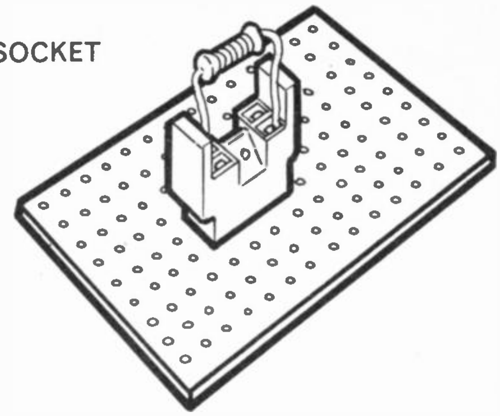


Fig. 1 (left) A simple operational amplifier. The graph shows the amount of gain for different values of resistor X. Fig. 2 (above) A Wien Bridge oscillator.

Readers' Bright Ideas; any idea that is published will be awarded payment according to its merit. The ideas have not been proved by us.

COMPONENT SOCKET



I have found that when constructing experiments and projects where components may need to be changed regularly, such as in timers, if you cut a section of an i.c. socket with a sharp knife, or a hacksaw and insert it into your circuit, it becomes a simple matter to remove components and make any necessary substitutions, see diagram.

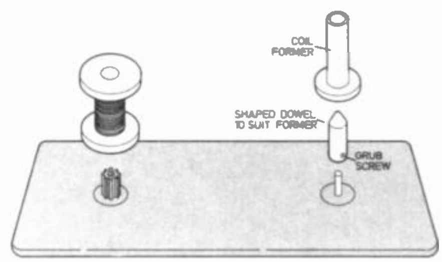
R. J. Bennett,
Walkergate, Newcastle-upon-Tyne

COIL WINDER COUNTER

Many radio enthusiasts will have experienced the frustration in winding the penultimate turn on a coil when some disaster occurs, such as dropping the wire perhaps.

A simple coil winding jig which automatically keeps count of the turns can be constructed from an old tape or cassettee deck fitted with a tap counter. Remove the spool carrier from the take-up spindle and replace with a piece of dowl suitably drilled and shaped to form a carrier for coil formers.

Place the spool of wire on the opposite spindle. The first turns should be made at a slow speed, increasing to "fast forward" for the bulk of the turns. The counter will indicate number of turns wound.



D. Greenhalgh,
Poyton, Cheshire

SQUARE one FOR BEGINNERS

EVEN the most sophisticated and modern manufacturing techniques employed today in the construction of electronic equipment have not eliminated the need for basic point-to-point wiring, so an understanding of the many different types, sizes and uses of wire is essential, particularly to those of us who pursue electronics as a hobby and the wiring forms an important part of many a project.

EQUIPMENT WIRE

Equipment wire is the type that is used for the wiring of electronic chassis, front panels and circuit boards, and is usually sheathed with p.v.c. or a similar insulator. It can be divided into a further two categories: single stranded, that is a single copper conductor sheathed with p.v.c.; and multi-stranded with more than one copper conductor grouped together and again sleeved with p.v.c.

When describing equipment wire, two figures are quoted, the first being the number of conductors in the wire and the second being the diameter in millimetres of each conductor in that wire. So for example, a 1/0·6 wire has one conductor 0·6mm in diameter whereas a 7/0·2 wire has seven smaller conductors, each of 0·2mm diameter. Table 1, below, gives the data on the popular sizes of equipment wire available.

Single stranded equipment wire must never be used in applications where the wire is likely to be continually "flexed" back and forth as this will eventually fracture the copper and the wire will break.

The ideal application for the single stranded wire is chassis and p.c.b. wiring, as once in place, it will not be required to bend or flex.

MULTI-STRANDED WIRE

In the cases where the wires in a piece of equipment do get subjected to a fair amount of flexing, as in a cableform or in front panel to circuit board wiring, a multi-stranded wire of the correct voltage and current rating must be used. Due to the nature of multi-stranded wire, it is able to bend more often without breaking and so lends itself to this type of wiring.

In instances where the wire will be frequently moved about, as for example, with a test probe, a wire with a large number of very small diameter strands and an extremely pliable p.v.c. sheath is used, the example in Table 1 being the 55/0·1 wire

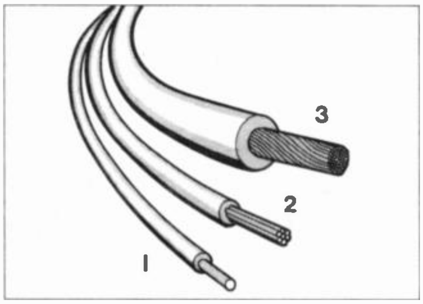


Fig. 1. Examples of equipment wire: (1) 1/0·6; (2) 7/0·2; and (3) 55/0·1

WIRE PREPARATION

In order to make a successful solder joint with a piece of wire, it must first be stripped of its insulation for about 6 to 10mm, and in the case of multi-stranded wires, the individual strands must be twisted together and tinned, thus making a rigid enough end to form a good mechanical joint prior to soldering.

TABLE 2
SOLID COPPER WIRE DATA

SIZE s.w.g.	NOMINAL DIA. (mm) t.c.w.	e.c.w.
16	1·62	1·73
18	1·22	1·31
20	0·91	1·01
22	0·71	0·73
24	0·56	0·63
26	0·46	0·53

t.c.w. = tinned copper wire
e.c.w. = enamelled copper wire

The stripping of the insulation is best performed with a special wire stripping plier, these being set carefully to the correct depth of cut to ensure that only the outer sheath is removed. Should the strippers damage one or more of the strands or nick the conductor, the end must be cropped off and the wire prepared once again as any weakness in the wire close to the joint will almost certainly fail.

A wire must never be pulled too tight and a good "rule of thumb" is to allow enough slack at both ends to completely remake the joint should the equipment be modified or serviced.

SOLID WIRE

Another type of wire the home constructor will encounter is solid copper wire of both the tinned and enamelled varieties.

Tinned copper wire (t.c.w.) has a single copper conductor, precoated with solder, supplied in sizes corresponding to the Standard Wire Gauge (s.w.g.), shown in Table 2. A typical application of t.c.w. being links on stripboard where a 20 or 22 s.w.g. wire would be used.

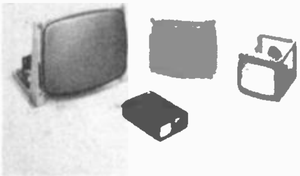
The enamelled copper wire (e.c.w.), also measured in s.w.g., is a little more specialised, its prime application being in wound components (transformers, chokes, etc.). The enamel coating provides insulation to prevent adjacent windings from shorting out on one another and must be scraped off to make a successful solder joint.

TABLE 1 EQUIPMENT WIRE DATA

SIZE	MAX. RATING	DESCRIPTION	TYPICAL APPLICATIONS
1/0·25mm (0·05mm²)	150Vr.m.s, 0·4A @ 25°C	silver plated copper, Kynar insulated, 0·5mm dia.	suitable for wire wrapping only
1/0·6mm (0·28mm²)	1kVr.m.s, 1·8A @ 70°C	tinned copper, p.v.c. insulated, 1·2mm dia.	rigid wiring of electronic equipment (chassis, p.c.b.s)
10/0·1mm (0·08mm²)	750Vr.m.s, 0·5A @ 70°C	tinned copper, stranded, p.v.c. insulated, 1·05mm dia.	wiring of electronic equipment where a degree of flexing of the wires is expected (front panels, external components)
7/0·2mm (0·22mm²)	1kVr.m.s. 1·4A @ 70°C	tinned copper, stranded, p.v.c. insulated, 1·2mm dia.	
16/0·2mm (0·5mm²)	1kVr.m.s, 3·0A @ 70°C	tinned copper, stranded, p.v.c. insulated, 1·6mm dia.	
24/0·2mm (0·75mm²)	1kVr.m.s, 4·5A @ 70°C	tinned copper, stranded, p.v.c. insulated, 2·0mm dia.	
32/0·2mm (1·0mm²)	1kVr.m.s, 6·0A @ 70°C	tinned copper, stranded, p.v.c. insulated, 2·5mm dia.	
55/0·1mm (0·43mm²)	650Vd.c. (500Va.c.), 2·5A @ 70°C	plain copper, stranded, pliable p.v.c. insulated, 2·8mm dia.	very flexible for test leads and probes

Effective cross sectional areas of the conductors are given in parentheses in the first column.

NEW · NEW · NEW · NEW PRODUCTS NEW · NEW · NEW · NEW



VIDEO MONITORS

The introduction of a complete range of professional video monitors is announced by Thandar Electronics.

Each monitor is supplied fully operational in chassis format with a choice of black and white or green phosphor tubes with the option of standard or non-glare screens.

The range of monitors are primarily aimed at the OEM test and measurement, computer and video markets although they are claimed to be ideally suited to many other areas.

Designated the TV2, TV5, TV9 and TV12 each type is claimed to be competitively priced with discounts for bulk purchases.

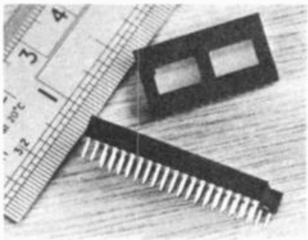
Thandar Electronics, Dept EE, London Road, St Ives, Huntingdon, Cambs PE17 4HJ.

FUNCTION GENERATOR

The new Levell Type TG301 Function Generator provides sine, square, triangle, pulse, sawtooth ramp and asymmetrical sine waveforms over the frequency range of 0·02Hz to 2·1MHz. The frequency can be swept over three decades by an external voltage.

The main output is 20 volts peak to peak from a 50 ohm source. A TTL output gives a fixed amplitude square wave or pulse waveform with a fast rise time suitable for driving up to 20 TTL loads or to trigger an oscilloscope. In addition, there is a variable d.c. offset facility enabling up to ±10 volts to be superimposed on the main output signal.

Levell Electronics Ltd, Dept EE, Moxon Street, Barnet, Herts EN5 5DS.



IC SOCKETS

Claiming a saving of up to 20 per cent board space, Texas Instruments is thought to be the first supplier to offer special i.c. sockets with 0·07 inch pin spacing.

These sockets have been produced to meet the increasing demands by new consumer semiconductor products beginning to appear on the market requiring 0·07 inch spacing. This is besides some of TI's own TMS 1000 range of 4-bit microcomputers.

At present only 28-pin and 40-pin versions are available. The contacts are of tin on copper alloy.

Texas Instruments Ltd, Dept EE, Manton Lane, Bedford MK41 7PA.

ACOUSTIC COUPLER

A new portable acoustic coupler modem that provides an acoustic link between a standard telephone handset and a microcomputer via an interface is announced by O.E. Ltd.

In addition to the standard application in linking computers together for data communication, it allows the microcomputer owner to convert his system into a Prestel/private Viewdata receiver. Also it is capable of receiving Telesoftware data transfers.

Designated PAC-M1, it is claimed to be the smallest and cheapest acoustically coupled modem currently available, and can be supplied ex-stock. The asynchronous full duplex F.S.K. modem transmits at 75 baud and receives at 1200 baud, meeting international requirements of C.C.I.T.T. V23. The standard interface is for RS232C/V24 recommendations.

O.E. Ltd, Dept EE, Industrial Estate, Appleby in Westmorland, Cumbria CA16 6HX.

18-NEEDLE PRINTER

The latest Philips GP300 matrix printer is now being marketed by Datac Ltd, the printer people.

This machine incorporates an 18-needle printhead giving a print matrix of up to 18 × 25 dots per character on a single pass. With such high resolution it is not only possible to print characters practically as good as "fully formed" ones, as with a daisy wheel printer, but by using a semi-graphics font it is claimed to be possible to print forms, bar-codes, logos and so on.

Specialised printout of this type can be performed at a rate of 80 characters/sec, but in addition, using a simpler 9 × 9 dot matrix the GP300 can print data-quality text at up to 300 characters/sec.

Datac Ltd, Dept EE, Tudor Road, Broadheath, Altrincham, Cheshire WA14 5TN.

MUSIC CENTRE

To complement their current range of conventional sized music centres, Hitachi are launching a compact, vertical format unit that is ideal for use where space is at a premium.

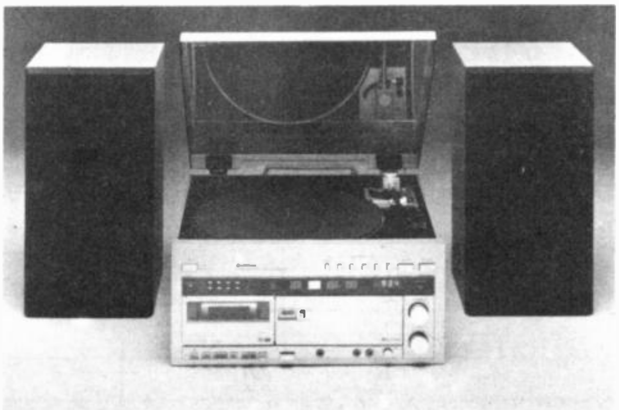
It is a full specification music centre but measures only 39cm wide × 20cm high and 40cm deep and features a tuner that covers m.w., l.w. and stereo f.m. (sensitivity 1μV). Digital tuning is a feature of this new model and in addition to manual station selection, it is equipped with 5 f.m. presets. L.e.d.s. are used to indicate stereo broadcasts and for tuning.

Power output is 20 watts per channel (r.m.s.) into a two-way 4 ohm speaker system with bass and treble units. The sound quality is further enhanced by the acceptability of metal tapes to extend the dynamic frequency range to 16kHz.

The cassette deck also features a Dolby noise reduction circuit and accepts CrO2 and normal tapes too. All the function controls are soft touch sensors for ease of operation and a bank of 6 l.e.d.s. are provided for monitoring sound levels on each channel.

The record deck has a two-speed belt drive turntable with wow and flutter of only 0·09 per cent DIN and uses a straight tone arm fitted with a moving magnet stereo cartridge. The deck can be set for manual play, repeat play and has a start and cut control with "one touch" operational facility.

Hitachi Sales (UK) Ltd, Dept EE, Hitachi House, Station Road, Hayes, Middx UB3 4DR.



CIRCUIT EXCHANGE

This is the spot where readers pass on to fellow enthusiasts useful and interesting circuits they have themselves devised.

Payment is made for all circuits published in this feature.

Contributions should be accompanied by a letter stating that the circuit idea offered is wholly or in significant part the original work of the sender and that it has not been offered for publication elsewhere.

I.C. TEST BED

I have designed the test-unit shown here for checking and identifying unmarked logic i.c.s of up to 16 pin d.i.l. size.

Because of the pin arrangement of the 9 digit, 7-segment display unit, the bulk of the circuit is used to drive the display itself. The oscillator comprising of IC5a, b is used to change the half of the i.c. being tested that is used to drive the display.

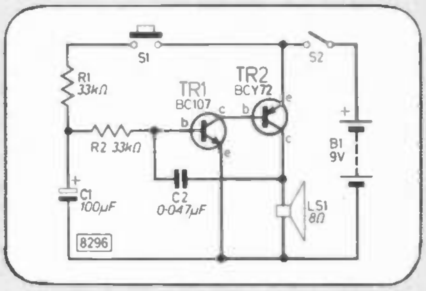
Each output of the test i.c. is gated to its corresponding l.e.d. on the display, and thus each half of the display is turned on and off in turn, but at such speed as to make it seem a continuous light, showing the relative states of each pin of the i.c.

Changing the i.c.'s environment is done by grounding different combinations of pins by using S1 to S16, or by the output probe. This can be used to provide a fixed frequency output, from the oscillator IC5c, d, or by manual pulses, of positive or ground values. The output probe can also be used with the input probe, to give a logic probe for external use, via the last display digit.

Power is supplied to the test i.c. by means of two flying leads, to a series of Soldercon pins, which also provide the "tap" points for use with the probes.

The whole unit can be made in an old calculator casing, using the keyboard, after rewiring, and the display unit; with the i.c. socket, Soldercon pins, and the ON/OFF; AUTO/MAN; and PULSE switches being mounted on the front panel.

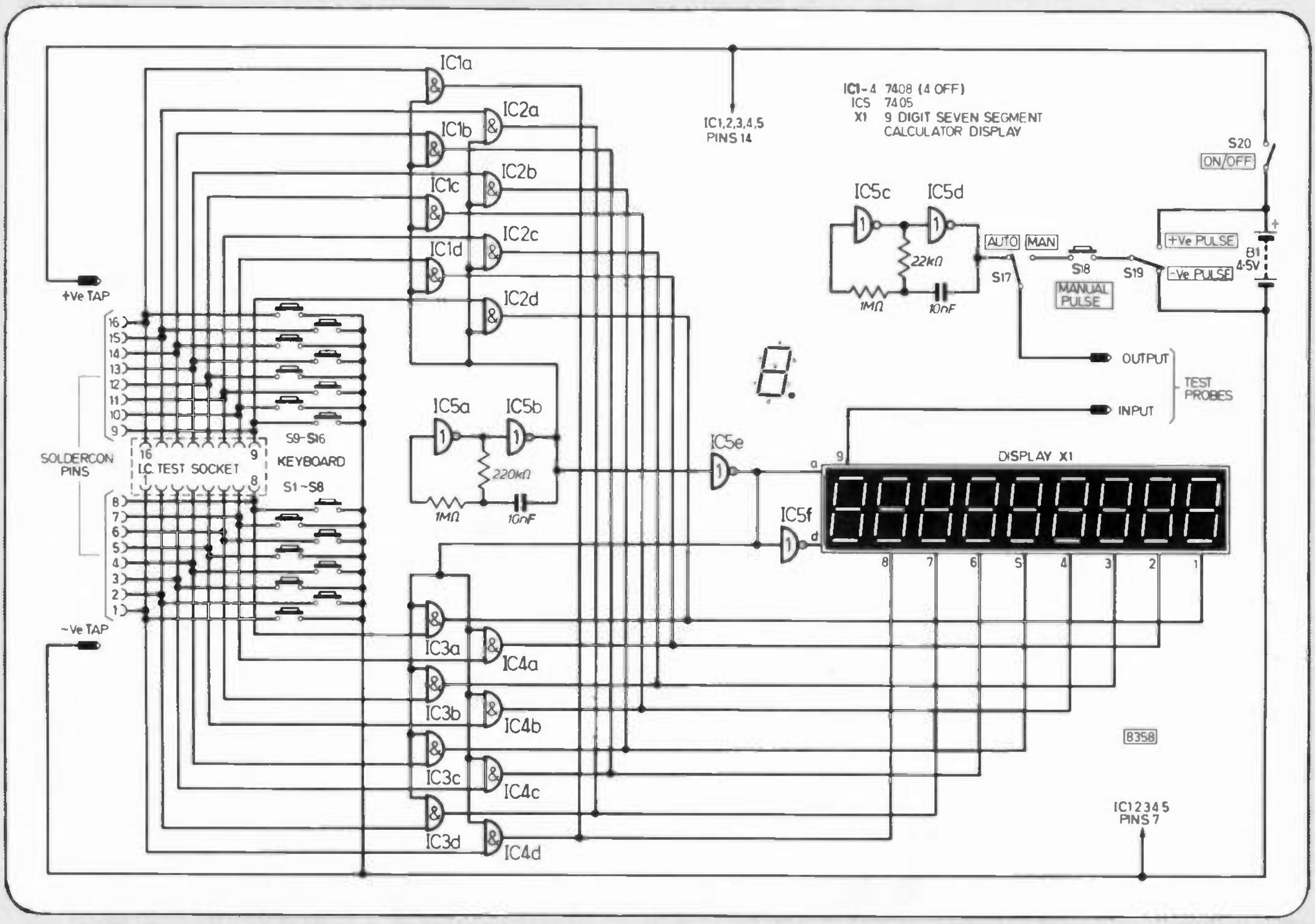
David Cullen,
Harrogate.



SIREN

The circuit shown above is for a British Police siren. When S1 is pressed a buzzing noise will be heard in LS1 which is continually gaining frequency as long as the button is held down. When you want the frequency to decrease, simply release S1.

Archie Waddell,
Dunbar.



LOOK

Kit includes tape transport mechanism, ready punched and back printed quality circuit board and all electronic parts i.e. semiconductors, resistors, capacitors, hardware, top cover, printed scale and mains transformer. You only supply solder & hook-up wire. Self-assembly simulated wood cabinet. £4.50 + £1.50 p+p.

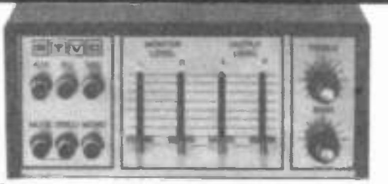
Featured in April issue Practical Electronics, reprint 50p - Free with Kit.

INTRODUCTORY OFFER – ONLY **£32·95** + £2.75 p&p.

P.E. STEREO CASSETTE RECORDER KIT

- NOISE REDUCTION SYSTEM
- AUTO STOP
- TAPE COUNTER
- SWITCHABLE E.Q.
- INDEPENDENT LEVEL CONTROLS
- TWIN V.U. METER
- WOW & FLUTTER 0.1%
- RECORD/PLAYBACK I.C. WITH ELECTRONIC SWITCHING
- FULLY VARIABLE RECORDING BIAS FOR ACCURATE MATCHING OF ALL TAPES

STEREO AMPLIFIER KIT



- Featuring latest SGS/ATES TDA 2006 10 watt output IC's with in-built thermal and short circuit protection.
- Mullard Stereo Preamplifier Module.
- Attractive black vinyl finish cabinet, 9"x 8¼"x 3¾" (approx).
- 10+10 Stereo converts to a 20 watt Disco amplifier.

To complete you just supply connecting wire and solder. Features include din input sockets for ceramic cartridge, microphone, tape or tuner. Outputs - tape, speakers and headphones. By the press of a button it transforms into a 20 watt mono disco amplifier with twin deck mixing. The kit incorporates a Mullard LP1183 pre-amp module, plus power amp assembly kit and mains power supply. Also features 4 slider level controls, rotary bass and treble controls and 6 push button switches. Silver finish fascia with matching knobs and contrasting cabinet. Instructions available, price 50p. Supplied FREE with kit.

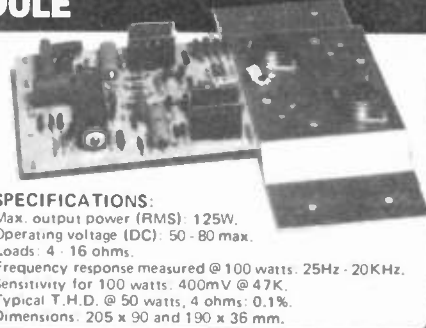
£16·50 + £2.90 p&p.

SPECIFICATIONS:	Suitable for 4 to 8 ohm speakers
Frequency response	40Hz – 20KHz
Input sensitivity	P.U. 150mV. Aux. 200mV. Mic. 1.5mV.
Tone controls	Bass ±12db @ 60Hz; Treble ±12db @ 10KHz
Distortion	0.1% typically @ 8 watts
Mains supply	220 – 250 volts 50Hz.

8" SPEAKER KIT Two 8" twin cone domestic speakers. £4.75 per stereo pair plus £1.70 p&p. when purchased with amplifier. Available separately £6.75 & £1.70 p+p.

125W HIGH POWER AMP MODULE

KIT: **£10·50** + £1.15 p&p BUILT: **£14·25** + £1.15 p&p.



The power amp kit is a module for high power applications – disco units, guitar amplifiers, public address systems and even high power domestic systems. The unit is protected against short circuiting of the load and is safe in an open circuit condition. A large safety margin exists by use of generously rated components, result, a high powered rugged unit. The PC board is back printed, etched and ready to drill for ease of construction and the aluminium chassis is preformed and ready to use. Supplied with all parts, circuit diagrams and instructions.

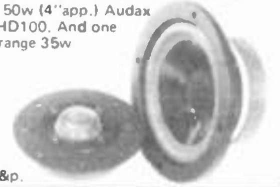
ACCESSORIES: Suitable mains power supply kit with transformer: £7.50 plus £3.15 p&p.
Suitable LS coupling electrolytic: £1.00 plus 25p p&p.

SPECIFICATIONS:
Max. output power (RMS): 125W.
Operating voltage (DC): 50 - 80 max.
Loads: 4 - 16 ohms.
Frequency response measured @ 100 watts: 25Hz - 20KHz.
Sensitivity for 100 watts: 400mV @ 47K.
Typical T.H.D. @ 50 watts, 4 ohms: 0.1%.
Dimensions: 205 x 90 and 190 x 36 mm.

HI-FI SPEAKERS AT BARGAIN PRICES

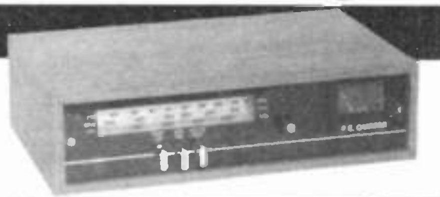
GOODMANS TWEETERS
8 ohm soft dome radiator tweeter (3¾"sq.) for use in up to 40W systems, with 2 element crossover.
£3.50 each (p&p £1) or **£5.95 pair** (p&p £2).

35 WATT MICRO 2-WAY SPEAKER SYSTEM



Unit comprises one 50w (4"app.) Audax soft dome tweeter HD100. And one 5" Audax bass/midrange 35w driver HIF11JSM. Complete with 2 element crossover. Total impedance of system 4 ohms.
£7.95 PER SET + £2.70 p&p.

P.E. STEREO TUNER KIT



This easy to build 3 band stereo AM/FM tuner kit is designed in conjunction with Practical Electronics (July 81 issue). For ease of construction and alignment it incorporates three Mullard modules and an I.C. IF. System.
FEATURES: VHF, MW, LW Bands, interstation muting and AFC on VHF. Tuning meter. Two back printed PCB's. Ready made chassis and scale. Aerial: AM - ferrite rod FM - 75 or 300 ohms. Stabalised power supply with 'C' core mains transformer. All components supplied are to P.E. strict specification. Front scale size: 10½" x 2½" approx. Complete with diagram and instructions.

£17·95 Plus £2.50 p&p.

Self assembly simulated wood cabinet sleeve to suit tuner only. Finish size: 11¼"x8½"x3¼". **£3.50** Plus £1.50 p&p.

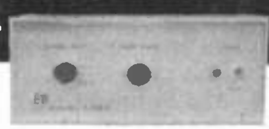
SPECIAL OFFER! TUNER KIT PLUS:
• Matching I.C. 10 watt per channel Power amp kit. • Mullard LP1183 built pre-amp, suitable for ceramic pick-up and aux. inputs. • Matching power supply kit with transformer. • Matching set of 4 slider controls for bass, treble and volumes. **£21.95** + £3.80 P&P.

PRACTICAL ELECTRONICS CAR RADIO KIT SERIES II

2 WAVE BAND, MW – LW
• Easy to build. • 5 push button tuning. • Modern design. • 6 watt output. • Ready etched and punched PCB. • Incorporates suppression circuits.
All the electronic components to build the radio, you supply only the wire and the solder, featured in Practical Electronics. Features: pre-set tuning with 5 push button options, black illuminated tuning scale. The P.E. Traveller has a 6 watt output neg. ground and incorporates an integrated circuit output stage, a Mullard IF Module LP1181 ceramic filter type pre-aligned and assembled, and a Bird pre-aligned push button tuning unit.
Suitable stainless steel fully retractable aerial (locking) and speaker (6"x4"app.) available as a complete kit. £2.50/pack + £1.50 p&p.

£12·95 + £2.00 p&p.

TV SOUND TUNER KIT



£11·45 + £1.50 p&p.

As featured in E.T.I. December '81 issue. Kit of parts including PCB, UHF tuner and selector switch with all components excluding case.
• Transformer £1.50 + £1.50 p&p (p&p free on transformer if ordered with kit). • Ready built LP1183 Module for simulated stereo operation. £1.95 + 75p p&p.

MONO MIXER AMP

£39·95 + £3.70 p&p.

50 WATT Six individually mixed inputs for two pick ups (Cer. or mag.), two moving coil microphones and two auxiliary for tape, tuner, organs, etc. Eight slider controls – six for level and two for master bass and treble, four extra treble controls for mic. and aux inputs. Size: 13¼"x 6½"x3¾"app. Power output 50 watts R.M.S. (continuous) for use with 4 to 8 ohm speakers. Attractive black vinyl case with matching fascia and knobs. Ready to use.

BIRD AUDIO STEREO CAR RADIO BOOSTER

To boost your car radio or radio cassette to 15W r.m.s. per channel.
£9·95 + £1.50 p&p.

ALL MAIL TO:
21A HIGH STREET, ACTON, W3 6NG.
Note: Goods despatched to UK postal addresses only. For further information send for instructions 20p plus stamped addressed envelope. All items subject to availablity. Prices correct at 31/1/82 and subject to change without notice. Please allow 7 working days from receipt of order for despatch.
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Open 9.30 – 5.30pm. Closed all day Thursday.
RTVC Limited reserve the right to update their products without notice.

RTVC

Sinclair ZX81 Personal Comp
the heart of a system that grows with you.

1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under £100. Not surprisingly, over 50,000 were sold.

In March 1981, the Sinclair lead increased dramatically. For just £69.95 the Sinclair ZX81 offers even more advanced facilities at an even lower price. Initially, even we were surprised by the demand – over 50,000 in the first 3 months!

Today, the Sinclair ZX81 is the heart of a computer system. You can add 16-times more memory with the ZX RAM pack. The ZX Printer offers an unbeatable combination of performance and price. And the ZX Software library is growing every day.

Lower price: higher capability
With the ZX81, it's still very simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

It uses the same micro-processor, but incorporates a new, more powerful 8K BASIC ROM – the 'trained intelligence' of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays.

And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, *and* to drive the new ZX Printer.

New BASIC manual

Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs

Kit: £49.95

Higher specification, lower price – how's it done?
Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

New, improved specification
- Z80A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function – useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer.
- Advanced 4-chip design: micro-processor, ROM, RAM, plus master chip – unique, custom-built chip replacing 18 ZX80 chips.

Built: £69.95

Kit or built – it's up to you!
You'll be surprised how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with built version).

Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.

uter-

Available now- the ZX Printer for only £49.95

Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM), the printer offers full alphanumerics *and* highly sophisticated graphics.

A special feature is COPY, which prints out exactly what is on the whole TV screen without the need for further intructions.

At last you can have a hard copy of your program listings – particularly useful when writing or editing programs.

And of course you can print out your results for permanent records or sending to a friend.

Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your computer – using a stackable connector so you *can* plug in a RAM pack as well. A roll of paper (65 ft long x 4 in wide) is supplied, along with full instructions.

16K-byte RAM pack for massive add-on memory.

Designed as a complete module to fit your Sinclair ZX80 or ZX81, the RAM pack simply plugs into the existing expansion port at the rear of the computer to multiply your data/program storage by 16!

Use it for long and complex programs or as a personal database. Yet it costs as little as half the price of competitive additional memory.

With the RAM pack, you can also run some of the more sophisticated ZX Software – the Business & Household management systems for example.

How to order your ZX81

BY PHONE – Access, Barclaycard or Trustcard holders can call 01-200 0200 for personal attention 24 hours a day, every day.

BY FREEPOST – use the no-stamp-needed coupon below. You can pay by cheque, postal order, Access, Barclaycard or Trustcard.

EITHER WAY – please allow up to 28 days for delivery. And there's a 14-day money-back option. We want you to be satisfied beyond doubt – and we have no doubt that you will be.

To: Sinclair Research Ltd, FREEPOST, Camberley, Surrey, GU15 3BR. **Order**

Qty	Item	Code	Item price £	Total £
	Sinclair ZX81 Personal Computer kit(s). Price includes ZX81 BASIC manual, excludes mains adaptor.	12	49.95	
	Ready-assembled Sinclair ZX81 Personal Computer(s). Price includes ZX81 BASIC manual and mains adaptor.	11	69.95	
	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	10	8.95	
	16K-BYTE RAM pack.	18	49.95	
	Sinclair ZX Printer.	27	49.95	
	8K BASIC ROM to fit ZX80.	17	19.95	
	Post and Packing.			2.95

☐ Please tick if you require a VAT receipt TOTAL £______

*I enclose a cheque/postal order payable to Sinclair Research Ltd. for £______

*Please charge to my Access/Barclaycard/Trustcard account no.

*Please delete/complete as applicable.

Please print.

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Address:

FREEPOST – no stamp needed. Offer applies to UK only. EVE05

sinclair ZX81

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I.C.s TRANSISTORS CAPACITORS · TOOLS RESISTORS HARDWARE · CASES KITS

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Make us your No. 1 SUPPLIER OF KITS and COMPONENTS for E.E. Projects. We supply carefully selected sets of parts to enable you to construct E.E. projects. Kits include ALL THE ELECTRONICS AND HARDWARE NEEDED. Printed circuit boards (fully etched, drilled and roller tinned) or Veroboard are, of course, included as specified in the original article, we even include nuts, screws and I.C. sockets. PRICES INCLUDE CASES unless otherwise stated. BATTERIES ARE NOT INCLUDED. COMPONENT SHEET INCLUDED. If you do not have the issue of E.E. which includes the project—you will need to order the instruction reprint at an extra 45p each.

Reprints available separately 45p each + p. & p. 40p.

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MINI EGG TIMER. Jan. 82. £3·69
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LED DICE. Mar. 81. £7·89.
LED FLASHER. Mar. 81. £4·01.
MODULATED TONE DOORBELL. Mar. 81. £6·21.
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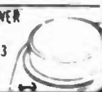

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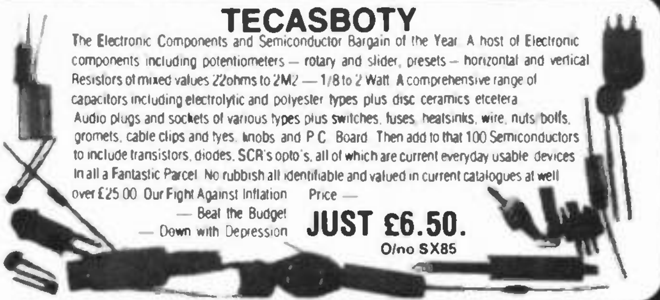

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Everyday Electronics, March 1982

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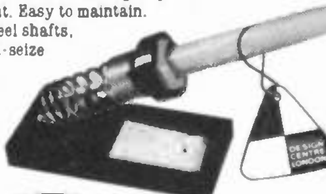

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5/82

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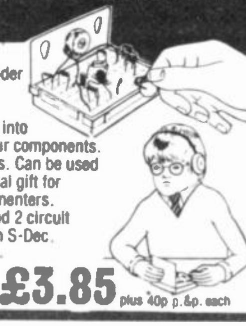

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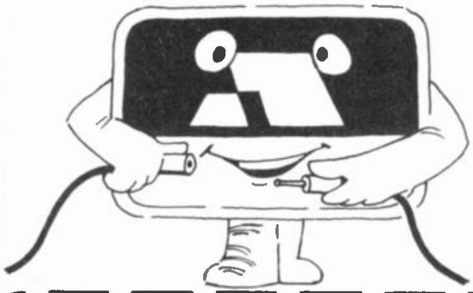

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MN55. 10 watt audio amp board with circuit.
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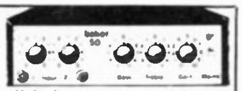

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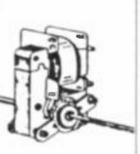

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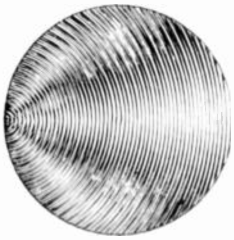

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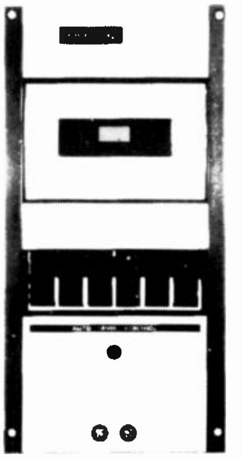

6 piano type keys

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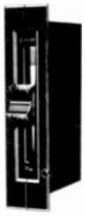

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★ Cut-out template supplied
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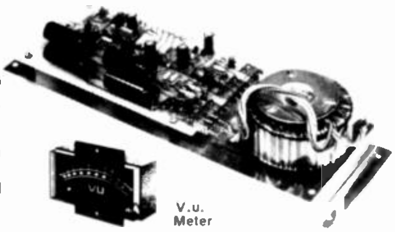
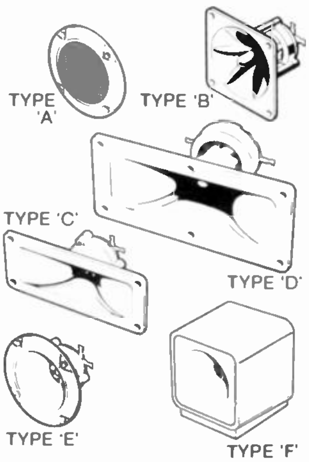
Price £22·50 + £2.50 P & P.

OMP **POWER AMPLIFIER MODULES**
100 WATTS R.M.S.

Power Amplifier Modules with integral toroidal transformer power supply and heat sink. Supplied as one complete built and tested unit. Can be fitted in minutes. Auxilliary stabilised supply and drive circuit incorporated to power an L.E.D. Vu meter available as an optional extra.
SPECIFICATION:
Max. output power 100 watts R.M.S. (OMP 100)
Loads: (Open and short circuit proof) 4–16 ohms
Frequency Response: 20Hz—25KHz ± 3dB
Sensitivity: for 100 watts 500mV at 10K
T.H.D. 00 1%
Size: 360 × 115 × 80mm
Prices: OMP 100 £29.99 P & P £2.00
V.u. Meter £6·50



PIEZO ELECTRIC TWEETERS – MOTOROLA
Join the Piezo revolution. The low dynamic mass (no voice coil) of a Piezo tweeter produces an improved transient response with a lower distortion level than ordinary dynamic tweeters. As a crossover is not required these units can be added to existing speaker systems of up to 100 watts (more if 2 put in series). **FREE EXPLANATORY LEAFLETS SUPPLIED WITH EACH TWEETER.**



TYPE 'A' (KSN1036A) 3" round with protective wire mesh. Ideal for bookshelf and medium sized Hi-Fi speakers. Price £3.45 each.

TYPE 'B' (KSN1005A) 3½" super horn. For general purpose speakers, disco and P.A. systems, etc. Price £4.35 each.

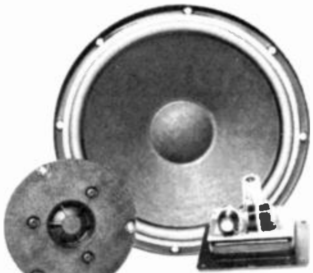
TYPE 'C' (KSN6016A) 2" × 5" wide dispersion horn. For Hi-Fi systems and quality discos, etc. Price £5.45 each.

TYPE 'D' (KSN1025A) 2" × 6" wide dispersion horn. Upper frequency response retained extending down to mid range (2,000 c/s). Suitable for Hi-Fi systems and quality discos. Price £6.90 each.

TYPE 'E' (KSN1038A) 3¾" horn tweeter with attractive silver finish trim. Suitable for Hi-Fi monitor systems, etc. Price £4.35 each.

TYPE 'F' (KSN1057A) Cased version of type 'E'. Free standing satellite tweeter. Perfect add on tweeter for conventional loudspeaker systems. Price £10.75 each.

U.K. post free (or SAE for Piezo leaflets).



MULLARD 40 WATT R.M.S. 8 ohm SPEAKER SYSTEM. Designed by Mullards specialist team in Belgium. Comprising of a Mullard 8" woofer with foam surround, a Mullard 3" dome tweeter and a cleverly designed B.K. Electronics crossover combining spring loaded loudspeaker terminals and recessed mounting panal. Supplied complete with installation and cabinet details.

Price £13·90 + £1·50 P & P per kit.

12" 80 watt R.M.S. loudspeaker.
A superb general purpose twin cone loudspeaker. 50 oz magnet. 2" aluminium voice coil. Rolled surround. Resonant frequency 25Hz. Frequency response to 13KHz. Sensitivity 95dB. Impedance 8ohm. **Attractive blue cone with aluminium centre dome.**
Price £17.99 ea + £2.50 P & P.

B.K. ELECTRONICS
DEPT E.E.

37 Whitehouse Meadows, Eastwood, Leigh-on-Sea, Essex SS9 5TY

★ SAE for current lists. ★ Official orders welcome. ★ All prices include VAT. ★ Mail order only. ★ All items packed (where applicable) in special energy absorbing PU foam. Callers welcome by prior appointment, please phone 0702-527572.