# EVERYDAY ELECTRONICS and computer PROJECTS

**JUNE 1983** 

85p

# TRS-80 and GENIE EPROM PROGRAMMER

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BBC Microcomputer

CARAVAN POWER SUPPLY

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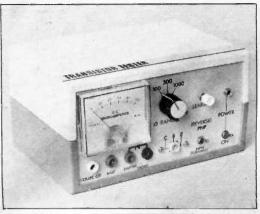
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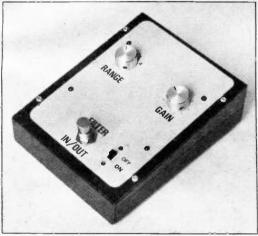
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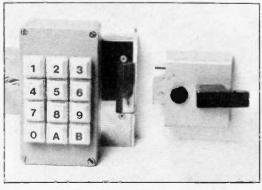
# ELECTRONICS and computer PROJECTS

#### **VOL. 12 NO. 6 JUNE 1983**

PROJECTS . . . THEORY . . . NEWS . . . COMMENT . . . POPULAR FEATURES . . .







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# AUTO-ELECTRONIC PRODUCTS

KITS OR READY BUILT

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YOUR CAR

# AS GOOD AS IT COULD BE? Is it EASY TO START in the cold and the damp? Total Energy

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SPARK POWER — 140W, SPARK ENERGY — 36mJ
SPARK DURATION — 500µS, STORED ENERGY — 135mJ

LOADED OUTPUT VOLTAGE
50pF load - 38kV.

50pF + 500k -- 26kV

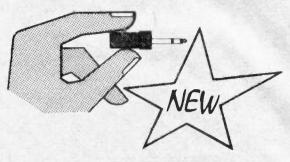
We challenge any manufacturer to publish better performance figures. Before you buy any other make, ask for the facts, its probably only an inductive system. But if an inductive system is what you really want, we'll still give you a good deal.

★ All ELECTRONIZE electronic ignitions feature: EASY FITTING, STANDARD/ELECTRONIC CHANGEOVER SWITCH, STATIC TIMING LIGHT and DESIGNED IN RELIABILITY (14 years experience and a 3 year guarantee).

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- ★ INSTANT ALARM OPERATION triggered by accessories or bonnet/boot opening.
- ★ 30 SECOND DELAY when system is armed allows owner to lock doors etc.
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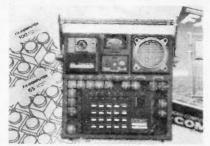
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LOW NOISE 10Ω to 10MΩ 10Ω to 10MΩ 10W E24 2 2p 10W E24 2 2p 10W E12 6p 2W E12 12p METAL FILM ULTRA STABLE	4 7 16 8p 4 7 25 9p 4 7 40 11p 4 7 63 12p 4 7 100 14p 10 25 8p 10 40 12p 10 63 14p	Double sided 100 = 160   1.65 100 = 220   2 15 203 = 220   4 55 Developer for above (do not use Sortium Hydroxi dell500mi   2.50	2N2907A 26p 2N2920 3 47 2N2923 25p 2N2924 15p 2N2925 15p 2N2926 10p 2N3053 27p 2N3054 56p 2N3055 60p	40872 89p AC125 35p AC126 25p AC127 25p AC128 25p AC132 39p AC141K 28p AC141K 28p AC151 51p	BC548C 15p BC549 13p BC549B 14p BC549C 15p BC550C 30p BC550C 33p BC557 15p BC557 16p BC557B 16p	credit card All in-stock i Please	no, or by mail tems despatch	or vast stocks. If order, Callers weed same day, O + 15% VAT. sie. TRY US	elcome. All pro	ducts first gra elcome from G sino VAT but al	ade franchised fovt. Depts, si llow £2.00 min.	i source. chools, etc.
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7405	14p	7437	23p	7483	30p
7406	19p	7438	24p	7485	60p
7407	19p	7440	14p	7486	19p
7408	13p	7442	30p	7489	180p
7409	13p	7444	85p	7490	19p
7410	13p	7446	58p	7491	34p
7411	15p	7447	36p	7492	24p
7412	17p	7448	43p	7493	24p
7413	. 17p	7450	14p	7494	33p
7414	23p	7451	14p	7495	33p
7416	19p	7453	14p	7496	38p
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14p

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74107

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4001	10p	4021	40p	4043	40p
4002	12p	4022	45p	4044	40p
4006	50p	4023	16p	4046	40p
4007	14p	4024	33p	4047	35p
4008	36p	4025	12p	4048	38p
4009	24p	4026	75p	4049	21p
4010	24p	4027	20p	4050	21p
4011	10p	4028	40p	4051	42p
4012	15p	4029	45p	4052	48p
4013	20p	4030	14p	4053	48p
4014	45p	4031	125p	4054	78p
4015	40p	4034	140p	4055	80p
4016	20p	4036	249p	4059	430p
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CA3189 ▶CA3241 TRAN AC126 AC126 AC127 AC187 AC188 AC178 AC188 AC178 AC188 AC178 AC188 AC168 AC189	29 DE 11 35 25 25 25 22 22 22 22 22 22 20 80 40 40 60 50 40 70 77 51 10	ORS  BC149 BC157 BC158 BC169 BC168 BC169 BC170 BC177 BC177 BC177 BC177 BC177 BC178 BC179 BC188 BC1882 BC1882 BC1888 BC1883 BC1883	9 8 10 8 45 10 10 8 18 18 18 10 10 10	BC517 BC547 BC548 BC549 BC558 BC770 BC771 BCY72 BD115 BD133 BD135 BD136 BD137 BD137 BD136 BD137 BD136 BD137 BD136 BD137	M3900 LM3909 40 7 10 10 18 18 18 55 50 40 30 30 35 35 110 110 110 110 110 110 110 110 110 11	45 70 BF337 8FR40 ▶BFR80 ▶BFX89 BFX85 BFX86 BFX87 BFY52 BFY53 BFY55 BFY56 BFY56 BFY56 BFY56 BFY58 BFY56 BFY58 BFY58 BFY58 BFY59 BFY58 BFY59 BFY	NE556 NE565 40 23 1 20 25 25 25 25 25 25 27 20 23 32 32 32 32 32 32 32 32 32 32 32 32	45 110 MPSU56 TIP29A TIP29B TIP29C TIP30B TIP30B TIP31C TIP31A TIP31C TIP32C TIP33A TIP33C TIP33A TIP35A TIP35A TIP36C TIP26A TIP36A	TL06 TL06: 60 30 55 37 35 50 37 35 37 35 37 35 105 125 125 125 135 45	1 40 2 60 2 TX109 2 TX300 2 TX300 2 TX300 2 TX302 2 TX302 2 TX500 2 TX501 2 TX501 2 TX503 2 TX504 2 NX068 2 NY068 2 NY08 2 NY08 2 NY08 2 NY08 2 NY08 2 NY132 2 NY1613 2 NY1613	8 12 14 16 15 17 30 15 15 15 18 25 20 40 20 20 32 40 20 32 45 45 45 45 45 45 45 45 45 45 45 45 45	4459 1034E 2N3055 2N3442 ▶ 2N370 2N3703 ▶ 2N3706 2N3706 2N3706 2N3707 2N3709 ≥ 2N3709 ≥ 2N3903 2N3904 2N3905 2N3905	285 200 120 2 6 4 6 9 9 10 10 170 3 195 9 18 40 65 90 10
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▶64mm 8 ohm speaker .	70
20mm panel fuseholder .	2
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Black pointer control knob	. 15
r Ultrasonic transducers	350
6V Electronic buzzer	60
12V Electronic buzzer .	65
PB2720 Piezo transducer .	75
▶64mm 64 ohm speaker	70
64mm 8 ohm speaker	70
20mm panel fuseholder .	25

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		100 1 7/1 20 01 100
►1N4001 1N4002	3	MULTIMETERS
1N4006 1N4007 1N5401 1N5404 1N5406 400mWzen	7 7 12 16 17 6	HT-120 4,000 opv A smart looking 11 range pocket sized multimeter with an impressivi spec. Complete with battery, etc. 650p each. HT-320 20,000 opv.
		Highly consisting 10 coops multi

Highly sensitive 19 range multi-meter including transistor tester. Overload protection. DC volts — 1000, AC volts — 1000; DC current 0.25A. 4 resistance ranges. Complete with batteries, leads, etc. 1395p

I	0.22 · 9p; 0.33, 0.47 · 13p; 0.68 ·
1	20p; 1u - 23p.
ı	Electrolytic, radial or axial leads:
ı	0.47/63V, 1/63V, 2.2/63V, 4.7/63V,
2000	10/25V - 7p; 22/25V, 47/25V - 8p;
-	100/25V - 9p; 220/25V - 14p;
3	470/25V - 22p; 1000/25V - 30p;
٦	2200/25V - 50p.
ı	Tag end power supply electrolytics:
B	2200/40V - 110p; 4700/40V - 160p
1	2200/63 V - 140p; 4700/63 V - 230p
ı	Polyester, miniature Siemens PCB:
1	1n, 2n2, 3n3, 4n7, 6n8, 10n, 15n, 7p;
i	22n, 33n, 47n, 68n, 8p; 100n, 9p;
ı	150n, 11p; 220n, 13p; 330n, 20p;
1	470n 26p; 680n, 29p; 1u 33p; 2u2,
1	50p.
ı	Tantalum bead:
1	0.1, 0 22, 0.33, 0.47, 1.0 @ 35V -
J	12p. 2.2, 4.7, 10 @ 25V - 20p;
1	15/16V - 30p; 22/16V - 27p; 33/
	16V - 45p; 47/6V - 27p; 47/16V -
i	70p: 68/6V - 40p: 100/10V - 90p.
4	Cer. disc. 22p-0.01u 50V. 3p each.
-1	GOT. GISC. 22p G.GTG GOT, SP COOT.

Cer. disc. 22p-0.01u 50V, 3p each Mullard miniature ceramic plate: 1.8pF to 100pF 6p each, Polystyrene, 5% tol: 10p-1000p, 6p; 1500-4700, 8p; 6800 0.012u, 10p. Trimmers, Mullard 808 series: 2-10 pF, 22p; 2-22pF, 30p; 5.5-65pF, 35p

BRIDGE	6.0	2A 200V	40
BEATLE	cne	2A 400V	45
RECTIF	Ens	5A 100V	80
		6A 400V 95	
1A 50V	20	VM18 DIL C	.9A
1A 400V	35	200V	50

#### EPSON PRINTERS

Latest generation printers from Epson, Logic seeking, bi-directional, bit image printing, 9 x 9 Matrix, Auto underline, Centonix 8 Bit Parallel Interface as standard.

RX80 100 CPS 80 column

FX80 160 CPS 80 column Tractor Feed



00	Carriage	£7	ner	printe

#### MIN. D CONNECTORS 25 way 37 way 125p 170p 240p 350p 195p 290p 290p 440p 4 100p 110p 9 way 15 way 60p 85p 120p 180p 90p 130p 160p 210p 100p 90p Plugs solder lugs Right angle Sockets lugs Right angle

SCR:

CONNECTORS
DIN Plug Sk. sek. Plug Skt. 2pin 96 90 2.5mm 10 10p 3 pin 12p 10p 3.5mm 90 90 5pin 13p 11p Standard16p 20p Phono 10p 12p Stereo 24p 25p 1mm 12p 13p 4mm 18p 17p UHF (CB) Connectors: PL259 Plug 40p. Reducer 14p. SO239 square chassis skt 38p. SO239S round chassis skt 40p.
IEC 3 pin 250V/6A. Plug chassis mounting

SWITCHES
Submin toggle: SPST 55p. SPDT 60p. DPDT 65p. Miniature toggle:
SPDT 80p. SPDT centre off 90p, DPDT 90p. DPDT centre off 100p.
Standard toggle: SPST 35p. DPDT48p
Miniature DPDT slide 12p. Push to make 14p. Push to break 22p.
Rotary type adjustable stop. 1P12W, 2P6W, 3P4W all 55p each.
DIL switches: 4SPST 80p 6 SPST 80p. 8SPST

SOCKETS	Low	Wire
8 pin	profile 6p	wrap 250
14 pin	8c	35o
16 pm	90	42p
18 pin	12p	52p
20 pin	13p	60p
22 pin	16p	/0p
24 pin	18p	70p
28 pin	23p	80p
40 pin	25p	98p
Soldercon pin	s 60P/J00	

SOLDERI	NG IRONS

1	Antex CS 17W Soldering iron	460
1	2.3 and 4.7mm bits to suit .	65
1	CS 17W iron: 450, element:	210
ı	Antex XS 25W	480
1	3,3 and 4.7mm bits to suit.	65
٦	Solder pump desoldering tool.	480
1	Spare nozzle for above	70
ı	10 metres 22swg solder .	100
١		

	VERO
TOOLS	VEROBLOC ◀ , . 350
Small trimming tool 22	Size 0.1 matrix: 2.5 x 1
Small pocket screwdriver . 16 Large pocket screwdriver . 13	2.5 x 3,75 75
Large pocket screwdriver . 13 6 piece precision screwdriver set	2.5 x 5
in plastic case 170	3.75 x 5
Low cost side cutters 160	Veropins per 100:
High quality side cutters . 650	Single sided 50
Low cost pliers 160 High quality pliers 650	Double sided 60
Wire strippers	Spot face cutter 105
Expo reliant drill 695	Pin insertion tool , 162
	Wiring pen and spool , . 310
Expo Titan drill 1025 Drill stand 1200	Spare spool 75p Combs . 6

	-		_				
AARCL		6116P3 6502 CPU	320 325	6852 6875	240 495	8228 8251	220 250
1	1	6522 VIA	295	6880	100	8253	390
		6532	570	81LS95	85	8255	225
		6551 ACIA	650	81 LS96	85	8259	390
2114L2	75	6800 CPU	220	81LS97	85	MC1488	55
2716	205	6802 CPU	250	8080A	250	MC1489	55
2532	290	6809 CPU	620	8085AC	340	Z80 A CPU	290
2732	290	6810 RAM	115	8156	350	Z80APIO	260
2764	540	6821 PIA	110	8212	110	Z80ACTC	260
4116P20	70	6840	360	8216	100	Z80ASIO	900
5101L-1	220	6850	110	8224	120	Z80A DMA	
	- *-		*		_		_

COMPONENT H	HTS		
n ideal opportunity			

An ideal opportunity	for the beginner or the	experienced constructor	
to obtain a wide rang	ge of components at great	atly reduced prices. 1/4W 5%	
Resistor kit. Contain	s 10 of each value from	4.7 ohms to 1M (total	
of 650 resistors) .			
Ceramic Cap. kit. 5 c	of each value - 22p to 0.0	01u (135 caps) 370	
	of each value from 0.01		
Preset kit. Contains	of each value from 100	ohms to 1M (total	
		, 425	
Nut and Bolt kit (tot	al 300 items): 180p		
25 6BA ¼" bolts	50 6BA washers	50 6BA nuts	
25 6BA 1/2" bolts	25 4BA ¼" bolts	50 6BA washers	
50 6BA nuts	25 6BA '%" bolts.		

R	ES	IST	ГО	RS

CMOS

%W 5% Carbon-film	E12 series 4.7
ohm - 1M, , ,	. 1p each.
1/2W 5% Carbon film	E12 series 4.7
ohm to 4M7	. 2p each.
1/4W 1% metal film E	24 series 10
ohm - 1M	. 6p each.

| Samm red | Samm red | 7 | Samm red | 7 | Samm red | 7 | Samm green | 10 | Samm yellow10 | Samm red | 17 | Sa

2NS777 45 Dual colour 60 Seven segment displays: Com cathode DL704 0.3" 95 DL707 0.3" 95 FNDS07 0.5" 100 0.5" 100 11.31 3 0.3"115 T1L312 0.3"115 LCD: 3% digit 580p. 4 digit 620p.

PCBMATERIALS	
Alfac transfer sheets - please	state
type (e.g. DIL pads etc.)	45
Dalo etch resistant pen	100
Fibre glass board 3.75 x 8"	80
Fibre glass board 8 x 12"	200
Ferric Chloride crystals	100

	lasti	c with	lid	3	luminiu x 2 x 1 x 2 ½ x 1	65 %" 95
3 4	1/2 X	x 1" 3 x 13	4" 8	5 6 B 7	x 2½ x 2 x 4 x 2 x 5 x 2 x 6 x 3.	120 165
	12 12	4019 4502		<b>6</b> 5	4528 4529	45 150

CIVIC	,3	4017	30	4030	249	4033	00	4082	12	4502	60	4529	150
	-	4018	45	4039	280	4059	430	4085	48	4503	32	4532 -	60
4000	10	4019	25	4040	40	4060	42	4086	50	4507	35	4534	400
4001	10	4020	42	4041	40	4063	80	4089	125	4508	110	4538	60
4002	12	4021	40	4042	38	4066	22	4093	18	4510	45	4543	50
4006	50	4022	45	4043	40	4067	225	-4094	68	4511	40	4549	360
4007	14	4023	16	4044	40	4068	14	4095	65	4512	40	4553	215
4008	36	4024	33	4046	40	4069	13	4097	290	4514	115	4555	35
4009	24	4025	12	4047	35	4070	13	4098	70	4515	115	4556	35
4010	24	4026	75	4048	38	4071	13	4099	70	4516	55	4559	390
4011	10	4027	20	4049	21	4072	13	40106	40	4518	40	4560	140
4012	15	4028	40	4050	21	4073	13	40109	110	4520	50	4584	35
4013	20	4029	45	4051	42	4075	13	40163	60	4521	130	4585	60
4014	45	4030	14	4052	48	4076	45	40173	100	4526	60	4724	140
4015	40	4031	125	4053	48	4077	14	40175	75	4527	50		
		LS20	12	LS75	20	LS123	34	LS160	35	LS197	45	LS353	60
LS T	TL.	LS21	12	LS76	17	LS125	24	LS161	35	LS221	50	LS365	28
		LS22	12	LS78	17	LS126	25	LS162	35	LS240	60	LS366	28
LS00	11	LS26	14	LS83	35.	LS132	. 35	LS163	35	LS241	55	LS367	28
LS01	11	LS27	12	LS85	48	LS136	26	LS164	40	LS242	55	LS368	29
LS02	11	LS30	12	LS86	16	LS138	30	LS165	55	LS243	55	LS373	58
LS03	12	LS32	13	LS90	24	LS139	30	LS166	60	LS244	55	LS374	60
LS04	12	LS37	14	LS92	25	LS145	70	LS170	75	LS245	70	LS375	43
LS05	12	LS38	15	LS93	24	LS147	150	LS173	60	LS247	48	LS377	60
LS08	12	LS40	13	LS95	38	LS148	75	LS174	45	LS251	28	LS378	57
LS09	12	LS42	28	LS96	95	LS151	38	LS175	45	LS257	32	LS390	45
LS10	12	LS47	35	LS107	40	LS153	38	LS190	35	LS258	32	LS393	40
LS11	12	LS48	45	LS109	21	LS154	75	LS191	35	LS259	55	LS399	156
LS12	12	LS51	14	LS112	21	LS155	33	LS192	35	LS266	20	LS541	78
LS13	19	LS55	14	LS113	21	LS156	36	LS193	36	LS273	58	LS670	135
LS14	30	LS73	18	LS114	22	LS157	26	LS195	32	LS279	30	20070	150
LS15	12	LS74	17	LS122	35	LS158	29	LS196-	45	LS283	38		
		7413	17	7444	85	7483	30	74122	38	74161	46	74190	40
TTL		7414	23	7446	58	7485	60	74123	38	74162	46	74191	40
_		7416	19	7447	36	7486	19	74125	33	74163	46	74192	40
7400	11	7417	19	7448	43	7489	180	74126	33	74164	46	74193	40
7401	- 11	7420	14	7450	14	7490	19	74132	30	74165	46	74194	40
7402	11	7421	19	7451	14	7491	34	74141	54	74167	150	74195	40
			19	7453	14	7492	24	74145	48	74170	115	74196	40
	12												
7403	12	7422											
7403 7404	12	7427	18	7454	14	7493	24	74147	75	74173	58	74197	40
7403													

74192	6 741	46	74163	33	74125	19	7486	36	7447	19	7416		
74193	6 741	46	74164	33	74126	180	7489	43	7448	19	7417	- 11	7400
74194	6 741	46	74165	30	74132	19	7490	14	7450	14	7420	11	7401
74195		150	74167	54	74141	34	7491	14	7451	19	7421	11	7402
74196		115	74170	48	74145	24	7492	14	7453	19	7422	12	7403
74197		58	74173	75	74147	24	7493	14	7454	18	7427	12	7404
74198		53	74174	60	74148	33	7494	14	7460	25	7428	14	7405
74199		45	74175	48	74150	33	7495	22	7472	13	7430	19	7406
				38	74153	38	7496	24	7473	20	7432	19	7407
				47	74154	86	7497	19	7474	20	7433	13	7408
				36	74155	78	74100	26	7475	23	7437	13	7409
				36	74156	22	74107	25	7476	24	7438	13	7410
				28	74157	24	74109	45	7480	14	7440	15	7411
		55	74182	55	74160	24	74121	65	7482	30	7442	17	7412
	5 2 5 8 0	35 42 75 38 100	74176 '74177 74179 74180 74181	38 47 36 36 28	74153 74154 74155 74156 74157	38 86 78 22 24	7496 7497 74100 74107 74109	19 26 25 45	7474 7475 7476 7480	20 20 23 24 14	7433 7437 7438 7440	19 13 13 13	7407 7408 7409 7410 7411

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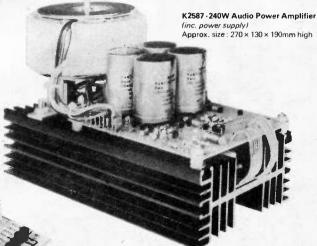
. . and remember, we have a 'rescue service' for instances where enthusiasm exceeds ability!





(timing from 1 sec to 99 mins 99 secs.) Actual size: 235 × 110mm

K2586 - Serial Controller/ Emulator (designed primarily for use with K2578 Velleman Eprom programmer) Actual size: 100 × 160mm.



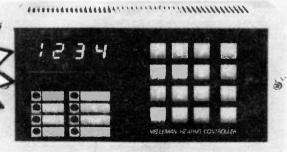
K2583 - Heating/ Temperature Controller (available in kit form or as a built and tested unit) Actual size: 235 × 110mm

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K2582 Stereo audio input selector

K2585 Codeclock
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Name		. ,	,									4															 ,	,			

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In the cut-throat world of consumer electronics, one of the questions designers apparently ponder over is "Will anyone notice if we save money by chopping this out?" In the domestic TV set, one of the first casualties seems to be the sound quality. Small speakers and no tone controls are common and all this is really quite sad, as the TV compan ies do their best to transmit the highest quality sound. Given this background a compact and independent TV tuner that connects direct to your Hi-Fi is a must for quality reproduction. The unit is mains operated.

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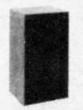
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# ERYDAY and computer PROJECT

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#### **HOLIDAY TRAIL**

HOUGHTS of summer and holidays to come have prompted two projects for caravan users and campers which are featured this month.

In the months ahead we can confidently expect car-caravan combinations to become increasingly commonplace on our roads as motorists and their families feel the urge to get away from it all and explore remote off-beat places. It is one of life's little oddities that such intrepid travellers usually like to bring along with them some of the amenities of civilised life. This is not difficult in fact, since there are many examples of portable electrical and electronic equipment suitable for such trips and capable of being powered from a 12-volt supply.

It is not wise of course to impose excessive additional load on the car battery and the best course is to use a separate car battery installed inside the caravan to power equipment such as interior lights, refrigerators, cassette players, radios, TV sets or personal computers during overnight stops. (This arrangement is not suitable for long stays at holiday sites.) The extra battery can be recharged from the car generator whilst travelling. Circuitry to permit this kind of operation without any harm to the car's normal electrical system is described in the article Caravan Power Supply.

Many caravanners as well as tent campers take with them a small absorption-type refrigerator powered from a gas cylinder. There is always the possibility of the gas supply becoming exhausted unexpectedly or some other fault developing with the resultant loss of foodstuff. A simple warning device powered by its own 9V battery will eliminate this danger. The Caravan Fridge Alarm may be built with either a visual or audible alarm and is operative when touring or at a fixed site.

Security is a matter for concern the whole year round, and electronic devices are being resorted to more and more in order to frustrate attempts at unauthorised entry. The Push Button Combination Lock described in this issue, when used with the recommended electrically operated lock release, will provide alternative means to unlock a cylinder-type lock whilst retaining the normal key operation. It will meet various needs, for example where a number of persons require access to premises but the issuing of keys to all individuals is not practical nor desirable. Being battery operated, the combination lock and associated release mechanism are immune from mains failures.

A word about next month's Everyday Electronics. Our new series Microcomputer Interfacing Techniques will be a must for all computer enthusiasts. This important series will explain how to get the most from your computer by linking it to the outside world. Appropriate electronic hardware will be described in each part. As each part will be vital to the whole do make sure of your copy every month by placing an order with your newsagent.

fred Remets

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Component Supplies

Readers should note that we do not supply electronic components for building the projects featured in EVERYDAY ELECTRONICS, but these requirements can be met by our advertisers.

All reasonable precautions are taken to ensure that the advice and data given to readers are reliable. We cannot, however, guarantee it and we cannot accept legal responsibility for it. Prices quoted are those current as we go to press.

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# EPROM PROGRAMMER TRS~80 & GENIE

A PORT-BASED SYSTEM DESIGNED FOR USE WITH A HOST COMPUTER TO PROGRAM +5V RAIL 1K, 2K AND 4K BYTE EPROMS







BY B.W.TERRELL B.S.c. & J.W.TERRELL M.S.c.

THE EE124 Eprom Programmer has been designed to be used with a host computer to program single supply rail EPROMS. Two versions are described in this article (i) for use with the TRS-80 Model I Level II microcomputer (ii) for use with the Video Genie, Genie I and II microcomputers. The construction of the units has been tailored to allow them to be easily connected to the computer using the system bus expansion cable. The prepared software is suitable only for these machines.

Although specifically designed for use with these models, the hardware may be used with other computers providing certain system signals are accessible and that suitable software is developed. It is expected that the only hardware modification needed for use with other Z80 based computers is to configure the finger sets, by means of an adaptor or a custom built cable/connector to align with the configuration of the system bus of the chosen computer. The signals that need to be accessible are: D0 to D7, A0 to A7, 0V, IN, OUT for use with the TRS-80 version. If IN and OUT are not available, but IORQ, RD, WR are, then the Genie version can be used. Users will of course have to develop their own software.

The EE124 plus TRS-80 or Genie can program the EPROMS listed in Table 1 which also gives the required setting of the MODE switch.

The pinning details for the EPROMS in Table 1 are given in Fig. 1.

#### SYSTEM DESCRIPTION

The EE Eprom Programmer comprises:

- (i) Programmer Logic Unit (PLU)
- (ii) EE124 Software cassette (T004)

#### Programmer Logic Unit

Access to the PLU is through a double sided p.c.b. connector set projecting through a slot in the front panel. The 20 + 20 (TRS-80) and 25 + 25 (Genie) fingers allow direct connection to these computers using the system bus expansion cable.

The PLU is equipped with the following facilities:

(a) A 24-pin Zero Insertion Force socket. This allows an EPROM to be inserted or removed from the socket without applying any pressure to the pins. The EPROM should be placed in the socket with the lever in the vertical position. Moving the lever to the horizontal position causes the socket contacts to securely grip the EPROM pins and make good electrical contact with all pins. To remove an EPROM, return the lever to the vertical position. It may then be easily lifted out of the socket.

(b) An EPROM power supply isolating switch. This is labelled HOT-SAFE. When in the SAFE position the OV, +5V and +25V supply lines to the socket are interrupted to allow the EPROM to be safely removed or inserted. If an EPROM is removed from, or inserted into, a HOT

socket, it may become permanently damaged.

(c) A two position MODE switch. When programming or reading EPROMS, the MODE switch must be set to A or B according to the EPROM type, see Table 1.

#### SOFTWARE

The EE124 Software is written in Z80 machine code and is suitable for use on the TRS-80 Model 1 Level II and Video Genie, Genie I and II microcomputers. It has many powerful features. Editing is particularly easy, with 256-byte page display, single interpage keystroke and full cursor control. The software is compatible with EDTASM so that object code prepared by EDTASM can be loaded and programmed quickly.

The commands provided are:
BURN COPY EXIT FILL LOAD MEMORY
NEW PAGE READ SAVE TEST ZERO

#### PRINCIPLE OF OPERATION

A block diagram illustrating the principle of operation of the EE124 Eprom Programmer is shown in Fig. 2.

It can be seen that the system is port based and has three latched OUT ports (252, 253 and 254) and one IN port (253). Once the MODE has been manually selected, the system is completely under software control. The mode referred to above has no connection with the two EPROM modes of operation described below.

#### Read Mode

In the read mode, the address and control data are clocked into the appropriate latches via the host computer data bus. Latch 253 output is dis-enabled by a control line from latch 252.

When an IN signal is generated (active low), the IN port is enabled and the corresponding EPROM data read into the host computer. Successive EPROM locations are read until halted by software.

#### Program Mode

In the program mode, both the EPROM address and the data to be programmed reach the EE124 via the host computer data bus. The low order address, high order address plus control data, and program data are sequentially clocked into the port latches.

A number of control cycles are then executed in which control data is sequentially clocked into port latch 252 to produce the following order of events:

(1) +25V to  $V_{pp}$ 

- (2) PGM pin to appropriate program level
- (3) maintain this level for 50ms
- (4) return PGM pin to previous level
- (5) remove +25V from  $V_{pp}$

(6) read and verify

The above steps are repeated until either the last location is programmed or a verification error occurs, whereupon the system returns to command mode.

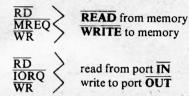
The assignment of the bits for each port are detailed in Table 2.

#### CIRCUIT DESCRIPTION

The complete circuit diagram of the Programmer for use with the TRS-80 computer is shown in Fig. 3b. The signals from the computer expansion slot reach the circuitry via the 40-way expansion cable.

The TRS-80 (and Genie) employs the Z80 microprocessor. Besides being able to address up to 64K memory locations, the Z80 also produces control signals and addresses to service up to 256 8-bit wide I/O ports.

The four Z80 signals for providing these and other control signals are MREQ (memory request), IORQ (input/output request), RD (read) and WR (write). Only four combinations of these outputs are allowed:



It is the latter, IN and OUT which are used in this design. In the TRS-80, these two signals are generated on board and made available at the expansion slot. These signals are active low (indicated by

Table 1. Eproms accommodated by the EE124 Eprom Programmer

Type No.	Manufacturer	Organisation	Mode
TMS2758-0 TMS2508 2758	Texas Texas Intel	1K × 8	A A A
TMS2516 2716 S4716 2716 MB8516 HN462716 MK2716 MCM2716 MPD2716 uPD2716 2716 SY2716 TMM323 M5L2716	Texas Intel AMI AMD Fujitsu Hitachi Mostek Motorola National NEC Signetics Synertek Toshiba Mitsubishi	2K × 8	44444444444
TMS2532 TMS25L32 HN462532 MCM2532	Texas Texas Hitachi Motorola	4K × 8	A A A
2732 HN462732 M5L2732 MB8532	Intel Hitachi Mitsubishi Fujitsu	4K × 8	B B B

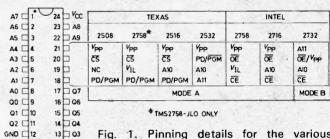


Fig. 1. Pinning details for the various EPROMS accommodated by the Programmer.

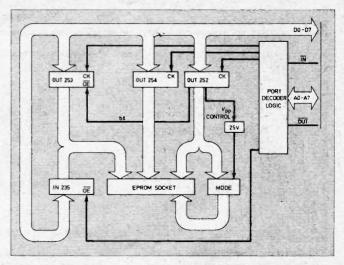


Fig. 2. Block diagram showing system operation.

Table 2. Selecting ports

during I/O cycle	Port Selected
A2 to A7	
All logic 1	252 253 254 255

Table 3. Truth table for 74LS139 (IC2)

Select in	nputs B	Output control (OE)	00	<u>O</u> ut	puts 02	<u>03</u>
X 0 0 1	X 0 1 0 1	1 0 0 0 0	0 1 1 1 1	H 1 0 1	i–Z 1 1 0	1 1 1 0

X means don't care.

the "bar"), which means that when they are selected they are set to logic 0. Every time a port is selected, either IN or OUT goes to logic 0 (depending on direction of data transfer). At all other times they are at logic 1.

During an IN and OUT, the port address is placed on the lower half of the address bus (A0 to A7) and data read from or written to the port via the data bus in the usual way.

The ports chosen for this design are 252, 253 and 254 which allows a very simple and unique decoding to be implemented, and these are of course not in use by the TRS-80 or Genie systems.

When ports 252 to 255 are addressed, bits A2 to A7 are at logic 1. These six signals reach the inputs of IC1, an 8-input NAND gate. Only when all inputs are at logic 1 does the output go to logic 0. For all other combinations the output remains at logic 1. IC1 output is used as a control signal for IC2.

The precise port being addressed in this range is determined by the levels on A0 and A1, see Table 2. These address lines reach the select inputs of IC2, a 2-to-4-line decoder. This chip has 3-state outputs: the two logic levels 1 and 0 and a third high impedance (Hi–Z) state which produces the same effect as physically disconnecting the outputs (Q0 to Q3) from the circuitry.

IC2 outputs are in the Hi–Z state when its OE control is at logic 1. Taking this pin to logic 0 allows the outputs to assume the logic levels selected by A0 and A1. The truth table for IC2 is given in Table 3. Port 255 (Q3) is not used.

The three outputs from IC2 reach inputs of NOR gates (IC3); IN and OUT also reach the appropriate IC3 gates. The outputs from IC3 provide the control signals for the following latches and buffer (IC5 to IC7 and IC8).

IC5, 6 and 7 are octal D-type latches. The information reaching the eight inputs is transferred and latched into the eight outputs by a positive going (low-to-high) pulse edge to the clock (CK) input. All inputs receive information from the data bus.

Suppose for example the CPU is OUTputting to port 252. The port address appears on the lower half of the address bus with data to be sent out on the data bus. As A0 and A1 are at logic 0, output Q0 is selected. A2 to A7 are all at logic 1 so IC1 output drops to logic 0 and this enables the outputs of IC2. OUT goes low later in the output cycle after time has been allowed for the data and address buses to stabilise. So initially a logic 0 reaches IC3a pin 12 and a logic 1 is on pin 11. Consequently the output of IC3a is at logic 0.

When OUT goes low, the output of

IC3a then goes high. This reaches the CK input of IC5 and the data bus information is clocked through and latched into the outputs of IC5. IC6 and IC7 operate in a similar manner.

Port 253 is wired as a bi-directional port, that is to say the CPU is able to read from (IN) and write to (OUT) this port address. The OUT section is IC7 with decoded control, and IC8 provides the IN. IC7 and IC8 are wired in anti-parallel.

Fig. 3a. Expansion bus contacts and additional circuitry (IC10) required by the Genie microcomputer.

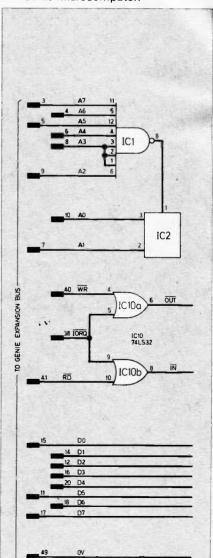


Table 4. Assignment of the ports

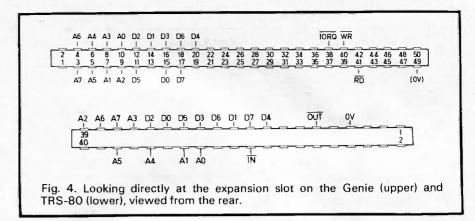
bit 0	4K × 8
bit 1         D1         (10)         A1         (2)         A9         (22)         A9         (21)         A10         (19)         A10         (19)         A10         (19)         A10         (19)         A10         (19)         A10         (19)         A11         (18)         A12         (18)         A13         (18)	18 (23)
	A9 (22) A10 (19) A11 (21)
Texas 2532 In  Notes  Numbers in parentheses are EPROM socket pin positions.	Intel 2732

IC8 is connected as an octal buffer with tri-state outputs. Its outputs are enabled by providing a logic 0 to its OE pins (1 and 19). Similar circuitry to the OUT ports is employed but here the decoded address signal and IN reach NOR gate IC3d. What is really required here is an or gate to give a logic 0 to pins 1 and 19 when IN253 is requested. To make convenient use of the local "spare" NOR gate in the IC3 package, an inverter is used to follow IC3d to construct the required or function. Thus when the decoded address control signal goes to logic 0 and IN falls to logic 0, IC8 is enabled and connects the EPROM data outputs to the computer data bus.

To program (burn) an EPROM location, the address of the location and the data to be burned must be presented to the appropriate EPROM address and data pins. Next +25V needs to be connected to the  $V_{\rm pp}$  pin and then a 50 millisecond pulse of the correct polarity fed to the programming a size  $V_{\rm pp}$  and  $V_{\rm pp}$  pin and the a so millisecond pulse of the correct polarity fed to the programming a size  $V_{\rm pp}$  pin and  $V_{\rm pp}$  pin and

ming pin.

Bit 7 of port 252 controls the +25V supply line, a logic 1 turns it on, a logic 0



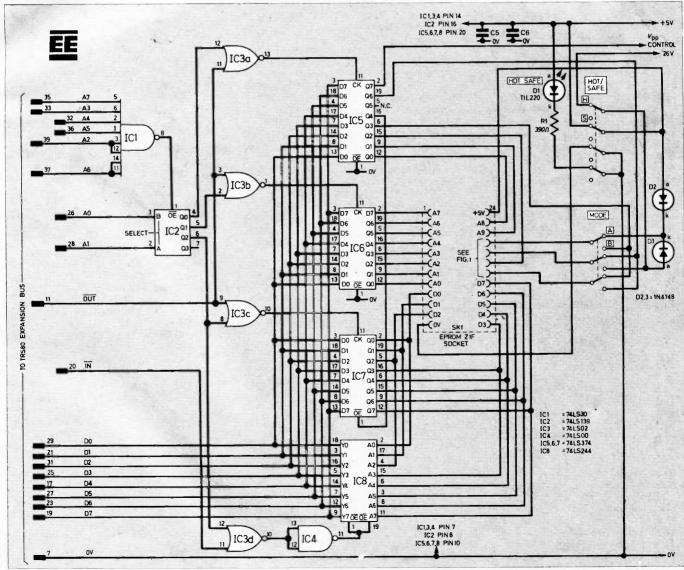
turns it off. The address is sent to the EPROM via IC6 (A0 to A7), and IC5 (A8 to A11). The data is sent via IC7. Control signals to present the 25V and programming pulse are sent via IC5 upper half.

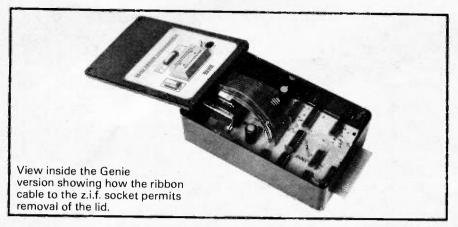
The control signals for the EPROMS listed in Table 1 vary in several respects as can be seen in Fig. 1. To accommodate the different organisations and memory

size it was found necessary to include a manually operated MODE switch, S1, in the design. The position of S1 in conjunction with software produces the required result.

To read an EPROM location, IC6 and IC5 provide the address and control information and IC8 provides the link to the data bus.

Fig. 3b. Circuit diagram of the TRS-80 version of the Programmer.





An EPROM should not be removed from or inserted into a powered up socket (hot socket). S2 functions as a HOT-SAFE switch. In the SAFE position the OV, 5V and 25V supply lines to the socket are interrupted. Light emitting diode D3, lit when the socket is HOT, provides an immediate visual indication of the switch

The Genie microcomputers (Video Genie, Genie I and II) do not provide IN and OUT at their expansion slots. They do provide the CPU signals, IORQ, RD and WR which allows IN and OUT to be derived. The circuitry for doing this is given in Fig. 3a. The IN and OUT outputs are to connect to the IN and OUT inputs in the main circuit diagram, Fig. 3a, to produce the complete circuit diagram for use with the Genie

microcomputers. The edge contacts for the two computer types are given in Fig. 4.

#### POWER SUPPLY

The power supply section of the Programmer is shown in Fig. 5. It powered.

The 240V a.c. mains voltage enters the unit and appears across T1 primary. There are two secondary windings, each rated at 9.5V 320mÅ. One voltage winding is half-wave rectified by D8 and then smoothed by C5. This provides a raw d.c. input to monolithic voltage regulator, IC9. The output from this device is a stabilised +5V with in-built short circuit protection.

The other secondary winding feeds a voltage doubling and smoothing circuit composed of D6, D7, C3 and C4. This produces a raw d.c. level of about 30V at maximum  $V_{pp}$  load. This is applied to the collector of TR1 and feeds Zener diode D4 (27V) through its series resistor R3. The base emitter drops approximately 0.7V to give about 26V at its emitter. This is the supply to  $V_{pp}$  through S2 and

This output stage is turned on (supplying 26V) or turned off (output is 0V) by the electronic switch composed of TR2 and TR3 and local components. The control signal for the switch comes from the software via bit 7 of IC5. A logic 1 to  $V_{\rm pp}$ 

produces +5V and +26V and is mains

These pins are tapered with heads. The board should be drilled 1mm diameter at these positions for the specified pin. The through-the-board connections are at each of the pad positions seen on the board topside. Track pins are used in all but four places, where the component lead is used instead. These are the decoupling capacitors C1 and C2 which of course must be soldered on both sides

CONTROL turns on TR3 and its collector drops to near OV. TR2 is therefore off and is effectively disconnected from D4. If now a logic 0 is presented, then TR3 is turned off. TR2 is now free to turn on via base bias resistor R4 and TR2 collector falls to near 0V. D4 is thus shunted and TR1 is held off so there is no voltage at TR1 emitter. R2 straps TR1 emitter to

Both versions of the Programmer

described here are constructed using two

printed circuit boards. The larger board

in each case is a double-sided type, that is to say, there is a track pattern on each side of the board. Interconnections are re-

quired between the two sides at numerous

places. Track pins are made specially for

such a connection and their use is

strongly recommended for this project.

OV in this condition.

**HARDWARE** 

of the board.

The p.c.b.s, supports and components have been tailored to suit the inexpensive but robust Vero General Purpose Plastic Box size  $180 \times 110 \times 55$ mm.

The board is supported on snap-fixing 6mm long plastic stand-off pillars fitted to the base of the case. These require a 3.8mm diameter hole drilled in the board and a 5mm diameter hole drilled in the

A slot is required in the front end of the case to accommodate the protruding finger set. A shaped hole is needed in the rear end to allow the mains cable to pass to the board via a strain relief bush. This securely grips the cable and prevents any strain being exerted at the soldered connection to the board.

The second smaller p.c.b. is a singlesided board. It holds the two switches and the z.i.f. socket and local components and is screwed to the underside of the lid using four 6BA fixings. Three rectangular cut-outs are required in the lid to suit the z.i.f. socket and the switches. A hole is also required to accommodate the panel mounted l.e.d.

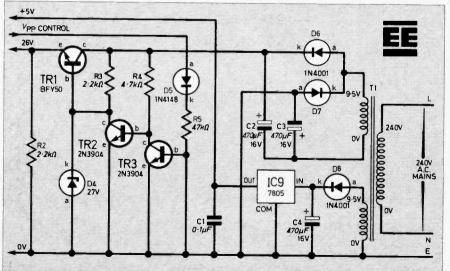
Begin construction by preparing the case. Full details are given in Figs. 6 to 8. The plastic is very easy to cut and file.

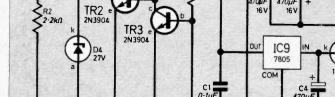
#### PRINTED CIRCUIT BOARDS

It is assumed that the drilled printed circuit boards have been obtained from the EE Printed Circuit Board Service with all holes drilled to suit the specified components.

Remove the two top corner cut-outs using a small hack-saw and then file smooth up to the border line so as to just remove it. Position the board (right-way

Fig. 5. Circuit diagram of the mains derived power supply of the Programmer.





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up) on the underside of the case and use the four board fixing holes to drill pilot holes in the case for the corresponding base fixing holes. Enlarge the case holes to 5mm diameter. Slightly countersink

both sides of these four holes.

Push the plastic pillars into the case holes and then check that the board fits onto the pillars and the finger set protrudes through and clears the slot. If all is well remove the board and make ready for assembly.

#### **ASSEMBLY**

All components are fitted to the board topside as can be seen in the layout diagrams, Fig. 9 (for TRS-80 version) and Fig. 10 (for Genie version). Begin by inserting all the track pins. You will find it easier to push these in from the topside as all topside pad positions are through-theboard interconnection points.

Remember to leave the four holes for C1 and C2, to be fitted later. Push the pins firmly into the board. Solder all pin topsides, turn over and solder all pin undersides. A small diameter bit is recommended for most of the soldering on this board, about 1.5mm diameter.

Next insert the i.c. sockets and solder. Check for solder bridges as you proceed. An eye glass will be especially useful for

this purpose.

Now position and solder all other low profile components: resistors, diodes and IC9 followed by the transistors and decoupling capacitors, C1, C2 and C6. Remember to solder C1 and C2 to top and underside. The electrolytic capacitors may next be inserted paying attention to polarity and finally fit and solder in T1. Prepare a length of mains cable 3-core and connect to the board according to layout diagram.

#### POWER SUPPLY CHECK

The assembly should now be thoroughly inspected, checking for possible solder bridges, unsoldered pins, correct orientation of diodes, transistors and capacitors. When you are satisfied, the power supply section should be checked. It is a good idea while testing to sit the board in its case with finger set protruding through the slot. This lessens the possibility of inadvertently touching the p.c.b. underside tracks carrying mains voltage.

Plug in and switch on at the mains. Identify the OV and +5V rails and check that the voltage is at or very close to +5V.

Attach a short length of fine wire to your voltmeter probes and check that there is 5V between each V<sub>cc</sub> and GND pin position at each socket. Too stout a wire has been found to excessively open the socket contact such that it is unable to make contact with the i.c. pin when inserted.

You should measure about 30V or more between 0V and TR1 collector. There should be no output at TR1 emitter. A lead connected between the free

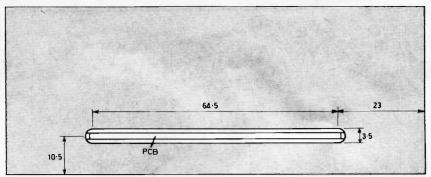


Fig. 6. Slot to be cut in the case front panel to suit the Genie version p.c.b. (830602).

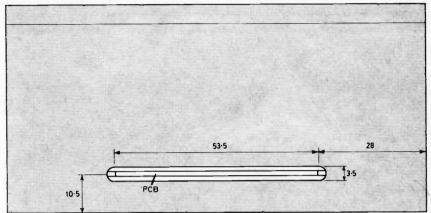


Fig. 7. Slot to be cut in the case front panel to suit the TRS-80 version p.c.b. (830601).

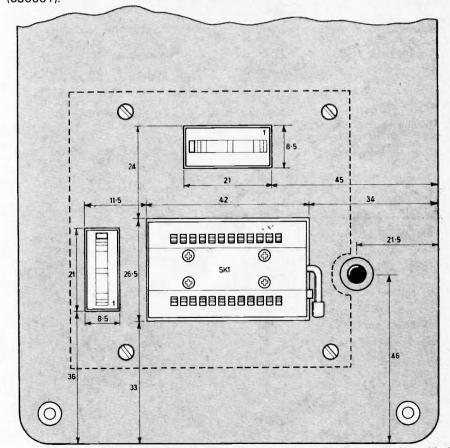
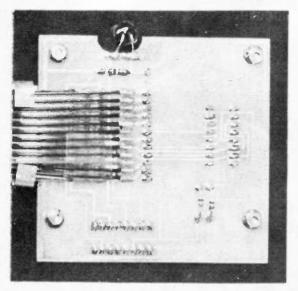


Fig. 8. Cut-out dimensions of the case lid to suit the p.c.b. (830603) and specified components. Note the orientation of the switches.

# **TRS~80**

### **EPROM PROGRAMMER**



The fitted top board fully populated showing ribbon cable running to lower board through a cable gripper.

### COMPONENTS TO THE

Resistors		TR2, TR3	2N3904 silicon npn
R1	390Ω		(2 off)
R2	2·2kΩ	TR1	BFY50 silicon npn
R3 R4, R5	$2\text{-}2\text{k}\Omega$ $\frac{1}{2}\text{W}$ 47k $\Omega$ (2 off)	IC1	74LS30 TTL 8-input NAND gate
stated oth	erwise	IC2	74LS139 TTL Dual 2-to-4 line decoder (3-state)
Capacitors		IC3	74LS02 TTL Quad
C1 C2–C4	0.01μF ceramic 470μF 16V elect.	100	2-input NOR gates
	radial (3 off)	IC4	74LS00 TTL Quad
C5, C6	O-1μF plastic or		2-input NAND gates
	ceramic (2 off)	IC5-IC7	74LS374 TTL Octal D-type flip-flops
Semicondu	ıctors		(3-state) (3 off)
D1, D2	1N4148 small signal silicon (2 off)	IC8	74LS244 TTL Octal buffers (3-state)
D3	TIL220 red l.e.d.	IC9	7805 5V 1A
D4	BZY88C27 27V 400mW Zener diode		monolithic voltage regulator TO-220
D6-D8	1N4001 1A 50V		package
	rectifier (3 off)	IC10	74LS32 TTL Quad
D5	1N4148 small signal silicon		2-input OR gates (Genie only)

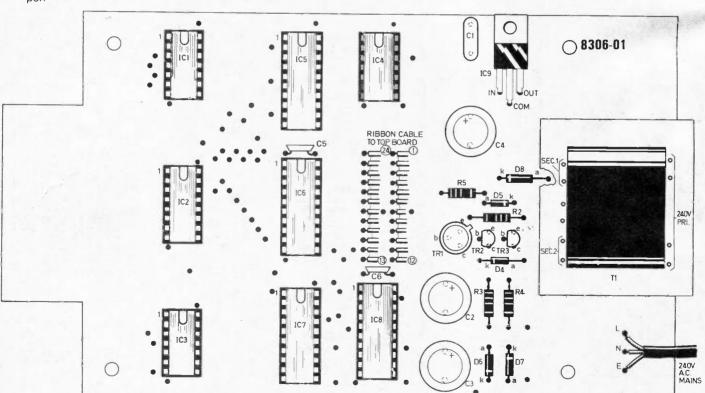


Fig. 9. Layout of the components of the topside of the TRS-80 version p.c.b. The black "dots" indicate the positions of the track pins to be soldered to both sides. Note that C5 and C6 are to be soldered top and underside.

# GENIE

### EPROM PROGRAMMER

#### Miscellaneous

Printed circuit boards: double-sided size 180 × 104mm Order Code: 8306-01 (TRS-80), 8306-02 (Genie); single-sided size 89 × 89mm Order Code: 8306-03; d.i.l. sockets: 20-pin (4 off), 16-pin (1 off), 14-pin (3 off, TRS-80), (4 off, Genie); plastics case Vero type 202-21391A; 1mm track pins (66 off, TRS-80), (79 off, Genie); 6mm long plastic stand-off pillars (Verospeed type 226-22549H) (4 off); self-adhesive rubber feet (4 off); mains cable strain relief bush; 6BA countersunk screws and

nuts, washers (4 sets); 3-core mains cable, 1m; 10-way flexible jumper link cable, 3 x 6 inch lengths (Verospeed type 226-22549H).

#### Software

T004 cassette: EE124 Eprom Programmer (TRS-80 & Genie)

approximate
GOSt £35 excluding
software

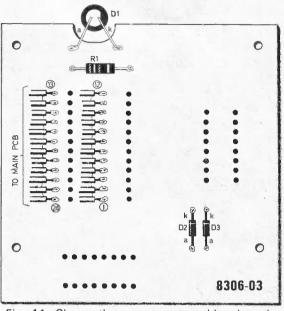


Fig. 11. Shows the components soldered to the "underside" of the top p.c.b. and ribbon cable connection points. For TRS-80 and Genje versions.

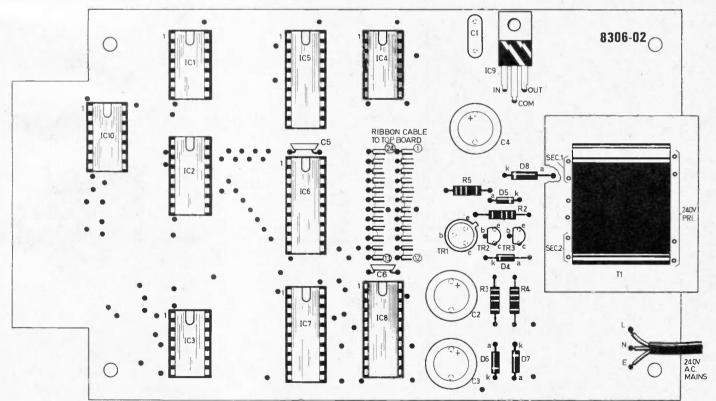


Fig. 10. Layout of the components on the topside of the Genie version p.c.b. The black "dots" indicate the positions of the track pins to be soldered to both sides. Note that C5 and C6 are to be soldered top and underside.

end of R5 and +5V should cause TR1 emitter voltage to become about 26V. If the above results are not obtained, switch off, investigate and remedy before

proceeding.

If all is satisfactory, unplug the unit from the mains and connect the interboard wiring cable. In the prototype, webbed 0.1 inch pitch ready-stripped and tinned cable was used. This is normally available in 10-wide lengths, and is very flexible. The two additional pairs were cut from a third length. Trim off excess from board underside.

The i.c.s may now be inserted. They all face the same way. Fit rubber feet at each corner of the case and push the board firmly onto its supports. Feed the mains cable through its exit hole, but do not fit the strain relief bush yet.

Prepare the case lid to accept the top panel components, see Fig. 8. Use a round file to remove the section of the board to clear the l.e.d. when fitted.

Components are to be mounted on both sides of the upper board. Fit S1, S2 and the z.i.f. socket on the top (uncoppered) side. Position the board so that the components fit into their apertures and then use the board fixing holes as a template to drill the fixing holes in the lid. Countersink the lid holes.

Use countersunk screws, huts and washers to fix the board secure. A dab of paint on the thread of the screw will prevent the fixing working loose in use. A label to identify the functions may now be attached. This will also conceal the fixing screws. Fit the l.e.d. clip. Insert the l.e.d. and bend its leads carefully using a pair of pliers so that the leads make contact with the rectangular pads on the p.c.b. (Fig. 11). Check polarity before soldering.

Solder D1, D2 and R1 to the board, feeding the shortened leads into the pad holes. Attach the self-adhesive flat cable gripper to the lid immediately in front of the board as seen in the photograph.

It only remains for the  $2 \times 12$ -way flat cables to be soldered to the appropriate rectangular pads adjacent to the z.i.f. pins. Trim the tinned leads to about 3mm before soldering. Double-sided tape will be found useful when carrying out this. Stick a short length of the tape onto the board immediately in front of each line of pads. Press each 12-wide cable in turn and solder. Ensure that there are no "shorts". A small screwdriver blade was used to hold the wire in contact with its pad during soldering to give a good joint. A third hand would be useful at this stage. When both cables have been soldered close the cable-gripper arms to hold secure.

Manipulate the cables to run away from the transformer and screw down the lid.

#### **TESTING**

Plug into the mains. The panel l.e.d. should be lit when S2 is in the HOT position and go out when set to SAFE. Set in HOT position. Check that the voltage between pin 12 of the socket (GND) and pin 24 (V<sub>cc</sub>) is +5V. With S1 set to MODE A, pin 21 (V<sub>pp</sub>) will read either 4.5V or about 25V depending on whether IC5 bit 7 has initialised at turn on to logic 1 or logic 0. In MODE B V<sub>pp</sub> will read about 26V or 0V depending on bit 7 state. This unknown state of bit 7 (IC5) clearly illustrates the danger of powering up the Programmer with an EPROM in the

socket. When certain conditions exist with 25V applied to V<sub>pp</sub> the EPROM will be destroyed.

In normal use, this condition will not exist since the software correctly initialises the system before instructing the user to insert the EPROM. Full details later.

Connect the Programmer to the computer using the appropriate expansion cable. Do not apply power to the Programmer. Turn on the computer. It should function normally. Turn off the computer. Turn on the Programmer and then the computer. Again the computer should function normally. If not turn off both units, investigate and remedy.

If results are satisfactory, run through the "Setting-Up Procedure" but do not insert an EPROM when instructed to. Set to MODE A and type 4 in response to the prompt at instruction No. 9. You are now at No. 12.

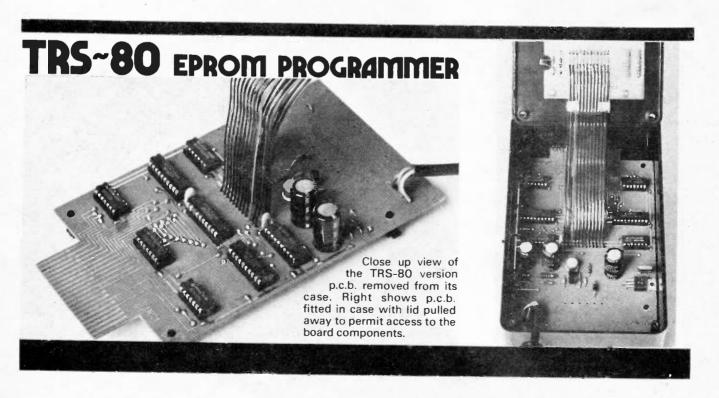
Type P# <ENTER>
Move the cursor to 00F0 and type in AA
Press <BREAK>
Type B0000:00FF <ENTER>

Check that the voltage at pin 21 is approximately 5V. Set your voltmeter to read 30V d.c. f.s.d. and connect across pin 12 and 21. Observe the meter and type <ENTER>. The needle should deflect to 25V for about 12 seconds and then fall back to its previous reading.

Check now that:

A0 to A3, A8 to A11, read logic 0 A4 to A7, read logic 1 D0, D2, D4, D6, read logic 0 D1, D3, D5, D7, read logic 1

Repeat the whole of this test procedure but this time set MODE B. V<sub>pp</sub> is now on pin 20. Before a "burn" takes place, this



pin should read OV, and during the burn it should read 26V approx. and return to OV after about 12 seconds. Check all data and address pins to read the same logic levels as before. If so the unit is functioning normally and is ready for use.

#### SETTING-UP PROCEDURE

Users are advised to read all of this section before attempting to use the system.

The EPROM socket should be empty and all equipment should be "off" before commencing the setting-up procedure which should then be carried out in the following sequence.

- 1. Connect the PLU to the computer using the system bus expansion cable.
- 2. Set the HOT-SAFE switch to SAFE.
- 3. Connect the PLU to a 240V a.c. mains supply and switch on.
- 4. Switch on the TRS-80/Genie and enter BASIC in the usual way by pressing the <ENTER> key.
- 5. EE124 is a machine code program which can only be loaded via the SYSTEM command. Type SYSTEM <ENTER> and the SYSTEM prompt \*?\_ will be displayed.
- 6. Depress the play button on the cassette recorder and check that the volume control is set between 5 and 6. Type the filename EE124 <ENTER>

The cassette motor will start and the program will load in the usual way.

7. Once the load is complete, the SYSTEM command prompt will again be displayed. This time type /<ENTER> The following message will be displayed

> EE124 SOFTWARE 1-1 **COPYRIGHT EVERYDAY ELECTRONICS 1983**

> SELECT MODE SWITCH\_

8. Refer to Table 1 and identify the MODE (A or B) for the EPROM which is to be programmed. Set the MODE switch accordingly and type <ENTER>

The following message will be displayed

#### SELECT 1, 2 OR 4 ?\_

- 9. The same EPROM socket is used to program three different sizes of EPROM. They are  $1K \times 8$ ,  $2K \times 8$ and  $4K \times 8$ . Thus, type
  - $1 < ENTER > for 1K \times 8$
  - $2 < ENTER > for 2K \times 8$
  - 4 <ENTER> for 4K × 8

The following message will be displayed

#### INSERT EPROM\_

- 10. Move the socket lever to the vertical position and insert the EPROM paying particular attention to polarity. Lock the EPROM into position.
- 11. Set the HOT-SAFE switch to HOT.
- 12. Type *<ENTER>*

and the system is ready for use. The command prompt [+] will be displayed and any of the commands on page 348 will be accepted.



The Eprom Programmer in use with the Genie II microcomputer. The screen shows that a 4K-byte EPROM has just been successfully "burned".

#### To remove an EPROM from a powered up Programmer

- A. Set the HOT-SAFE switch to SAFE.
- B. Move the socket lever to the vertical position and lift out the EPROM.

At the end of a programming session, do not turn off any mains supply without having first removed the EPROM. Follow steps A and B with:

- C. Switch off Programmer.
- D. Switch off computer.



#### COMMANDS

All items appearing in ruled boxes are automatically displayed on the screen.

All commands are vetted by the syntax analyser. This is a routine which checks the structure of commands. If the structure of a command is incorrect, a SYNTAX ERROR message will be displayed.

Commands are of a particularly simple form and are checked against the following production rules:

<Command>

<Command letter> < Parameters> <Command letter> B|C|F|L|M|N|P|R|S|T|X|Z

<Parameters>

<Address> <Address> :<Address>

<Null string>

<Address> <H>>

# \* . < HHHH> 0 1 2 3 4 5 6 7 8 9 A B C D E F

# \* and . are shorthand notations for first, last and current address, respectively. Spaces are ignored by the syntax analyser.

#### Example

(a) #:\* (b) \* (c) . (d) 2410:\* (e) .:\* (f) 2410:2490 The above parameters are not considered by the analyser to be syntactically incorrect but may be described as BAD PARAMETERS when used with certain commands. The following are considered to be syntactically incorrect:

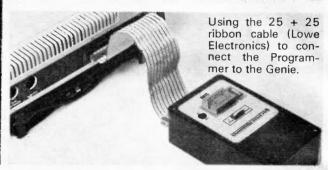
(a) #\* (b) 2410.2490 (c) :2490 (d) 2410. (e) .:

All commands must start with a bona fide command letter otherwise an ILLEGAL COMMAND message will be displayed. If the syntax of a command is correct, the legality of any parameters will be determined by the nature of the command.

A complete explanation of the commands and examples of their use will accompany the T004 software cassette available from the EE Software Service.

#### Table 5. Summary of commands

Command	Description
В	Burns bytes from the buffer to the EPROM
С	Copies bytes from the EPROM to the buffer
F	Fills buffer locations with FF
L	Loads SYSTEM tape into the buffer
М	Memory sets origin
N	New executes a cold restart
Р	Page displays 256 bytes from the buffer
R	Read displays 256 bytes from the EPROM
S	Saves contents of buffer locations
Т	Tests EPROM locations for FF
X	Exits to Basic
Z	Zeros buffer locations



buffer. (4300≤HL & DL≤52FF.)

#### ENHANCING THE SOFTWARF

The authors feel that the set of 12 commands is sufficient for most needs but that there may be some users who wish to enhance the software by adding extra commands. This can easily be done.

The command table is situated from 5318 to 533B; each command cell of 3 bytes consists of

#### COMMAND LETTER LSB MSB

Space for four extra commands has been left from 533C to 5347. Simply type

in the three elements of a new command cell. The syntax of the new command will automatically be checked and on jumping to the command address, the top of the stack will hold the BAD PARAMETER(S) address.

CALL 58DO

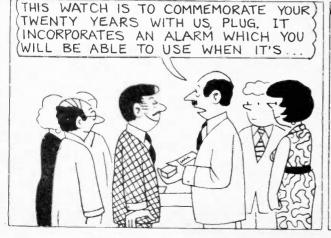
CALL 5AIC

returns HL, DE with command parameters. returns HL, DE with buffer addresses, i.e. command addresses which have adjusted for origin of EPROM and position of

#### COPYING SYSTEM TAPES

SYSTEM tapes can be easily copied, edited and created using the M, L, P and S commands. However, it must be remembered that although programs appear to be in main memory, they are actually stored in the buffer. They can only be run by first saving them onto cassette using the S command and then by loading them into main store from Basic using the SYSTEM command.

#### **BY DOUG BAKER**





# Logic Symbols

Fast acting "Schmitt" versions of the NAND and INVERTING gates are also available and these are identified by a "hysterisis loop" symbol. Fig. 4 shows a Schmitt INVERTER and NAND gate. They obey the truth tables for the INVERTER and NAND gates, respectively.

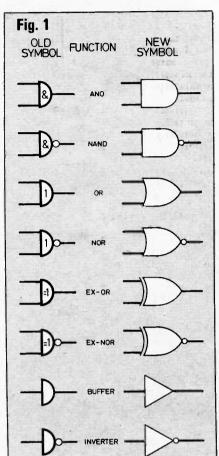
You will have noticed this month that we are using a different set of symbols in circuit diagrams to represent logic gates. These changes have been made to agree with those symbols found in manufacturers logic i.c. data books and application notes, as well as logic and microprocessor books (especially those titles from America) and other journals.

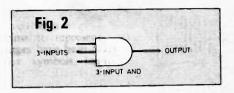
The symbols for the gates need no qualifying letter inside the symbol outline, it is the shape of the symbol which conveys its logic function. In Fig. 1 you can see the "old" symbol followed by its logic description and the "new" symbol for each of the different types of gate. These apply to both TTL and CMOS families.

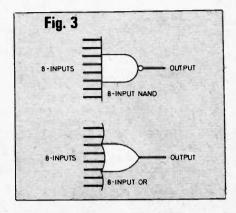
All gates with the exception of the Buffer and Inverter types, are shown as 2-input gates. For example, the first one in the list is fully described as a 2-input AND gate. AND gates with more inputs would be represented by drawing the elongated "D" with a number of lines equal to the number of inputs, into the flat of the "D"; Fig. 2 shows a 3-input AND gate. Other 3-input gate types are drawn similarly.

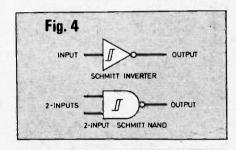
For a large number of inputs, the symbol is not made larger, but its input face is, see Fig. 3, which shows an 8-input NAND gate and an 8-input or gate.

The difference between AND and NAND, and OR and NOR symbols is the small circle at the output. This is a negating sign. A logic 1 produced on the gate-side of the circle becomes a logic 0 at the other side. Similarly a logic 0 becomes logic 1. This can be seen in the truth tables.









#### AND

Inp	outs	Output
Α	В	С
0	0	0
0	1	0
1	0	0
1	1	1

#### NAND

Inp	outs	Output
Α	В	С
0	0	1
0	1	1
1	0	1
2	1	0

#### OR

TRUTH TABLES

Inputs		Output
Α	В	С
0	0	0
0	1	1
1	0	1
1	1	1

#### NOR

Inputs		Output
Α	В	С
0	0	1
0	1	0
1	0	0
1	1	0

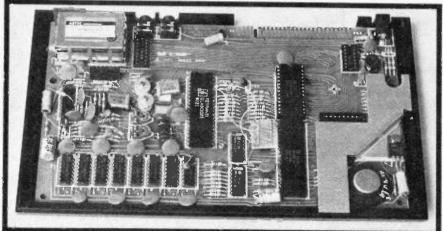
EX-OR

Inputs		Output	
А	В	С	
0	0	0	
0	1	1	
1	0	1	
1	1	0	

#### **EX-NOR**

Inputs		Output
A	В	С
0	0	1
0	1	0
1	0	0
1	1	1





(Top) The Sinclair ZX Spectrum is supplied complete with 1.2A mains adaptor, manual, and all the necessary leads to connect it to a TV and cassette player. (Above) The printed circuit board assembly showing the edge finger set at the rear which provides access to the control, data and address buses for expansion purposes.

THE ZX Spectrum package comprises the computer, a 1-2A mains adaptor, a TV aerial lead, two cassette recorder leads, an introductory booklet and a comprehensive user's manual.

The computer is housed in an attractive plastic case, slightly longer than the ZX81 and measures 233mm wide by 144mm deep by 30mm high. A 29-way double-sided finger set is situated at the back from which full data, address and control busses can be accessed, and the system is controlled by the Z80A microprocessor, a faster version of the well-known Z80µP.

The mains adaptor connects to the Spectrum via a female cassette power connector, which is an improvement on the male miniature jack plug used on the ZX81. The adaptor is sufficiently powerful to run the ZX printer, unlike the standard 0.7A adaptor which accompanies the ZX81. However, the printer also comes with a 1.2A adaptor, and ZX Spectrum owners who buy the printer will have paid for a spare 1.2A adaptor!

#### **KEYBOARD**

The keyboard is made up of 40 "moving" keys with full upper and lower case, and is a significant improvement on the ZX81's touch-sensitive keyboard. All keys are at normal typewriter pitch, but the keyboard is not suitable for touch typing. For a non-ZX81 user who is used to single character entry on a full-size QWERTY keyboard, the Spectrum keyboard will take some getting used to.

There are many good points, however. All keys have auto-repeat which makes input and editing so much easier than the ZX81. If the cursor is positioned at the end of a long program line, for example, it can quickly and painlessly be moved back to the beginning of the line simply by holding down the CAPS SHIFT and key. Every time a key is pressed, a click (albeit barely audible) can be heard from the internal loudspeaker.

All BASIC words can be obtained by pressing a single key, as with the ZX81. However, accessing the set below the keys requires practice. For example, to access the keyword CIRCLE, both shift keys, CAPS SHIFT and SYMBOL SHIFT, need to be pressed to change the K cursor to the E cursor. Then the SYMBOL SHIFT and the H key need to be

# SPECIAL REPORT SINGLAR Z

pressed for the word CIRCLE to appear. This sounds a rather long and complicated process, and indeed the number of keystrokes required to access some words is more than the number of characters in the word itself! Nevertheless, this is something that can be easily mastered.

#### DISPLAY

Users with black and white only TV's could be excused at times from thinking that the ZX Spectrum is just a ZX81 in a different case, for the screen format is identical to the ZX81. The main display, excluding the border which is unused on the ZX81, is split up into 24 rows of 32 columns. The bottom two rows (at least) are reserved for all program and run-time input. While this is fine for the beginner, it can be a limitation and a source of irritation to the more advanced programmer.

The main display of 22 lines of 32

The main display of 22 lines of 32 characters is made up of 176 by 256 dots (called pixels), each of which can be controlled individually. The trade off between resolution and memory is a difficult one but one which the Spectrum designers

seem to have got right.

Eight colours are available and are good on the whole, although certain combinations of colours in adjacent character positions give rise to blurring and instability along vertical boundaries. The colours have been sensibly arranged so that users with black and white televisions see ordered shades of grey ranging from white (colour code 0) to black (colour code 7). Pixels within each character position (and there are 64 of them arranged on an 8-by-8 grid) can only be one of two of the eight available colours and are aptly named PAPER (background) and INK (foreground). This could be considered a limitation, but is another instance where extra memory would be required to store the colour attributes of the pixels if more than two colours per character position were allowed. Again, they have got it right.

Furthermore, each character position can be set to flash and/or to be extra bright using the FLASH and BRIGHT commands. Together with BORDER, which sets the border colour, INVERSE which gives inverse video (that is PAPER colour becomes INK colour and viceversa) and OVER which superimposes any printing or plotting that is already on

the screen, these all add up to a comprehensive and impressive range of colour graphics.

#### BASIC

The Spectrum uses what is essentially a super-set of ZX81 BASIC. The interpreter and operating system are stored in 16K of ROM and the system runs at the speed of the ZX81 in FAST mode with the steady non-flicker display of the '81 in SLOW mode.

The instruction words READ and DATA, which were missing from the ZX81, have been included together with the very useful RESTORE n, which restores the data pointer to program line n. Dummy reads of data are no longer necessary to reposition the data pointer.

The instruction IN and OUT are very useful additions so that port boards and other devices can be controlled directly from BASIC without recourse to machine code. A powerful feature of the Spectrum BASIC is the ability for users to define their own functions using the DEF FN instruction.

For example, DEF FN L\$(a£,n) = a\$(TO n) returns the first n characters of a\$ so that L\$("PUTTY",3) = "PUT". Those of you familiar with Microsoft BASIC will recognise that this function is equivalent to LEFT£. Functions may use up to 26 numeric and 26 string arguments and can be mixed, as in the above.

Another powerful and unusual feature of Spectrum BASIC is the full expression evaluator which is called during program execution whenever an expression, constant or variable, is encountered.

Graphics commands are comprehensive. PLOT controls the INK of a pixel and DRAW draws lines as well as parts of circles if an additional parameter is supplied.

#### SOUND

Tucked away inside the bottom right-hand corner of the Spectrum is a small loudspeaker. Under command of the instruction BEEP, notes of varying pitch and duration can be generated. Unfortunately, the sound is barely audible, which is a pity. BEEP also ties up the CPU for the duration of the tone and it is not possible to break into the system at this time. [An amplifier to increase the

volume of BEEP and other sounds was featured in the April '83 issue of EE. Full constructional details were given.]

#### TAPE STORAGE

The ZX81 cassette interface, as many users will know, is very unreliable. How many times have users waited for several minutes to load a long program only to find at the end, for some unexplained reason, that the data has not been accepted? These problems are well-known to ZX81 users, and so it comes as no surprise to find that a new cassette interface has been designed for the Spectrum. It is very reliable and fast. The Baud rate (number of bits transferred per second) has been increased six-fold to 1500 and a 16K program now takes only 100 seconds to load.

Not only is the system more reliable, but a VERIFY command has also been included so that a saved program can be compared with what the computer intended to be saved. Also, two programs, one stored in memory and the other on tape, can be combined using MERGE.

There are a number of other features which enable data files, other than programs, to be stored on tape. Blocks of machine code can be saved and loaded from BASIC and arrays can be transferred and merged individually. The contents of the entire screen can be stored using a single command and loading is equally as simple.

#### CONCLUSIONS

The 16K version is priced at £125 and the 48K version at £175. Undeniably, both represent superb value for money. Each microdrive will sell for under £50 and the RS232 for about £20.

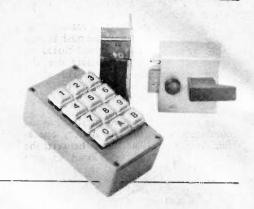
Readers seriously considering buying a computer for the first time would not go far wrong it they bought the ZX Spectrum. The machine is not only a good one but it is well supported by software houses and add-on manufacturers, which is a very important point for a potential buyer to consider.

Early supply and production difficulties brought Sinclair Research much criticism from the computing press, but these problems are now behind them and the ZX Spectrum looks set to be an even bigger winner than the ZX81.

# SPECTRUN

BY J.W. TERRELL M.Sc.

# PUSH BUTTON COMBINATION LOCK BY J. HADLEY



THE Push Button Combination Lock provides a convenient alternative to a key operated lock, especially when a number of people use the same door. This system is designed to use a lock release mechanism which can easily be fitted in place of the door frame mounted part of a cylinder lock, and which allows the lock to be used with a key, if required.

The circuit is battery powered, making for simpler installation and allowing operation during mains failure. Provision is made in the design to cater for the situation when the battery voltage eventually falls to a level at which the lock

release fails to operate.

#### PRINCIPLE OF OPERATION

A number of designs for push button locks have been published which rely on relatively complex digital circuitry. The design to be described here makes use of the principle of transferred charge using the basic concept shown in Fig. 1.

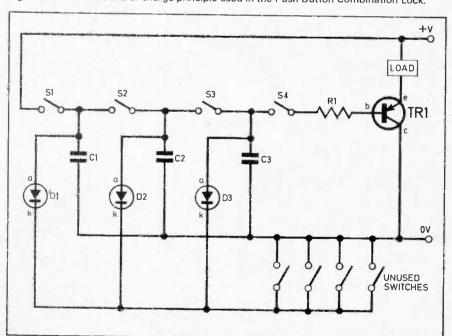
When switch S1 is momentarily closed, capacitor C1 is charged to the supply

voltage. When switch S2 is momentarily closed, the charge on C1 is shared between C1 and C2. Similarly switch S3 transfers charge to C3; this stored charge is used to operate the lock release circuit by momentarily closing switch S4.

Switches S1, S2, S3, and S4 are selected from a keyboard of twelve or sixteen keys to provide the sequence of numbers required. Unused switches are connected through a common line, such that, if any incorrect key is pressed all charged capacitors are discharged via diodes D1, D2, and D3, and the sequence will then have to be restarted.

The simple arrangement of Fig. 1 has two disadvantages. The first is that the voltage falls at each transfer. If the values of the capacitors are equal the voltage is halved at each transfer and the voltage on C3 is only a quarter of the supply voltage. Secondly, the switching arrangement precludes the use of commercially available keyboards which usually have a common connection to one side of the switches.

Fig. 1. Circuit of the transfer charge principle used in the Push Button Combination Lock.



#### THE CIRCUIT

The circuit shown in Fig. 2 overcomes these disadvantages by using CMOS NAND gates, as buffer stages, between each capacitor. This allows almost the full supply voltage to be transferred between each capacitor.

The operation of the circuit is as follows: when switch S1 is closed, C1 is charged through R1 and when released the voltage on C1 decays exponentially. Providing that this voltage is still greater than half the supply voltage, closing switch S2 will cause the output of gate IC1a to go low, which in turn causes the

output of gate IC1b to go high.

C2 then charges through D3 and R4. The second pair of NAND gates (IC1c and IC1d) perform the same function by charging C3 when switch S3 is closed. The lock release is operated when switch S4 is closed, causing the output of gate IC2a to go low, switching on transistor TR3 which provides sufficient base current to cause TR4 to go into saturation.

#### LOCK RELEASE

The lock release coil is connected between the positive supply and the collector of TR4 via a 2.2 ohm resistor. This resistor limits the coil current when the battery voltage is high.

When the battery voltage has fallen to a level where the lock release fails to operate, the 2.2 ohm resistor can be bypassed by closing switch S5 at the same time as S4 is closed. The output of gate IC2d goes low when S5 is closed and this switches on TR1 and TR2. Since the collector of TR2 is connected directly to the coil, the full supply voltage, less the saturation voltage of TR2, appears across the coil.

The normal sequence of operation is to momentarily close S1, then S2, then S3 and finally S4 to operate the lock release. When the lock fails to operate, because the battery voltage is too low, the sequence is repeated but S4 and S5 are closed simultaneously.

This will allow the door to be opened in spite of the low battery voltage, but is also an indication that the batteries should be replaced before their voltage falls to a level at which the lock release

will fail to operate even when the override switch is used.

The value of the charging resistor used in the circuit requires that the push button switches S1, S2 and S3 are held closed for about half a second to ensure that the capacitors are fully charged. This slows down the maximum keying rate and provides added security against random keying.

Any switch not used in the selected combination, or for low battery operation, is connected as shown between the positive supply and the input to gate IC2b. Operating any of these switches causes the output of IC2b to go low and

as the door is opened. As can be seen from the graph in Fig. 3, the battery voltage on load has fallen to 6.2V after 4000 operations and that a further 200 operations are possible using the override switch, before the battery voltage has fallen to 5.2V.

Knowing the average daily use will enable the battery life to be estimated. Over an extended period there will be an additional loss of capacity due to storage effect which can amount to about 10 per cent per annum. For this reason it is not economical to use the higher powered HP2 cells, which have twice the capacity of HP11s, unless justified by frequent use.

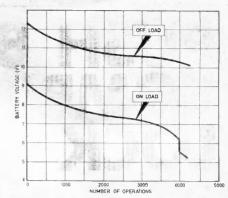


Fig. 3. Battery deterioration graph of voltage against number of operations.

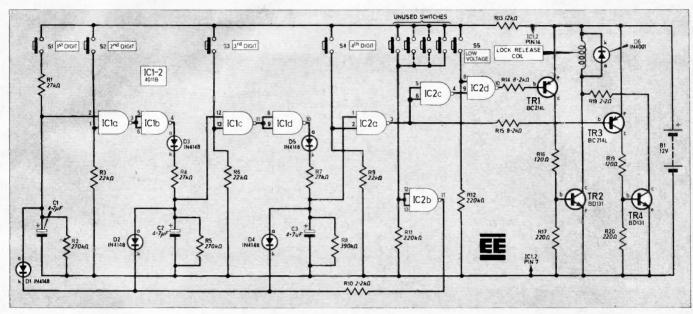


Fig. 2. Complete circuit diagram for the Push Button Combination Lock. The push switches S1 to S5 and the unused switches make up the keyboard and are housed in a separate case.

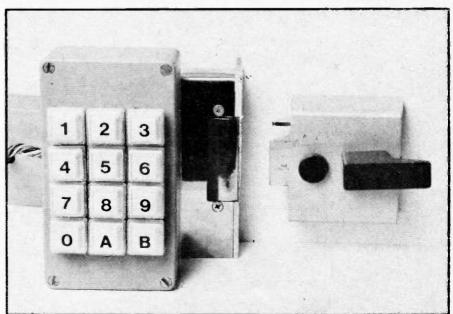
this discharges any of the capacitors (C1, C2 and C3) which have a charge. Pushing any wrong button therefore requires the correct sequence to be restarted at S1.

#### CHOICE OF BATTERIES

The lock release is designed to operate on a nominal 12V, but will operate down to about 4V, providing that pressure is not applied to the release, by pushing against the door, until the lock release has been activated.

With the  $2\cdot 2$  ohm resistor, the circuit and lock release will operate down to 6V or less. Using eight  $1\frac{1}{2}V$  cells to provide an initial voltage of 12V allows a long battery life to be realised. Current drain is negligible on standby and 800mA when the lock is operated. HP11 batteries are capable of supplying this current and to check that a reasonable life can be expected, the manufacturers data has been supplemented by an accelerated life test.

The test used a time switch to operate the circuit for two seconds every 15 minutes. Two seconds is typical of the time for which the peak current is drawn Foreground shows the keyboard housing, lock release mechanism and a typical cylinder lock. The control unit is partially obscured by the keyboard case.



### **COMPONENTS**

#### Resistors

27kΩ (3 off) R1.4.7 270kΩ (2 off) R2 5 R3,6,9 22kΩ (2 off) R8 390kΩ R10  $2 \cdot 2k\Omega$ R11,12 220kΩ (2 off) R13  $12k\Omega$ R14,15 8-2kΩ (2 off) R16,19 120Ω (2 off) page 369 R17,20 220Ω (2 off)  $2.2\Omega$  3W wire wound  $\pm 5\%$ R18

R18  $2 \cdot 2\Omega$  3W wire wound  $\pm 5\%$ All  $\frac{1}{4}$ W carbon film  $\pm 5\%$  unless otherwise stated

#### Capacitors

C1,2,3 4.7µF 25V tantalum (3 off)

#### Semiconductors

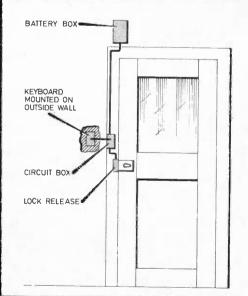
D1-5 D4 Silicon (5 off)
D6 1N4001 silicon
TR1,3 BC214L npn silicon (2 off)
TR2,4 BD131 npn silicon (2 off)
IC1,2 4011B CMOS quad
2-input NAND gate

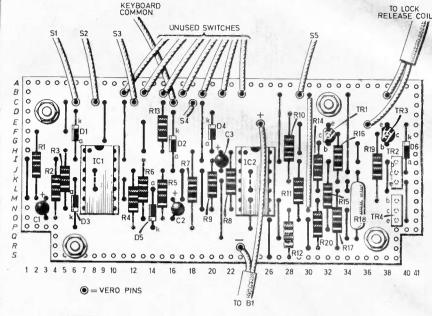
#### Miscellaneous

S1–12 12-way (or 16-way) keyboard with common connection (not matrix type)
B1–8 HP11 1-5V battery (8 off) Diecast or plastic case, 112 × 62 × 31mm (for main circuit); plastic case 190 × 110 × 60mm (for batteries); 0-1in matrix stripboard, 19 strips by 41 holes; surface mounted electric lock release; battery holder for 4 × HP11 (2 off); 14-pin i.c. holder; Veropins; 7/0-2mm wire; 2-core

## Approx. cost **£10** excluding lock & cases.

mains cable; mounting hardware.





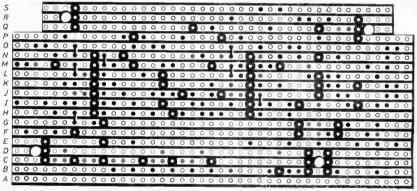
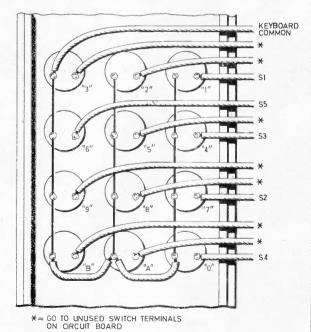
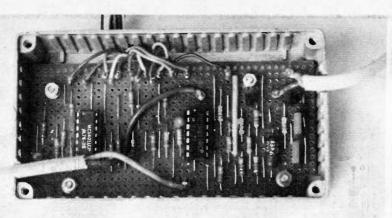


Fig. 4. Component layout, underside showing breaks in the copper and interwiring cables of the main lock control board. Pay special attention to the small links on the underside of the board.

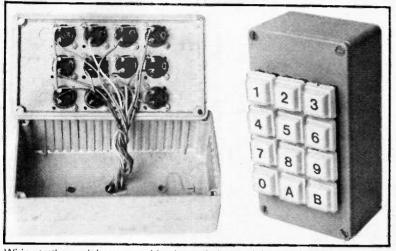
Fig. 5 (Right). Wiring to the individual push-switches which make up a 12-way keyboard unit. The combination shown is 1740 with 6 as the low voltage key.

Fig. 6 (Left). Suggested mounting arrangement of the various units around the door and door frame.

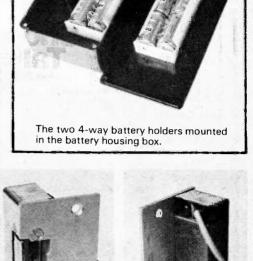




The main lock circuit board mounted in the control unit.



Wiring to the push button combination switches and the exterior of the keyboard box showing "coding" of the push switches.



Front and rear views of the lock mechanism. The lock 'solenoid" coil is shown on the right.

#### **KEYBOARD**

Keyboards are available commercially with 12 or 16 buttons and the single pole, not the matrix version, is required in this application. Alternatively, one can be made up from the wide selection of momentary action push button switches available from suppliers.

The circuit does not allow the use of repeated numbers so that the sequence 8593, for example, can be used but 8595 cannot. Because one button is used for low battery voltage, a 12-way keyboard will have  $11 \times 10 \times 9 \times 8$  combinations and a 16-way keyboard will have 15 x 14  $\times$  13  $\times$  12 combinations.

These are equal to 7920 and 32,760, respectively. To anyone trying to operate the lock by pushing buttons at random, the chance of success at the first attempt is 1 in 20,736 (that is 1 in 124) for the 12way keyboard, and 1 in 65,536 (1 in 164) for the 16-way keyboard.

#### CIRCUIT BOARD

The main lock circuit was built on a piece of 0.1in matrix stripboard, 19 strips by 41 holes and this is shown in Fig. 4. All wired connections to the keyboard must be made to Veropins as this facilitates the changing of the combination at a later date.

The usual care should be taken when inserting polarised components (tantalum capacitors and diodes) and to note the orientation of the semiconductors.

The layout requires a number of links. some of which are beneath the i.c. holders and also on the trackside of the board. These latter links are shown on the trackside view in Fig. 4.

The finished board is housed in a plastic or diecast box,  $112 \times 62 \times 31$ mm.

The wiring of a keyboard made from individual switches (a 12-way is shown) is given in Fig. 5. This is made from 12 momentary action key switches in a plastic or diecast box,  $120 \times 65 \times 40$ mm. Alternatively, a proprietary keypad can be used and this will have one side of the switches already commoned up.

#### INSTALLATION

The actual positioning of the units around the door will be determined by the available space. It is probably more convenient to install the batteries in a separate box and one arrangement is shown in Fig. 6.

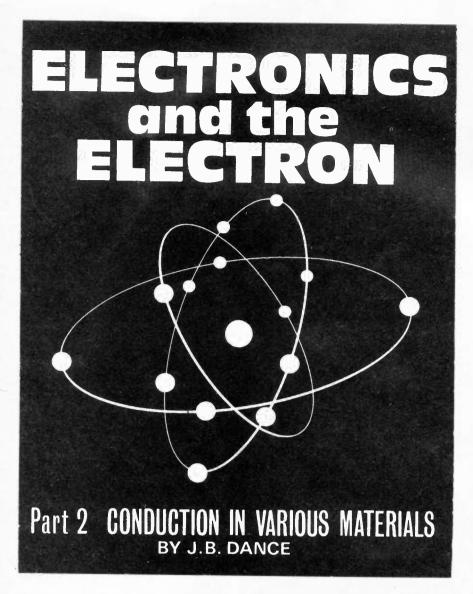
An alternative would be to fit the keyboard and circuit box on the door and feed the lock release with a cable to the hinge side of the door and around the door frame.

The HP11 batteries are housed in a plastic case, size  $190 \times 110 \times 60$ mm, using two, 4-way battery holders, one screwed to the base and the other to the lid of the box. Connections from the batteries and to the lock release should be made with 2-way mains cable.

#### SETTING THE COMBINATION

A wire from each switch, together with the common switch connection, is brought through the wall or door to the circuit box. The required sequence of digits is selected from the 12 or 16 switches of the keyboard and the wire from the first switch is wired to the pin marked S1. Similarly the second, third and fourth selected switches are wired to the pins marked S2, S3 and S4.

A fifth switch is selected to function as the low battery voltage switch and this is connected to the pin marked \$5 on the circuit board layout. All switches not used in the sequence are connected to the row of pins marked. There are sufficient pins shown for a 12-way keyboard. If a 16-way keyboard is used four more pins can be added or two wires can be connected to a single pin. Finally the common lead is connected to the pin shown.



CONDUCTION is the flow of an electric current through a material; it can occur in solids, liquids and gases. Indeed, an electric current can even flow through a vacuum.

#### **CURRENT FLOW**

The flow of an electric current involves the movement of electric charge. The charges which move may be positive charges, negative charges or both types, depending on the material through which the current is flowing. The term "electric charge" signifies the amount of electricity present or the amount flowing per unit time.

In order to understand electric currents, we must look at matter on the atomic scale. We then find that the flow of an electric current consists of the flow of extremely minute charged particles. In a metal these charged particles are electrons, but in liquids and gases positive ions can also contribute to the flow of current. If all the charged particles in a material are held firmly in position, no current can flow.

Charged particles are known as ions. Electrons are a rather special form of charged particle and one does not usually apply the term ion to an electron. If a neutral atom containing a positive nucleus and a number of electrons loses one of these electrons, we have a positive ion. Similarly if a neutral atom gains an electron, it becomes a negative ion.

In order to cause a steady electric current to flow through a material an electric voltage or e.m.f. (electromotive force) must be applied across the material concerned. In general the greater this voltage, the greater the current which will flow through a given piece of the material.

The voltage may be regarded as the driving force which causes the current to flow through the material. It may be compared with the water pressure between two points in a water system which causes water to flow through the system.

#### OHM'S LAW

Ohm's Law states that the voltage across a conductor is directly proportional to the current passing through it.

That is:

#### $V \propto I$

In general we do not like proportional signs, so we change the proportional sign to an equals sign and introduce a constant, R:

$$V = IR$$

This quantity R is the resistance of the material through which the current is flowing in ohms.

Most metals obey Ohm's Law; that is, the voltage across a given piece of the metal is proportional to the current flowing through it. However, there are many materials which do not obey this law. For example, in many semiconductor devices the current is not proportional to the voltage across the device.

Instead of saying that such materials do not obey Ohm's Law, one can say that the resistance of the material varies with the applied voltage.

#### CONVENTIONAL CURRENT

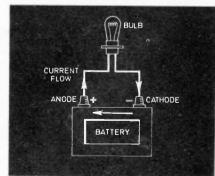
If one connects a battery to a small lamp, as in Fig. 2.1, current is said to flow from the positive terminal of the battery (which is known as the anode) through the bulb to the negative terminal (which is known as the cathode). In any external circuit which a battery feeds, current is said to flow from the positive to the negative electrode.

However, inside the battery the current must flow from the cathode to the anode in order to be able to continue flowing around the circuit. This matter concerning the direction of current flow can be quite confusing, so inexperienced readers should always be careful to give it an adequate amount of thought.

When the battery is being charged (Fig. 2.2), however, the current flows from the positive connection of the charger into the battery and through the battery to the cathode from where it returns to the charger. Thus it flows through the battery in the opposite direction to that shown in Fig. 2.1.

The battery charger in Fig. 2.2 must provide a voltage which exceeds the battery voltage by a small amount so that it can force the current through the battery against the e.m.f. of the battery.

Fig. 2.1. The direction of the conventional current flow from a battery through a lamp bulb.



The direction of current flow to which we have been referring is known as the conventional current, since it is the direction of current flow accepted by most people. In actual fact the particles which carry the electric charge in any metallic wire are electrons. Electrons carry a negative charge and therefore flow from the negative to the positive electrode in the circuit external to the battery. It can be seen from Fig. 2.3 that the direction of the electron flow is opposite to that of the conventional current flow.

#### AN HISTORICAL MATTER

If the flow of electrons is from the negative to the positive electrode, why do we have a conventional current flowing in the opposite direction? This is essentially an historical matter.

When the terms "positive" and "negative" were given to the two types of electric charge and voltage a very long time ago, there was no particular reason why these terms should be allocated in one of the two possible ways and very

little was known about electricity at the

time. The electron had not been dis-

covered.

It so happens that the anode of a battery was allocated the "positive" sign and the cathode the "negative" sign. When, much later, electrons were discovered, it followed that they had a negative charge on this convention. Hence these negatively charged particles flow towards a part of the circuit which is at a more positive potential, whilst current was assumed to flow from the positive through the external circuit to the negative connection of the battery.

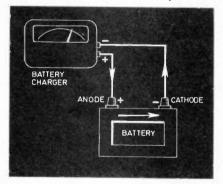


Fig. 2.2. The current flow from a charger through a battery; note that the current flows in the opposite direction through the battery to the current in Fig. 2.1.

From time to time authorities have suggested that we change the direction in which we consider a conventional current to flow so that it would become the same as the direction of the electron flow. However, if this change were made now, it would cause enormous confusion; for example, the arrow in all circuit diagrams containing diode or transistor symbols would have to be reversed in direction. When using a circuit one would have to think whether it had been published before or after the change.

In any case, positive ions flow in the same direction as our present conventional current. If we changed the conventional direction of current flow, we should meet the same problem with positive ion movement as we now have with electrons. One may note that the flow of current in the "metal" of antimatter, if it exists, is in the same direction as our conventional current, since charge carriers are positive positrons (the antiparticles of the electron).

Thus it appears we shall continue to regard conventional current as flowing from positive to negative electrodes in the external circuit of a battery.

#### **MATERIALS**

In some substances, such as metals, only a small voltage is required across a length of the material to produce a substantial current in it. Such materials are known as "good conductors".

In other materials, such as glass, the application of even a very high voltage across a thin layer of the material will produce only a very small current. Bad conductors are known as insulators.

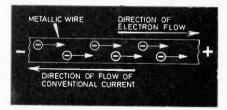
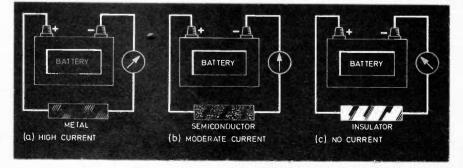


Fig. 2.3 (above). In a metallic wire the current is carried by the minute electrons which move towards the positive side. However, the conventionally accepted direction of current flow is opposite to movement of the electrons.

Fig. 2.4 (below). A battery will produce (a) a high current in a metal bar (b) a moderate current in a bar of a semiconductor and (c) no detectable current in an insulating bar.



In addition to the good conductors and insulators, there is a third class of materials known as "semi-conductors" which pass only a small current when a moderate voltage is applied across a thin slice of the material. It is this class of materials which makes modern electronics possible, since the flow of current through the material can be controlled by small input signals.

For completeness we will mention that a fourth class of materials can exist at very low temperatures which are known as "super-conductors". The resistance in a superconductor is almost zero, but the property of super-conduction disappears as the material is warmed only by a relatively small amount above the absolute

zero of temperature.

#### METALLIC CONDUCTION

An atom consists of a central positively charged nucleus with electrons situated near to it. In a metal the inner electrons (those near to the nucleus) are fixed firmly in position, since the attraction between their negative charge and the positively charged nucleus prevents them from breaking away from the latter.

However, the outer electrons in a metal are free to move anywhere within that piece of metal. If a voltage is applied across the metal, electrons will flow towards the positive side and other electrons will enter the metal at the negative side. The battery which drives the electrons through the metal can be regarded as a pump which pumps electrons out of its cathode and receives a corresponding number back at its anode.

Thus it is the availability of huge numbers of electrons which are free to move in the metal which renders it a good con-

ductor.

#### **INSULATORS**

In the case of insulators, the electrons are all fixed in positions by the electrical forces. The chemical bonds which hold electrons in position are electrical forces. A relatively large amount of energy is required to enable one of these electrons to break free and this amount of energy is not normally available for any one electron at room temperature. Thus there is nothing in an insulator which can carry an electric charge and any flow of current is extremely small.

In all solid materials the positively charged nuclei are held firmly in position by electrical forces and cannot contribute to conduction. It is only the movement of electrons which can make an appreciable contribution to the conductivity of any

solid.

It is interesting to note that insulators will become conductors if their temperature is raised by an adequate amount. For example, if one applies a potential of about 200V across a glass rod about 20cm long by winding copper wires around each end and then heats the centre of the rod, a large current will pass when the temperature approaches red

heat and this current will be adequate to maintain the temperature of the rod.

The increase of conductivity is partly due to the heat energy enabling electrons in the glass to escape from the atoms to which they are normally fixed and partly due to the high temperature softening the glass so that ions can start to move as one approaches the liquid state.

#### SEMICONDUCTORS

In semiconductor materials there are a limited number of free electrons able to move in the material. This number is extremely small when compared with the number of free electrons in a metal. Thus the current which flows when a small voltage is applied across a semiconductor material is very much smaller than that which flows when a similar potential is

applied across a piece of metal of similar dimensions.

A semiconductor material is rather like an insulator, but the amount of energy required to release some of the electrons is far smaller. A few of the electrons acquire enough energy from the heat in the material for them to break away from the atoms to which they are normally attached and they can then contribute to conduction.

If the temperature of a semiconductor material is raised, the extra heat energy enables a much greater proportion of the electrons in the material to move. Thus the conductivity of a semiconductor material increases greatly with increasing temperature. The silicon semiconductor material used in most modern semiconductor devices cannot be used as a semiconductor above a temperature of

about 200 degrees C, since the number of mobile electrons is then too great for it to be regarded as a semiconductor material.

Modern semiconductor devices are made using extremely pure silicon to which certain elements have been added, but the early transistors were made using germanium. Silicon and germanium are elements, but certain compounds are also semiconductors; for example, cadmium sulphide is used in photoconductive cells, gallium phosphide in light emitting diodes and gallium arsenide in infra-red detectors and lasers.

Semiconductor products are often known as "solid-state devices" since the materials in them are solids, unlike the earlier radio valves in which electrons flow in an evacuated enclosure.

Next month we shall continue our discussion on conduction in various materials.

## 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.

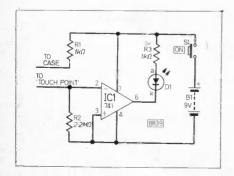
Contributions should be accompanied by a letter stating that the circuit idea offered is wholly or in significant part the original work of the sender and that it has not been offered for publication elsewhere.

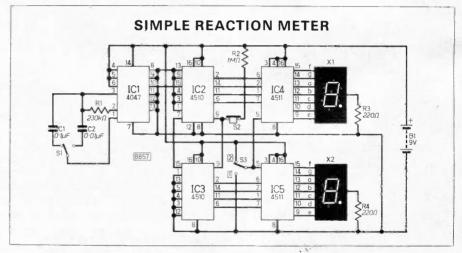
## PROBELESS CONTINUITY TESTER

CONTINUITY testers usually have two test probes. But in the present model, there is only one "touch point" instead of the probes. The device to be tested is held by one of its leads in one hand and the tester is held in the other. The other lead of the device is touched against the "touch point" (some metallic object about the size of a coin or even smaller. This is fixed on an insulated panel to isolate it from the tester case which is metallic.) The current flows from the metal body of the tester, through your body, the device and into the "touch point". This current is detected by the IC1 lighting up D1.

The "touch point" can be the head of a drawing pin. It should be insulated from the metal case, while mounting

J. Sreekumar, Cochin, India.





HIS is based on the 4047B multivibrator IC1 connected as an astable. S1 controls the frequency. When S1 is switched to C1  $(0.1\mu F)$  the frequency is 10Hz. At C2 (0.01μF) the frequency is100Hz. Resistor R1 is 230k (220k and 10k in series). This value is required in order to obtain fair accuracy. The pulse is fed into the 4510B BCD counter. This feeds binary into the 4511B which decodes it to drive a seven-segment common cathode display. The first 4510B (IC2) feeds a pulse which has been divided by 10 into the second counter stage IC3, IC5, which operates in the same way. S2 is push-to-break and resets both digits to 0.

S3 is the latch which when in position 1 (connected to negative) allows the 4511B to display the pulses being coun-

ted. When S3 is positive (position 2) the 4511B displays the number which was being counted at the exact moment the switch was turned to positive.

How to time a person's speed: The subject undergoing test holds S3 (which is in positon 1). Another person holds S2 pressed so the digits are at 0. As soon as S2 is released the digits start counting the pulses, and when the person being timed sees the digits counting, he switches S3 to position 2, this latches the 4511B so the time is displayed. To reset, S3 is returned to position 1 and S2 pressed. Timing can be accurate to 1/10 of a second or 1/100 of a second depending on what range S1 is set to.

Z. Karim, London E13.



Bargain

Offer

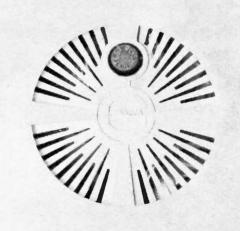
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# PLANT CULTIVATION

## AUTOMATIC GREENHOUSE WATERING SYSTEM

SUITABLE FOR GREENHOUSE OR CONSERVATORY THIS SYSTEM ENSURES ADEQUATE WATERING OF PLANTS AND ENABLES THEM TO BE LEFT FOR LONG PERIODS WITHOUT PERSONAL ATTENTION. A BOON FOR HOLIDAY TIMES.



# Microcomputer Interfacing Techniques PERIPHERAL CIRCUITS & SOFTWARE

THIS IS THE FIRST OF A SERIES OF ARTICLES TO HELP THE ELECTRONICS EXPERIMENTER BUILD AND USE A RANGE OF SIMPLE PERIPHERAL UNITS WHICH CAN BE INTERFACED WITH 6502-BASED MICROCOMPUTERS. EACH PART WILL INCLUDE A CONSTRUCTIONAL PROJECT.

## TRI BOOST

A tone correction unit for the guitarist to boost the treble, mid-range or bass sections of the audio spectrum. Footswitch operation.

## **DIGI ALARM**

Using an electret microphone insert and a.f. amplifier, this will boost sound from any wristwatch alarm making it suitable for bedside use.



**JULY 1983 ISSUE ON SALE FRIDAY, JUNE 17** 

# FOR YOUR ENTERTAINMENT

BY BARRY FOX

#### **Computer Forecast**

I've been doing some long overdue donkey work on computing. I wonder how many readers are in the same boat as I am? Too busy earning a living at work that doesn't involve computers to spend the time necessary to get to grips with computing

With this in mind I'll make a public bet. I bet that within a couple of years there are word processors, and computer filing systems, on the market that require absolutely no knowledge of computing. You'll use them as easily as you use a typewriter. The software program will be in a dedicated chip inside the keyboard so that it's ready for action the moment you switch it on.

I'll also bet that the machines that make a killing on this market come from Japan. It will be the video boom all over again. While Western companies are still trying to sell equipment that requires the proud purchaser to make all manner of compromises, the Japanese will have quietly designed a range of computer equipment that is tailor-made for people who don't want to know anything about computers. Mark my words!

#### **Medical Cure**

Meanwhile, anyone who wants to use a computer as a working tool (for instance, I wanted to use one for indexing my files on audio and video topics) has got no choice. They have to learn a bit about computing or do without.

As a mixed blessing I ended up in hospital and convalescing for a couple of weeks. So I spent the time learning something about computers.

I'm not recommending that people who need to learn the rudiments get themselves into hospital, but if you are in the same unfortunate position I strongly suggest that you turn it to your advantage. Even if you aren't very interested in computing, it's better than watching someone else's choice of TV programme on the ward set.

To my surprise I found that modern hospitals now have mains power points by each bed. If you get on the right side of the ward nursing staff, they will let you bring in a small computing system, like a Sinclair, and run it on the bedside table.

I was lucky in finding a couple of doctors on the ward round who were both computer buffs. They encouraged me to bring in a computer and the ward sister said: "All right, provided it doesn't make any noise".

Other hospitals, and other wards, may have a different policy. But all is not lost. Your answer here is to use a pocket computer, like the Sharp PC 1211. The same model is also sold by Tandy.

The cost is well under £100 and although these units look like calculators, they are in fact full-blown computers, albeit with fairly limited memory. With a cassette interface you can write programs, dump them onto tape and load them again the next day.

The instruction book that comes with the Sharp is pretty clumsily written, and the Tandy version is much better. But with either, and some hard work, you can do some very useful ground work on basic computing and BASIC program language.

Bear this in mind if you have advance warning that you are likely to be laid up, in hospital or in bed, for a couple of weeks. It's a good opportunity to turn a stroke of bad luck to your advantage.

#### **Hospital Radio**

Here's another tip for anyone facing a stint in hospital. Unless you are very ill, you'll soon get bored. Even if you are learning computing, you'll want to listen to the radio as well. But the radio systems in even modern hospitals leave a lot to be desired.

They use acoustic stethoscopes, like those in long-haul airlines, and you can only listen to a limited choice of channels piped through to your bed by the hospital distribution system. It's also likely to be in mono only.

The answer is to take along a personal stereo cassette player, or radio with headphones. However, do check that a tape player produces good sound while it is being shaken around, as well as while it is laying stationary on a shop counter.

Some of the cheaper models produce awful wow and flutter as soon as you use them on the move. It won't matter in hospital, but it will drive you crazy if you later try and use the player while you are walking or jogging.

By the way, if you are visiting someone in hospital and you can afford an expensive present, a personal cassette player or radio will probably be far more welcome than flowers or fruit.

#### Video In A Spin

The video games boom is levelling off. Atari in America has laid off a quarter of its workforce.

Personally, I'm not surprised, and I'm certainly not sorry, that the public is fast growing tired of blasting blips off a TV screen. The games manufacturers are trying to counter the loss of interest with ever more exotic cartridges.

One trend is to sell games that are "spinoffs" from feature films, like *Tron, Star Wars* and *Raiders of the Lost Ark.* Another trend is towards semi-sadistic games, like guiding chickens across a busy road. And in America, there are now pornographic games, from strip poker to all manner of unmentionables

All the signs are that all these are the desperate efforts of a dying industry. But there is growth in games programs for micros. Businessmen and householders are buying small computers because they think they ought to use them for accounting, calculation or word processing. As often as not the only programs they end up running are games programs.

#### **Joystick**

Accessory firms are also making money out of video games. For a little over £10 each you can buy exotic joystick controls to replace those that come as standard with TV games.

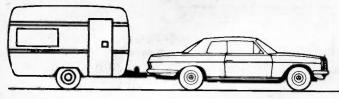
Most hand controllers for home TV games use a separate joystick and firing button to steer and blast blips on the screen. Usually, only one shot is fired for each press of the button.

New add-on controls from American manufacturers Spectravision and Disc-Washer do better than that. They come with a standard 9-pin D-plug which fits straight into the control socket of an Atari game or Commodore computer. The firing button is on top of the joystick, under the player's thumb.

The makers reckon that this brings consistently higher scores. It also means that right and left handed users can for the first time compete on equal terms.

For really high scores you have to pay an extra £8 and plug in a DiscWasher Constant Fire adaptor between the joystick plug and circuit. This contains an integrated circuit which is powered by spare d.c. from the games unit and generates a constant pulse fire cycle every time the thumb button is pressed. So on the screen there is a machine-gun effect.

Gadgets like these are selling well, partly because people just love to buy extra addon gadgets. But it's also partly because the hand controllers with TV games get very hard use, wear out and need replacing with new ones fairly frequently.



# CARAVAN POWER SUPPLY

BY T. R. de Vaux-Balbirnie

THE author is one who believes that caravanning can be made more pleasurable by the benefits of electronics. Fluorescent lights, electric water pumps, extractor fans and cooker hoods are convenient, while cassette recorders, television and, perhaps, a video game or personal computer, can be useful on wet days and in making a true home-fromhome.

#### **POWER SUPPLY**

The battery in the towing vehicle may be used to power any 12V equipment but this ties up the car since it must be parked nearby. Some members of the family might wish to use it leaving the others behind. So there is much to be said in favour of a separate battery for the caravan. This is useful, even at home,

since the interior light may be used without having to couple up the car.

It will be noted that an auxiliary battery is only used for the interior equipment, the exterior lights on the caravan receive their power from the car system in the usual way.

#### **CHARGER**

Assuming the auxiliary battery to be fully charged before setting out on a trip, it could only be expected to give a short period of service without being recharged. The present system has been designed to keep the battery topped up with charge, at a rate of about 2A on touring holidays. It is not designed for use on long-stay holidays at a fixed location. Since charging is effected by the generator in the car, the project is best

where stops are for a few days at a time, followed by periods of towing.

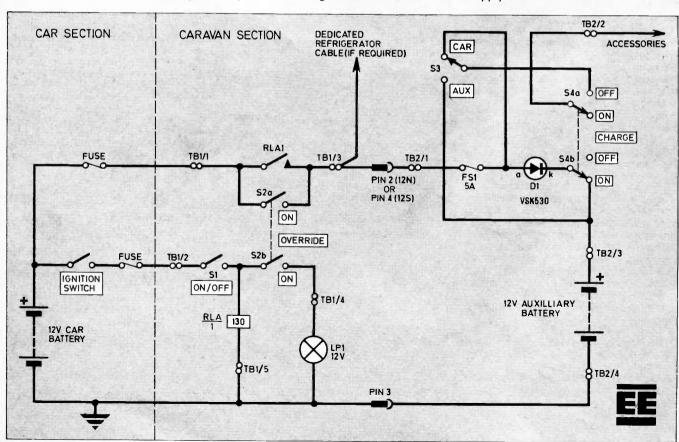
Readers wishing to keep a battery charged on fixed-site holidays would be advised to buy a commercial unit offering mains facilities and to choose a site with mains outlets.

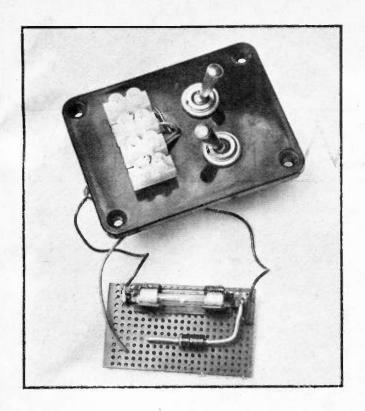
The project described is for a negativeearth car. It is equally suitable for positive-earth systems and the simple modifications required are described later.

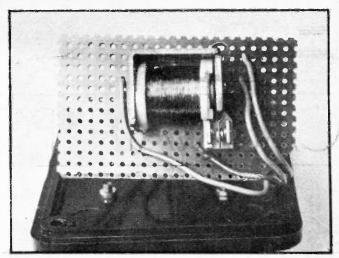
#### RESISTANCE

When driving along there will normally be about 14V available from the car charging system. This will exist at the accessory pin on the drawbar socket. From here, current is directed through existing wiring to the caravan and used to charge the auxiliary battery.

Fig. 1. Complete circuit diagram of the Caravan Power Supply.







Above—The matrix board mounted relay in the car section. The two switches and 5-way terminal block (not shown in this view) are mounted on the lid.

Left—The caravan mounted section of the Power Supply, showing the diode and fuse constructed on a piece of plain matrix board. Switches and terminal block are again assembled on the case lid.

Since the caravan battery is nominally 12V, there will only be about 2V available to drive current through the circuit. For charging at 2A, using Ohm's law, we get:

$$R = \frac{V}{I} = \frac{2}{2} = 1 \text{ ohm}$$

From this it is clear that the resistance of all wiring must be kept low or a poor charge rate is to be expected. If a refrigerator is powered through the accessory cable, there is likely to be an excessive voltage drop due to the high current flowing. It is always much better to supply a refrigerator through a dedicated run of cable. This is difficult where the car is fitted with a single socket (the 12N (Normal) system), because there is no spare connection.

On recent outfits (both cars and caravans manufactured since October 1979) there is a second socket fitted to the drawbar, the 12S (Supplementary) socket. The 12S socket has pin 6 reserved for refrigerators. When a refrigerator is fitted in an older outfit, it would still be wise to fit a 12S socket. This is available from caravan accessory shops.

An alternative to fitting a 12S socket would be to tape a supplementary wire to the 7-core cable and use a weatherproof connector for powering the refrigerator.

#### HOUSING

The Caravan Power Supply is built into two similar plastic boxes, each fitted with two switches. One part is located in the boot of the towing car and the other in a front locker of the caravan adjacent to the auxiliary battery. The circuit diagram of the entire system is shown in Fig. 1.

The car mounted case contains a relay, RLA1. This permits charging of the caravan battery only whilst the ignition of the car is on. This is necessary as there will be no chance of a well-charged car battery draining into a poorly-charged auxiliary battery.

The first switch, S1, switches off the system. This is useful to avoid mechanical wear on the relay during long non-towing periods. The second switch, S2, over-rides the relay for a reason to be explained later. When over-ridden, a warning light illuminates on the dashboard when the ignition is next switched on.

#### CARAVAN SECTION

The caravan section of the project carries a fuse, FS1, and diode D1. The diode directs current to the caravan system and, under no circumstances, the other way. An ordinary p-n junction diode would lead to a voltage drop of up to 1V and a poor rate of charge. Instead, a Schottky barrier diode is used. This is more expensive than the conventional type but gives a more acceptable voltage drop of about 0.2V.

Switch S4 on the caravan section selects either ON CHARGE (when driving along) or OFF CHARGE (when parked). When OFF CHARGE the caravan equipment may be used. S3 is labelled CAR/AUX. This selects the battery from which current is to be drawn. When the car is available there seems no point in draining the auxiliary battery.

To enable the car battery to power accessories it will be necessary to set S2 to OVER-RIDE, hence the purpose of this switch.

#### COMPONENT BOARD

The circuits for each panel are illustrated in Fig. 2 and Fig. 3. The diagrams should make the connections clear. Note that the specified relay is fitted with change-over contacts but only the "energise-to-make" (or normally open) contacts are used. The diode is secured by passing its negative connection through a hole in the panel and bending it. The polarity of the diode is important and the white band shows the cathode.

#### **COMPONENTS**

#### Semiconductors

, D1 VSK530 5A Schottky barrier rectifier



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#### Miscellaneous

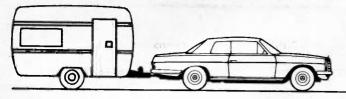
S1,2,3,4 d.p.d.t. toggle (4 off) RLA miniature relay, 12V, 130Ω coil with 30A

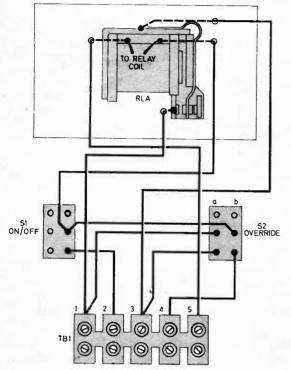
rated contacts LP1 12V, 2·2W panel lamp FS1 5A fuse

0-1 inch plain matrix board, 12 strips by 21 holes (2 off); plastic case, 76 × 56 × 35mm (ABS case type MB1) (2 off); terminal block 6-way (2 off).

Approx. cost
Guidance only

£12





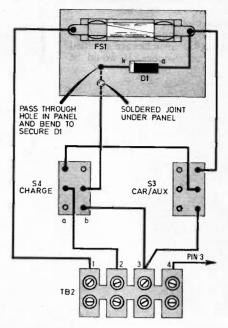


Fig. 2 (left). Diagram showing wiring details of the car section, consisting of a relay RLA1 and switches, S1 and S2.

Fig. 3 (above). Wiring details of switches, S3 and S4 in the caravan section, showing diode and fuse connections.

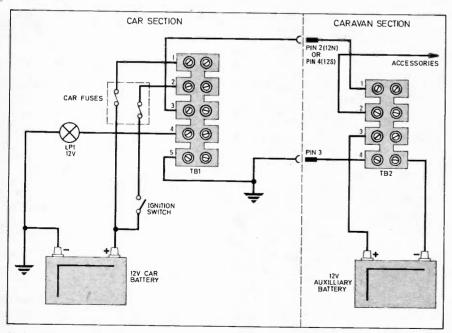


Fig. 4. Interwiring details for the car and caravan sections, note that the connections between the two sections are made via the 7-pin (12N or 12S) socket. See Table 1.

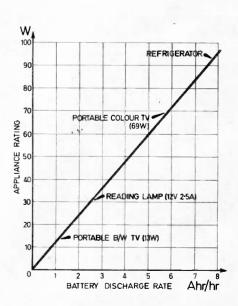


Fig. 5. Graph showing the typical discharge rate for the caravan auxiliary battery, for various electrical appliances.

Solder 100mm long wires to the components as indicated in the diagrams for connection to the terminal blocks. Drill the boxes for the switches and terminal strip fixings. Drill a small hole near each terminal strip to accept the wires from the circuit panels. Attach the switches and terminal blocks. Insert the circuit panels, pass the wires through the holes and wire up the terminal blocks.

For ease of ordering and uniformity of appearance, all four switches are specified as d.p.d.t. toggle switches. It would be possible, although hardly worthwhile, to make a small saving by using simpler switches for S1, S2 and S3. The switches must be of at least 3A rating. Small brackets may be attached to the boxes to enable them to be fitted in position.

#### INTERWIRING

Refer to Fig. 4 for wiring details. Choose a convenient place in the rear for the car section. This should be close to the existing wiring to the 7-pin drawbar socket. Remember that access is required

to operate the switches.

Locate the wire which leads to the accessory pin on the drawbar socket. (See Table 1.) Break this wire and extend the free ends using "bullet" connectors. The end leading to the 7-pin socket should be connected to TB1/3 and the other end to TB1/1. Two runs of light-duty auto-type wire should be made to TB1/2 and TB1/4. The former connects to a fuse which is live only when the ignition is switched on and the latter to one terminal of the warning light positioned on the dashboard of the car. The remaining connection, TB1/5 is earthed by being connected to the metal body of the car. The unused terminal of the warning light is

The caravan section may now be wired up. The locker chosen for the box and auxiliary battery should be as close as possible to the inlet connections from the 7-pin plug. These are often located in the locker itself or under the caravan. The wire leading to the accessories should be found, removed from its terminal, and connected to TB2/2.

The free terminal should be connected through a short length of wire to TB2/1. TB2/3 and TB2/4 are respectively the positive and negative connection for the auxiliary battery. TB2/4 is earthed by connecting it to the wire which leads to pin 3 on the 7-pin plug. Proper connectors should be used for the auxiliary battery, do not rely on crocodile clips or other make-shift methods. (Note previous comment about refrigerators.) On no account may one be powered through the caravan section of the unit.

#### POSITIVE EARTH

For positive-earth cars, reverse the connections to the diode and the auxiliary battery.

#### **TESTING**

Note that all tests must be made with the caravan stationary as the law does

#### TABLE 1 7-Pin Socket Connections

Pin No	12N (Normal)	12S (Supplementary)
1	Left indicator	Reversing light and catch if fitted
2	Foglight (accessories if no 12S fitted)	Battery charging
3	Earth	Earth
4	Right indicator	Accessories
5	Right sidelights and number plate	Warning lights
6	Stop lights	Refrigerator
7	Left-hand sidelights/ number plate	Spare

Looking at sockets from the plug side, pins are numbered clockwise with No. 1 at the top. Pin 7 is in the centre.

not permit riding in a caravan. Satisfactory testing can only be carried out using a 0-5A ammeter. First switch off all accessories and disconnect the wire from the positive terminal of the auxiliary battery. Connect the positive terminal of the meter to the free wire and the negative terminal to the battery terminal. Now set the switches in the following way:

#### Car Section:

S1 (on-off switch)	ON
S2 (over-ride switch)	OFF

#### Caravan Section:

S3 (CAR/AUX switch)	TO EITHER
	POSITION
S4 (CHARGE switch)	ON

The ammeter should give no reading. Switch the ignition on but do not start the engine yet. A click may be heard as the relay operates and a small reading may be observed on the ammeter. Run the engine at a fast idle. The ammeter should indicate a current depending on the state of charge of the auxiliary battery. It may be expected to be 2A or so and higher for a very poorly charged battery.

Now check the circuit in the discharge mode. Remove the ammeter and reconnect the battery wire. Set the switches as follows and switch a caravan light on:

ar Section:	
S1 (ON-OFF switch)	ON
S2 (over-ripe switch)	ON

#### Caravan Section:

S3 (CAR/AUX switch)	AUX
S4 (CHARGE switch)	OF

Assuming the auxiliary battery is charged, then the caravan light should be on. Now set the CAR/AUX switch to CAR. The caravan light should stay on. This time it receives current from the car battery. Remember that the relay must be over-ridden, using S2, before the car battery can supply current. Test by switching S2 OFF—the interior light should now go off. Test the warning light by setting the OVER-RIDE switch to ON with the ignition on.

#### AUXILIARY BATTERY

Any 12V car battery will serve for the auxiliary supply. It is always wise to choose a battery of the same size and having the same fittings as the car battery. It may then be used as a spare battery in an emergency. Budget batteries are quite suitable and will have a long life since the auxiliary supply is only intended for light-duty use. Even a battery from a breaker's yard may be satisfactory but reject one if it shows signs of neglect or if it has been left in a discharged state for a long time.

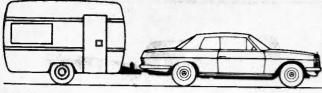
During long periods of non-use the battery should be charged periodically to keep it in good condition. Alternatively it may be exchanged with the car battery from time to time. Always keep the terminals clean and tight and remember to charge it fully before setting out on

holiday.

#### SWITCH FUNCTIONS

- S1 To cancel the system for the winter months. When on, the relay operates each time the ignition is switched on whether towing or not. This is not harmful but causes unnecessary mechanical wear.
- S2 To over-ride the relay. This is only needed when parked and the car battery is required to power caravan accessories.
- \$3 CAR/AUX-with \$4 OFF set \$3 to AUX to operate equipment from the caravan supply. Set to CAR (with S2 ON) to operate equipment from car battery.
- S4 CHARGE switch. Set to ON when driving along to keep auxiliary battery charged. Set to OFF when parked. When S4 is ON, S3 may be set in either position.

The warning light comes on if S2 is left at OVER-RIDE and the ignition is switched on. It would be bad practice to leave it this way.



# CARAVAN FRIDGE ALARM

BY T.R. de Vaux-Balbirnie

A REFRIGERATOR is regarded as an essential piece of caravanning equipment and can certainly simplify a holiday. Tent campers are also seeing the benefit of a well-stocked fridge. Unfortunately, refrigerators are prone to failure for the simplest reasons, a gas bottle running out or a poor electrical connection and this causes great inconvenience unless discovered in time.

This project is an alarm which will provide early warning of fridge failure. It gives a signal by means of either a lamp or a buzzer. The audible signal is useful when at a fixed site. The visible signal is more appropriate when towing.

In this case, the unit is placed in the front window of the caravan and the lamp observed through a car rear-view mirror. It would be a simple matter to construct the project for buzzer-only warning if preferred.

#### PLASTIC BOX

The project appears as a small plastic box with two switches mounted on top. The first is simply an on-off switch. The second is used to select either lamp or buzzer warning. A terminal block is used to connect the unit to the sensor on the fridge.

The box contains its own battery. One reason for this is because the most common cause of failure while towing is failure of the electrical supply. The alarm would also fail to work if it received current from the same source as the fridge.

Although the internal 9V battery is small, excellent service may be expected even where the unit is switched on continuously for long periods. This is because the standby current requirement of the circuit is extremely low, about 15 microamps. When the alarm is actually operating the current rises to about 15mA (buzzer) or 60mA (lamp).

The Caravan Fridge Alarm was designed for use with absorption fridges of the type used in caravans and for camping. It may be used with certain compressor fridges of the household type but readers would need to make their own tests to find out if this is possible.

#### **OPERATION**

Previous designs have relied on the rise in temperature inside the fridge when it

fails. Unfortunately, there may be difficulty inserting the sensor into the cabinet without disturbing the thermal insulation. This project, by contrast, works by sensing the fall in temperature of an easily-accessible part behind the fridge.

A small boiler is an essential component of an absorption fridge. This is maintained at a high temperature by means of either a gas flame or an electric heater. The sensor is applied close to this and if the electric or gas supply fails then the boiler will cool and the alarm trigger. An adjustment on the circuit panels allows this to happen at a suitable preset temperature.

Although nearly fool-proof, this method of detecting failure is not quite so. If the refrigerant itself were to fail then the boiler would stay hot but the fridge would not work. Circumstances like this are thought very unlikely.

#### CIRCUIT DESCRIPTION

The circuit for the Caravan Fridge Alarm is shown in Fig. 1. The sensor detecting the fall in temperature is a suitably protected bead thermistor, RTH1. VR1, R1, RTH1 and R2 form a potential divider across the battery. When the unit is switched on at S2, a small current will flow continuously. This is too low to cause serious battery drain on account of the very high resistance involved.

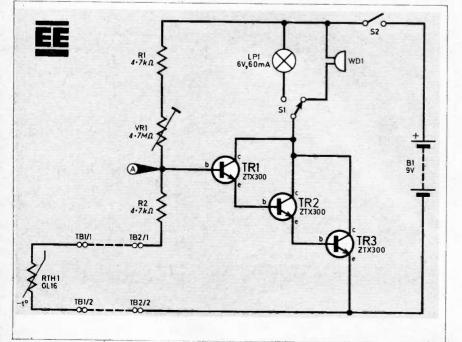
When RTH1 is hot and the refrigerator operating normally, its resistance will be comparatively low and the voltage at point A less than the 0.7V needed to turn on TR1. When RTH1 cools, its resistance rises and the voltage at point A will rise above 0.7V so TR1, TR2 and TR3 will turn on.

These three transistors are connected in a very high gain arrangement called a "Darlington triple". The base current entering TR1 in order to operate the alarm at the end of the chain is exceptionally low. This leads to a very sharp response. The two-way switch, S1, allows current to flow to either the lamp, LP1, or the buzzer, WD1.

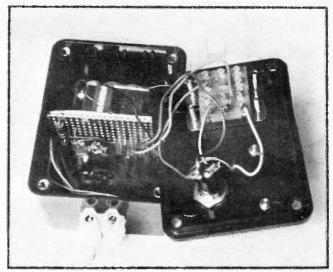
Switches S1 and S2 are specified as d.p.d.t. types since these are readily available. It would be possible to use a s.p.d.t. for S1 and a s.p.s.t. for S2 with a slight saving in cost.

VR1 is the adjustment whereby the alarm operates at a preset temperature within its range.

Fig. 1. Main circuit diagram of the Caravan Fridge Alarm.







(Above). Prototype with the lid removed showing the internal layout and use of moulded guides to mount the circuit board.

(Left). The completed prototype Caravan Fridge Alarm showing the case mounted components.

#### **COMPONENT BOARD**

The circuit panel is constructed on a piece of 0·1 inch matrix stripboard 12 strips by 21 holes in size. Refer to Fig. 2 and solder all components into position. Any breaks in the stripboard should be made prior to inserting components. Check carefully that no solder bridges have been left between adjacent copper tracks. End by soldering connecting leads to Veropins as shown in Fig. 2.

#### COMPONENTS

#### Resistors

R1,2  $4.7k\Omega$  (2 off)

#### **Semiconductors**

TR1,2,3 ZTX300 npn silicon (3 off)

#### Miscellaneous

 $\begin{array}{ll} \text{S1,2} & \text{d.p.d.t. slide (2 off)} \\ \text{VR1} & 4 \cdot 7 \, \text{M} \Omega \text{ horizontal} \\ \text{skeleton preset} \end{array}$ 

RTH1 GL16 glass bead thermistor

B1 9V PP3 WD1 6V buzzer

LP1 6V, 60mA indicating lamp

0-1 inch matrix stripboard, 12 strips by 21 holes; plastic case, 76 × 35mm (ABS case type MB1); terminal block 2-way (2 off); metal spring clip.

Approx. cost Guidance only £9.00

#### **TESTING**

A test may now be made on the circuit panel before fitting it into its case. Set VR1 to about mid-position and connect the thermistor as shown in Fig. 2. Connect the 6V bulb and then connect up the battery terminals. The lamp will probably light.

With the help of an assistant, warm RTH1 by holding a lighted match 50mm below it for a few seconds. The lamp should go off and re-light when the thermistor cools. If this does not happen then some adjustment to VR1 is required. The final setting for VR1 can only be found at the end when the sensor is in position on the fridge.

#### **CASE**

Prepare the case by drilling holes for the switches, lampholder, the buzzer and terminal block fixings. A suitable layout is shown in the photograph. Drill a small hole next to the terminal block position for the wires which will pass through from the component panel. Drill a similar hole for the buzzer wires to pass through. Attach all remaining components and complete the wiring (Fig. 3).

#### SENSOR

It is essential to use a thermistor of the same type as specified in the components list. Suggested positions for the sensor are shown in the photographs, these cover the

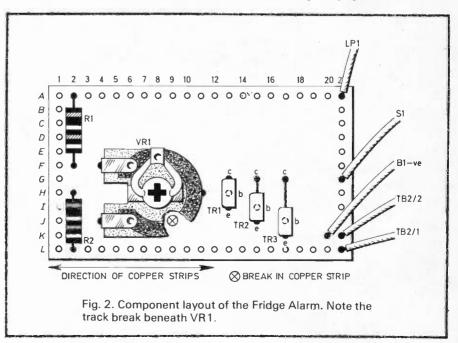
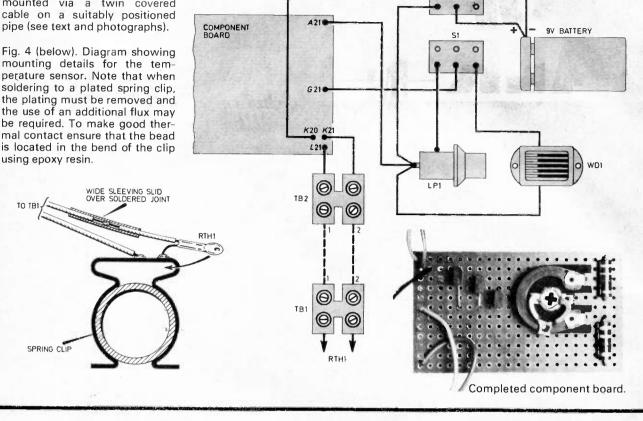


Fig. 3 (right). Diagram showing offboard wiring details. Note that TB1 and RTH1 are remotely mounted via a twin covered cable on a suitably positioned pipe (see text and photographs).

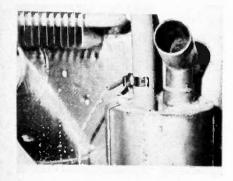
Fig. 4 (below). Diagram showing mounting details for the temperature sensor. Note that when soldering to a plated spring clip, the plating must be removed and the use of an additional flux may be required. To make good thermal contact ensure that the bead is located in the bend of the clip



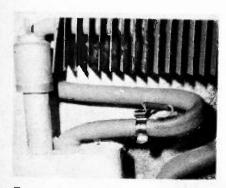
S2

0

0



Temperature sensor shown mounted on the Electrolux Fridge.



Temperature sensor shown mounted on the Camping Gaz Fridge.

Electrolux and Camping Gaz type refrigerators. Readers with other fridges should have no difficulty finding a suitable place.

The chosen position must feel very hot when the unit is at full operating temperature but warm enough to hold comfortably by hand about 15 minutes after switching off. On no account may the sensor be placed where it could disturb thermal insulation or interfere with the combustion of gas (inside the flue, for example).

The thermistor is very delicate and some protection is required. The method tried with the prototype is shown in Fig. 4. Alternatively, the thermistor may be secured to a small piece of thin sheet copper and this wired into position. Whatever method is used, it is essential that the sensor makes good thermal contact with the refrigerator.

Make sure that the thermistor leads cannot short circuit or the project will not work. The two thermistor leads are extended to reach TB1 which is attached to a convenient mounting point behind the fridge. Make certain that the wires are kept clear of all hot parts.

#### SETTING UP

Link TB1 at the refrigerator to TB2 at the unit using light-duty twin stranded wire. Run the fridge to operating temperature. Switch the unit on at S2 and set S1 to LAMP. If the lamp comes on, adjust VR1 until it goes off. Allow the fridge to cool down. If the lamp comes on, readjust VR1 to keep it off. When the sensor feels just warm rather than hot, adjust VR1 so that the lamp is just on.

Check that the system works with the buzzer as well as the lamp. If the alarm operates continuously, suspect a break in the wire between the sensor and the unit. Note that it is normal for the warning, whether by lamp or buzzer, to begin gradually rather than suddenly.

When in position, the battery could cause short circuits to the copper strips of the circuit panel. To prevent this, place a piece of cardboard between the battery and panel. Use a little foam plastic to prevent the battery from moving around inside the case.

It is most important to allow for as large a drop in temperature as convenient to trigger the alarm. If this precaution is not observed the standby current consumption of the circuit will be higher than need be and the life of the battery reduced.

If a multimeter is available then this current may be checked with the sensor at full operating temperature. It should be about 15-20 microamps. When doing this, it is essential not to allow the alarm to operate since the increased current would damage the meter.

# SHOP TALL BY DAVE BARRINGTON

#### Catalogues

We have received just two catalogues this month. The first is the lavishly printed 48-page "Instruments for Testing and Design" from Global Specialties Corporation.

This catalogue covers digital logic probes and meters to function generators and a new oscilloscope multiplexer. The new 8-channel scope multiplexer, type 8001, extends the versatility of any single or dual channel scope by permitting viewing and comparison of eight channel analog or digital display.

For the constructor, there is a range of solderless breadboarding systems.

Copies of the "Instruments for Testing and Design" catalogue may be obtained from: Global Specialties Corporation, Dept EE, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ.

For the Sinclair ZX81 and Spectrum home computer users, **Redditch Electronics** have just re-issued their accessories pamphlet.

This 16-page pamphlet lists such items as a add-on keyboard, input/out-put port boards and a music board. Also listed are a range of multi-pin connectors and a small range of books and tapes covering programming and using ZX81 and Spectrum machines.

Copies of the Redditch ZX81 and Spectrum Accessories pamphlet may be obtained from: Redditch Electronics, Dept EE, 21 Ferney Hill Avenue, Redditch, Worcs, B97 4RU.

#### Self-Service Multimeter

The latest addition to the range of multimeters and component test equipment stocked by **Alcon Instruments** is the Miselco T50 Super Multimeter. It has an input sensitivity of  $50k\Omega/V$ , large mirrored scale, switched ranges (39 in all) to measure resistance, d.c. and a.c. voltages and current, dB range and is fully protected against overload.

The p.c.b. and meter movement are factory calibrated such that any board will match any movement and maintain calibration. In this way the user is relieved of the worries of any repair or re-calibration problems.

The overall accuracy of the T50 Super is 2.5 per cent on all d.c. ranges and 3 per cent on a.c. The  $16\mu A$  100 degree movement incorporates an anti-parallax mirror.

The T50 SUPER Multimeter, housed in a two-tone brown plastics case, costs £52.35 plus VAT, without batteries. Included with the meter are a set of test probes/leads, instructions, circuit diagram and spare fuse.

Further information of the complete range of test meters may be obtained from: Alcon Instruments Ltd., Dept EE, 19 Mulberry Walk, London SW3 6DZ.



#### CONSTRUCTIONAL PROJECTS

Caravan Power Supply & Fridge Alarm

The heavy duty relay used in the Caravan Power Supply should be rated at least 3A contacts. The type used in the author's model was a 12V d.c. 3OA automobile type. This is stocked by Maplin and listed as: YX99H (12V 3OA Relay).

The 5A Schottky barrier diode D1, type VSK 530, should be ordered through a RS Components supplier. This carries the RS code 262-466.

The thermistor GL16 used in the Caravan Fridge Alarm is sometimes listed as G16 and TH-B11 types. These devices have a resistance of 1MO at 20°C.

The wiring for both models should be rated at approximately 5A.

#### Combination Lock

The only source for the lock release mechanism for the Combination Lock we have been able to locate is: Altype Security Systems, Dept EE, 310 High Street, Watford, Herts. This is known as type 203 and costs £11 (including postage) plus VAT. If any readers know of a similar device we would be pleased to hear from them.

We do not envisage any component purchasing problems for the *Transistor Tester* or the *Envelope Shaper for Bass Guitar*.

#### Eprom Programmer

The Eprom Programmer p.c.b. has been designed to accept the PO609 (and C0609) transformer from Ambit. The top board (8306-03) has been laid-out to accept the Erg D16A4-2 d.i.l. switches; these are stocked by RS Components (337-510). The z.i.f. socket is manufactured by Wimslow and is also stocked by RS (402-232). RS Components only supply to account customers and not to the general public. You will have to order through your local electrical/electronic dealer. Verospeed supply the "webbed" ribbon cable (226-22549H).

### EE PRINTED CIRCUIT BOARD SERVICE

The printed circuit boards (drilled and roller tinned) for the Eprom Programmer may be obtained from Everyday Electronics: 8306-01 (TRS-80 version) £6.95; 8306-02 (Genie version) £6.95; 8306-03 £1.50. All prices include VAT and postage and packing. Remittances should be sent to Everyday Electronics PCB Service, Everyday Electronics PCB Service, Everyday Electronics, Editorial Offices, King's Reach Tower, Stamford Street, London SE1 9LS. Cheques should be crossed and made payable to IPC Magazines Ltd.

#### Printed Circuit Master Copies

For those constructors who wish to make their own Eprom Programmer p.c.b.s, photostat copies of the printed circuit masters may be obtained by sending a stamped SAE (A4 size) to the address above.

#### **EVERYDAY ELECTRONICS SOFTWARE SERVICE**

The EE Software Service provides an easy and reliable means of program entry for our computer-based projects. All programs have been tested by us and consist of two good quality copies of the working program on cassette tape. Certain program listings are also available.

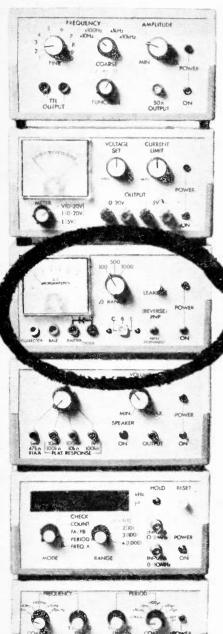
All prices include VAT, postage and packing. Remittances should be sent to Everyday Electronics Software Service, Editorial Offices, King's Reach Tower, Stamford Street, London SE1 9LS. Cheques should be crossed and made payable to IPC Magazines Ltd.

PROJECT TITLE	CASSETTE	CASSETTE	LISTING	LISTING
	CODE	COST	CODE	COST
ZX81 SPEED COMPUTING SYSTEM (Feb 83) REAL-TIME CLOCK (Apple) (May 83) REAL-TIME CLOCK (BBC) (May 83) EPROM PROGRAMMER (TRS-80 & GENIE) (June 83)*	T001 T002 T003	£2.95 £2.95 £2.95 £3.95	L001 L002 L003	£2.95 £2.95 £2.95

Includes Command List with examples.

#### THE TEST GEAR 83 SERIES CONSISTS OF:

# DUAL POWER SUPPLY FUNCTION GENERATOR TRANSISTOR TESTER PULSE GENERATOR LABORATORY AMPLIFIER FREQUENCY METER



THE ADVENT of solderless breadboard systems has made it possible to re-use electronic components many times. The circuit can be breadboarded and the final version is built with the same components.

It is inevitable, however, that some transistors may be destroyed by incorrect connections or a design error. So some form of quickly testing transistors (and diodes) is desirable to ensure that the final circuit functions as the prototype did.

#### **SPECIFICATIONS**

A second reason for making a Transistor Tester a useful piece of laboratory equipment is to check the specification of a particular device against that given in the transistor data book.

The current gain  $(h_{fe})$  of a transistor is usually given as a typical value or specified as being between an upper and a lower limit. As this parameter is one of the most important design considerations, an accurate reading is desirable.

Bargain packs are a useful source of cheap transistors and the Transistor Tester will sort them into good/bad, npn/pnp and identify the leads of unknown types.

#### TRANSISTOR PRINCIPLES

Transistors have two major roles in electronic circuits; as switches (digital applications) and amplifiers (analogue electronics). In both of these spheres, the transistor is a current controlled and current controlling device. The voltages in

a circuit are determined by resistors using the Ohms law relationship.

The most frequently used connection for a transistor is the common emitter configuration, and it is this method of connection that is used by the Transistor Tester. (See Fig. 1a and 1b.)

The collector current  $(I_C)$  of the transistor is given by:

$$I_{\rm C} = h_{\rm FE} \times I_{\rm B}$$

where  $I_{\rm B}$  is the base current and  $h_{\rm FE}$  is the large signal (or static) current gain. In order to distinguish between the large signal current gain and the small signal (or dynamic) current gain, the former uses capital letters for the "FE" suffix on the notation.

The small signal current gain,  $h_{fe}$  (note the use of lower-case letters for "fe"), is given by:

 $h_{\text{fe}} = \frac{\text{change in collector current}}{\text{change in base current}}$ 

 $h_{\rm fe} = \frac{\delta i_{\rm c}}{\delta i_{\rm b}} (\delta \text{ meaning "change in"})$ 

As this is a ratio of two currents, it has no units. It is sometimes known as the forward current transfer ratio. Note also the use of lower-case letters indicating that  $i_c$  and  $i_b$  are small signal values.

#### CHARACTERISTIC CURVES

The transistor characteristics can be plotted graphically as shown in Fig. 2. If the base current  $(I_B)$  is fixed and the collector-emitter voltage  $(V_{CE})$  is varied, the collector current  $(I_C)$  can be measured

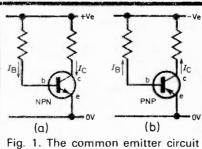
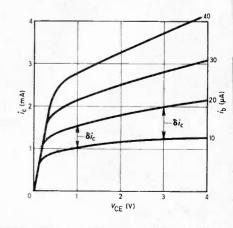


Fig. 1. The common emitter circuit configuration for (a) an *npn* transistor and (b) a *pnp* transistor.

Fig. 2 (right). The common emitter characteristic curves for a typical npn transistor. Note that the change in  $i_c$  increases as  $V_{\text{CE}}$  increases for the same change in  $i_{\text{b}}$ .



#### **SPECIFICATIONS**

Functions: measures the current gain (hee) of npn and pnp transistors. Tests

diodes. Determines leakage current.

Gain ranges: 0-100

0-500 0-1000

Conditions:  $V_{CE} = 3.5V$ 

 $I_{\rm b} = 100 \mu A, 20 \mu A,$ 

10μA respectively

Leakage:

0-100uA

Power:

9V PP6 battery

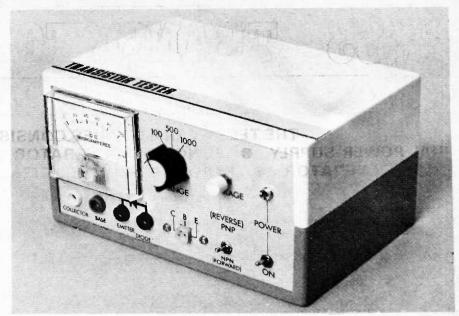
and plotted as in the diagram. This is done for a number of values of IB to produce a series of curves.

It can be seen that the change in IC compared with the change in  $I_{\rm B}$  varies slightly as  $V_{\rm CE}$  increases. Therefore the gain is not constant throughout and this implies that  $h_{FE}$  is not equal to  $h_{fe}$  (as  $h_{FE}$ is constant).

However, for most purposes, this difference is too small to be of any consequence and in most applications they can be assumed to be equal. The Transistor Tester measures gain by fixing the base current and measuring the collector current.

#### CIRCUIT DESCRIPTION

Unlike all other units in the Test Gear 83 series, the Transistor Tester is battery powered since the current consumption is low and its use intermittent.



The Test Gear 83 Transistor Tester unit.

The actual current consumption is about 5mA with no transistor connected and rises to around 15mA dependent upon the gain of the transistor under test.

The use of an l.e.d. continually on to indicate power would be wasteful as the current consumption of the l.e.d. would be greater than that of the Tester!

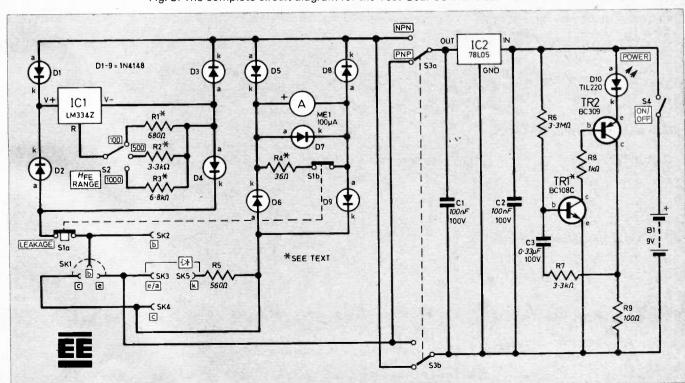
Therefore, a small relaxation oscillator built around TR1 and TR2 pulses the l.e.d. about 90 times a minute thus reducing the average consumption to 0.9mA. This was found to be particularly effective in indicating that the unit was on.

The constructor may replace the battery with a mains power supply unit in which case the flasher circuit would not be required. For this modification, it is recommended that R9 is increased to 820 ohms and TR1, TR2, R6, R7, R8 and C3 are omitted. The collector and emitter pads of TR2 will need to be linked if the original p.c.b. layout is retained.

#### REGULATOR

The voltage regulator, IC2, provides a current limited supply of 5V. The low

Fig. 3. The complete circuit diagram for the Test Gear 83 Transistor Tester.



voltage will prevent damage to the transistor under test if the polarity switch (NPN/PNP) is incorrectly set. The current being limited to 100mA will protect the meter in the event of a short circuited transistor being placed in the test socket.

The capacitors C1 and C2 ensure the high frequency stability of the supply.

The polarity of the transistor under test is set by S3. This simply reverses the polarity of the power supply. In order to keep this switching arrangement uncomplicated, two bridge rectifiers are employed. The first, D1 to D4, ensures that the constant current generator (IC1) is always connected to the correct polarity power supply.

The second bridge, D5, D7, D8 and D9, avoids the necessity of having to switch the polarity of the meter, ME1.

Resistors R1, R2 and R3 are used to set the base current  $(I_B)$  of the transistor under test. R4 is a meter shunt resistor to set the meter sensitivity to 10mA fullscale deflection.

For the purposes of measuring leakage current, the base current is removed and the shunt resistor (R4) open circuited to return the meter sensitivity to 100µA f.s.d. This is done by depressing switch S2.

Note that most silicon transistors, including power types, should register very little leakage current and anything over 10μA should be regarded with suspicion. Germanium transistors will have a slightly higher leakage current.

#### CIRCUIT OPTIONS

Depending on the degree of accuracy the constructor requires, there are two options for the values of resistors R1 to R4. Should the high accuracy be chosen, then a fixed value resistor is used in series with a preset (in parallel with a preset in the case of R4). The values are shown in Table 1.

TABLE 1							
		High accuracy	Low accuracy				
	T1	$620\Omega$ in series with $100\Omega$ preset.	680Ω ±2%				
	R2	$3k\Omega$ in series with $470\Omega$ preset.	3⋅3kΩ ±2%				
	R3	$6 \cdot 2k\Omega$ in series with $1k\Omega$ preset.	6⋅8kΩ ±2%				
	R4	$39\Omega$ in parallel with $1\text{k}\Omega$ preset.	36Ω ±2%				

Provision is made on the p.c.b. layout for the presets. If however, an accuracy of around 10 per cent (worst case) is sufficient, then the fixed value resistors also listed in Table 1 can be used without the presets. Three links will be required on the p.c.b.

If the high accuracy version is selected, then a digital multimeter with a 200µA range will be needed to calibrate the base current.

#### COMPONENTS TO

#### Resistors

#### (High accuracy version)

R1	$620\Omega$
R2	$3k\Omega$
R3	6-2kΩ
R4	$39\Omega$
All met	al film +2%

VR1	$100\Omega$ miniature
	horizontal prese
VR2	470Ω miniature

470Ω miniature

horizontal preset

horizontal preset VR3 1kΩ miniature horizontal preset VR4 1kO miniature

#### (Low accuracy version)

6800 R2  $3.3k\Omega$ R3 6.8kΩ  $36\Omega$ All metal film ±2%

(All versi	ons)
R5	$560\Omega$
R6	3.3MΩ
R7	3⋅3kΩ
R8	1kΩ
R9	100Ω
All cark	on film +5%

#### Capacitors

C1,2 100nF, 100V Siemens type polyester (2 off) 0.33 µF, 100V Siemens type polyester

#### Semiconductors

D1-9	1N4148 silicon (9 off)
D10	TIL220 0.2in red l.e.d.
TR1	BC108C npn silicon
TR2	BC309B pnp silicon
101	LM2247 adjustable ourre

adjustable current source IC2 78L05 5V, 100mA regulator

#### Miscellaneous

S1	d.p.d.t. non-latching push button	

1-pole, 12-way midget rotary (with stop set at 3-ways)

S3 d.p.d.t. miniature toggle **S4** s.p.s.t. miniature toggle SK1 TO5 pin circle transistor socket

SK2-5 4mm banana socket (4 off) colours to suit

MF1 100μA f.s.d. panel meter with 1.4k $\Omega$  coil (type ML52)

B1 9V PP6 battery

Verocase type 202-21036C; single-sided p.c.b. 155 x 57mm; battery clip; chrome l.e.d. mounting bezel; control knob; 7/0-2mm wire; Veropins.

#### CIRCUIT BOARD

A single p.c.b. is used, and it is designed to be attached to the terminals on the back of the panel meter. If a different meter is used, the spacing of the mounting holes may need to be modified. It is wise to check this before etching the p.c.b.

Alternatively, the p.c.b. assembly can be mounted on the base of the Verocase.

The layout and full-size track artwork are given in Fig. 4. Solder all components to the board in the normal order, taking all usual precautions with the polarity of the diodes and the orientation of the semiconductors. Veropins should always be used for the flying leads.

If the preset resistors are not used, the wire links drawn as dotted lines on Fig. 4 must be fitted adjacent to R1, R2 and R3. Note that R4 does not require a link to be fitted in place of the preset as this is in parallel with R4.

#### FRONT PANEL

The front panel is drilled to suit the controls and meter as shown in Fig. 5. The large hole for the meter can be made by drilling a series of small holes and cutting out the connecting pieces. The rough edge is then finished with a halfround file.

The dimensions of this cut-out and all mounting holes should ideally be checked against the actual components to be used as some variation does occur between different manufacturers.

The transistor socket, SK1 (T05 pin circle), is first mounted onto a piece of plastic or p.c.b. material and then fixed to the front panel from the reverse side with two screws.

Constructors may wish to fit other types of transistor sockets but in practice, the T05 type is suitable for most popular transistors.

The four 4mm sockets are for use in testing diodes and larger transistors via flying leads.

The wiring is carried out with a flexible 7/0.2mm equipment wire and the recommended length for each is about 150mm.

# TRANSISTOR TESTER

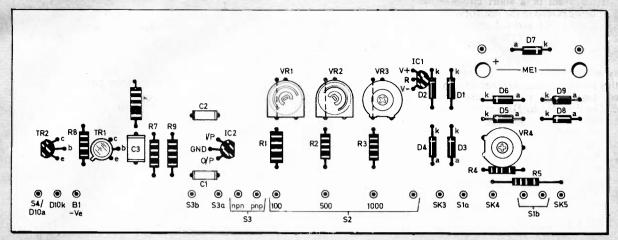
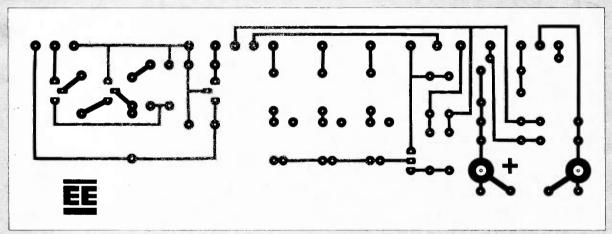
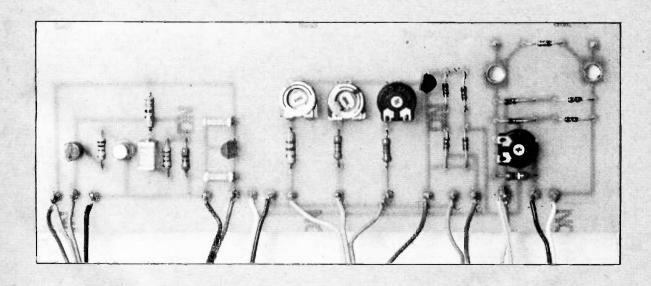


Fig. 4. Full-size p.c.b. artwork and component layout. Note that the three wire links shown as dotted lines below VR1, VR2 and VR3 are only required if the low accuracy version is built and the presets are omitted. No link is required in place of VR4. The board is mounted directly onto the meter terminals and it is advisable to check the pitch of these terminals before etching and drilling.





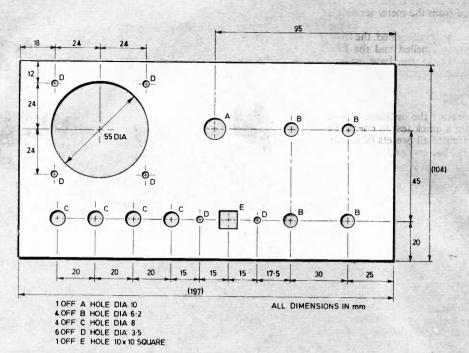


Fig. 5. Front panel drilling details. Note that the meter cut-out may vary for different panel meters.

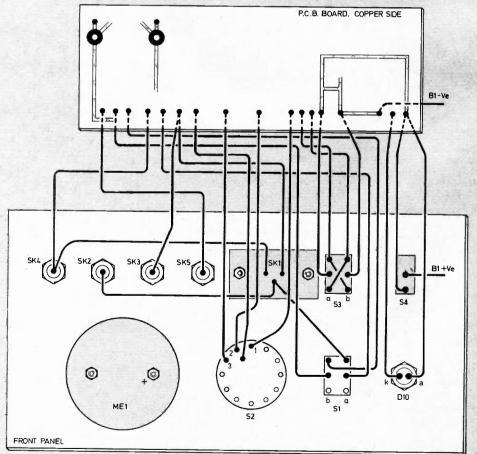


Fig. 6. Interwiring diagram with the p.c.b. shown from the trackside and folded down. All connections to the board are made on the component side.

The wiring diagram in Fig. 6 shows all interconnections but note that the p.c.b. is shown removed from the meter terminals

Finally, the case is assembled, the front panel controls are labelled and the PP6 battery is secured to the base with a double-sided adhesive tab.

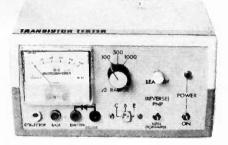
#### CALIBRATION

Before calibrating the instrument, it is advisable to run a quick test to check the basic circuit. Centre all presets (if fitted), connect the 9V battery and switch on. The l.e.d. should flash about 90 times a minute (three times in two seconds).

The voltage across C1 should be 5V. If so, a transistor of known polarity can be inserted into the test socket and the polarity switch set to the correct position. The meter should register a reading indicating that the circuit is functioning.

To set the base current, a digital microammeter is connected between the base and emitter sockets on the Transistor Tester, the positive lead to the base socket with the polarity switch set to NPN.

The RANGE switch is set to the first position, labelled 100 on the front panel, and the preset resistor in series with R1



Front view of the prototype model showing the control labelling. Note that the meter full-scale deflection reading depends upon the position of the Range switch.

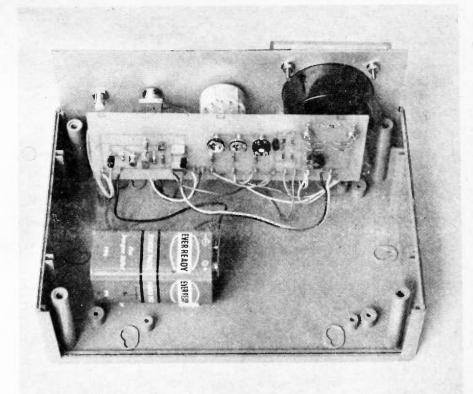
(marked VR1 on Fig. 4) is adjusted to read 100µA on the microammeter.

The RANGE switch is then set to the second position, labelled 500 on the front panel, and the preset in series with R2 (marked VR2 on Fig. 4) is adjusted to read 20uA on the microammeter.

With the RANGE switch in the third position, labelled 1000 on the front panel, the preset in series with R3 (marked VR3 on Fig. 4) is adjusted to read 10µA on the microammeter.

The fourth and final calibration is to set the full-scale deflection of the panel meter, ME1, to 10mA by adjusting the shunt resistor, R4. A one kilohm potentiometer is required and this is connected in series with a digital milliammeter between the collector and emitter sockets of the Tester. The positive probe to the collector with the polarity switch in the NPN position.

Adjust the one kilohm potentiometer for a reading of 10mA on the milliammeter and then adjust the preset in



The front panel assembly viewed from the rear with the top and back panel removed. The battery is secured with double-sided adhesive foam tabs.

parallel with R4 (marked VR4 on Fig. 4) until the panel meter, MEI, reads fullscale deflection. Calibration is complete.

Using the Transistor Tester to measure the gain of a transistor is fairly straightforward. The device is inserted into the test socket and the polarity switch set to the correct setting (if known).

The meter will give a reading of static gain  $(h_{FE})$ . According to the position of the range switch, S2, the meter reading is multiplied by 1 (for the 100 setting), 5 (for 500) and 10 (for 1000).

The leakage current of a transistor is measured by depressing the LEAKAGE switch, S1, and the meter will give a reading in microamps (uA).

Diodes are connected as indicated on the front panel, that is anode (a) to the diode socket and cathode (k) to the emitter socket, and a meter reading should register with the polarity switch in the NPN (FOWARD) position. The reading is unimportant, it just shows that a current is flowing.

When the polarity switch is changed to the PNP (REVERSE) position, all current flow should cease, indicated by no move-



ment of the panel meter. Any other result indicates a faulty diode.

To ascertain the reverse biased leakage current of a diode, the LEAKAGE switch, S1, is depressed and the meter will give a reading in microamps (µA).

#### PROGRAM CONDITIONER

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# BOOK REVIEWS

### TOWERS' INTERNATIONAL DIGITAL I.C. SELECTOR

Author

Price

T. D. Towers, MBE, MA, BSc,

C.Eng, MIERE £9.95 limp edition

Size 248 × 174mm. 256 pages Publisher W. Foulsham & Co Ltd

ISBN 0-572-01179-2

FOR THOSE readers unfamiliar with Towers' previous semiconductor guides, including Transistors, Linear i.c.s and Microprocessors, they are comprehensive and painstakingly researched data tables listing all currently available type numbers. The Digital Integrated Circuit Selector is no different and gives electrical and mechanical data on over 13,000 American, European, British and Japanese devices.

The data is listed under type numbers in alphanumerical order and gives details on logic family (CMOS, TTL and so on), application, description, packaging, some important specifications and a suitable substitute (should one exist). Perhaps the most useful information for day-to-day use is the pin-out diagrams for the

dual-in-line versions of all the digital i.c.s listed.

As digital electronics is becoming increasingly important with the advent of the cheap microprocessor, a guide of this nature is invaluable to the hobbyist, teacher, engineer and buyer alike and in many cases will invalidate the need for numerous manufacturers' data books.

G.P.H.

#### **ELECTRONICS POCKET BOOK**

Author E. A. Parr, BSc, C.Eng, MIEE f6.40 limp edition

Price £6.40 limp edition
Size 185 × 120mm. 350 pages
Publisher Butterworth & Co Ltd

0-408-00481-9

NOT A NEW book as the first edition was published twenty years ago, but still as useful today. Now in its fourth edition, the completely new Electronics Pocket Book has been fully updated and now includes sections on digital techniques, computers, opto-devices and all the usual branches of electronic design.

For the student and hobbyist, this handy reference work is an ideal source of readily available, and perhaps more importantly understandable, information.

G.P.H.

#### **HOW TO USE OP-AMPS**

Author E. A. Parr, BSc, C.Eng, MIEE

Price £2.25 limp edition

Size 175 × 110mm. 154 pages

Publisher Bernard Babani Ltd

1SBN 0-85934-063-5

ONE PART of my technical education that was sadly lacking was that of the use of the op-amp. These eight-legged little creatures had always eluded me so it was a pleasant surprise to find this book most readable and obviously written by a man who has a great deal of respect for what is probably the most versatile i.c. available to the engineer.

The text starts with first principles and continues in as nonmathematical fashion as is possible to explain design techniques using op-amps in applications as diversified as audio circuits and

industrial control.

As an op-amp i.c. can now be purchased for little more than the price of a simple transistor and yet still give high gain and predictable performance, an understanding of their function is essential for cost-effective design.

G.P.H.

# NTELLIGENCE

BY PAUL YOUNG

#### **Changing Times**

A short while ago, I read about an American, he was driving over the Hudson when he noticed that his watch had stopped. He opened his window, tossed it into the river and took a new one out of the glove pocket. In the USA electronic watches can be purchased for about three dollars, at that price it is not even worthwhile changing the battery!

I recently made a purchase which makes me think we may have already reached that stage in this country. My wife's watch stopped and our local horologist having closed down, I decided to buy her a digital one to tide her over. I bought her a dainty wristwatch, quartz controlled with the time and date functions. It was elegant to look at had a stainless steel bracelet and a twelve month's guarantee. All fairly routine, but the price, believe it or not was £2.95 including VAT!

This set me thinking. If you take off the VAT and assume that it must have passed through at least one pair of hands before it reaches the shop, what does the actual manufacturer receive for it, and equally important, what is the worker who assembles it paid?

The Government of the day is always urging manufacturers to be more competitive, but how do they compete with that? Robots? Yes, possibly, but there is one big drawback to replacing your workforce with Robots. Robots don't have wage packets, and taken to its ultimate conclusion, the manufacturer finishes up with no customers.

#### **Fascinating Gift**

I believe it was Einstein who came up with the theory, "That when sitting on a red hot stove, a few seconds would seem like half an hour, and conversely, when sitting next to a beautiful girl, half an hour would seem like a few seconds". Naturally whimsical Young wants to know how the time would compare between sitting next to a beautiful stove and sitting on a hot girl?

While pondering on these profound theories, I came up with one which is equally true, and which in the fullness of time you will be able to test out for yourself. It is this, as you get older, you will find that time passes more quickly. When you reach the status of senior citizen you will find it is whizzing by.

All of which brings me to a case in point. Earlier in the year I had been sent an amusing Christmas story by my brother, which I fully intended to pass on to you. Before I could sort it out and type it, we have arrived at the June issue. Here is his story, later than planned but blame it on Anno Domini (see above).

"Are children starting earlier these days? I am old enough to remember when little girls (that is under 10 years old) asked Father Christmas for things like dolls and prams. Apparently all that is changing. My boss's daughter just five years old and already getting to grips with computer programming decided she would like an electronic construction kit for Christmas.

We found a kit comprising of 150 different projects with a well produced 200-page construction manual. At £12 it was excellent value, but the real point was this.

On getting the kit home, my boss who is a top flight electronic and computer boffin, decided to try out some of the experiments (after the children were packed off to bed). He admitted next day, that he found making up the circuits with discrete components, so fascinating that he was up 'till the small hours experimenting, I gather that the kit has proved so successful it has actually stopped young Hannah from chattering for hours on end. Almost a miracle I understand."

Well I don't know if any moral can be drawn, but at least it is a useful tip to Mums and Dads as to what to buy their children—of either sex.

# Do you think that designing and understanding electronic circuits is beyond you?

The summer edition of Electronics Digest, Gateway To Circuit Design, provides a step-by-step introduction for the newcomer to the art of circuit design. Firstly, you'll be introduced to the commoner electronic components — but not in a passive way. Electronics is a practical subject, so Gateway To Circuit Design will enable you to build simple circuits for yourself, and take measurements on them (along the way learning how to use a multimeter). Once these introductions are over, Gateway To Circuit Design shows you what goes into the design of a wide range of electronic equipment — for audio, computing and electronic music, for instance.

Gateway To Electronics is an occasional popular series in Electronics Digest, published by Argus Specialist Publications. Previous issues in the series have concentrated on projects; now we'd like you to design your own!

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# ENVELOPE SHAPER for BASS GUITAR

#### BY A. NIEMIRO

THE Envelope Shaper is not the most common of guitar effect pedals, but nonetheless produces a distinctive and useful sound. Operating by varying the tone of the instrument in sympathy with the signal level, the shaper produces a sound reminiscent of a "Wah-Wah" unit, but does away with the need for a mechanical pedal, so leaving the musician free to concentrate on playing his instrument.

The prototype was designed specifically for use with electric bass guitar which, when used with the shaper, gives a colourful and prominent sound especially appropriate in Soul and Funk music. However, the addition of a range switch increases the versatility considerably and allows the unit to be used equally well with lead and rhythm guitar and electric piano.

The unit is built into a small case and foot-operated so that the musician may switch the effect in and out whilst playing.

#### FILTER DESIGN

The actual sound effect is obtained by feeding the instrument signal through a bandpass or resonant filter. Such filters give a frequency response as shown in Fig. 1.

It was decided to achieve this response by employing a multiple feedback circuit; the basic form of which is shown in Fig. 2. If  $R_{\rm IN}$  is much greater than  $R_{\rm A}$  then the centre or resonant frequency of the filter is given by:

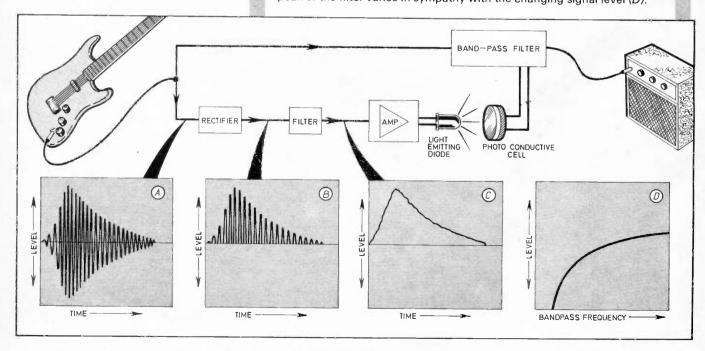
$$f_{\rm o} = \frac{1}{2\pi \times C \times \sqrt{R_{\rm A} \times R_{\rm B}}}$$

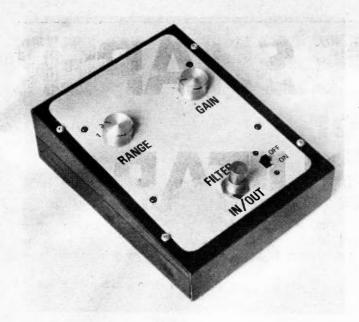
#### **HOW IT WORKS**

The input signal from an electric musical instrument is split up and fed through two separate paths in the Envelope Shaper.

The control signal passes through an active rectifier which converts the a.c. input signal (A) into a chopped d.c. signal as shown in B. This is then smoothed and filtered by a resistor-capacitor network which removes the high-frequency components to give a d.c. voltage that is the envelope or "outline" of the original signal (C). This voltage is then amplified to a suitable level to drive an l.e.d. The brightness of this l.e.d. is, therefore, dependent only upon the amplitude of the input signal.

The input signal also passes through a band-pass filter. This section only allows through a narrow band of frequencies close to the filter's resonant frequency which is determined by the resistance of the photocell. Since the photocell is placed opposite the l.e.d. the resonant peak of the filter varies in sympathy with the changing signal level (D).





The completed sound effects pedal showing the layout of the front panel.

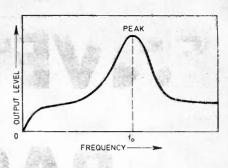
Fig. 2 (below). Diagram showing basic multiple feed-

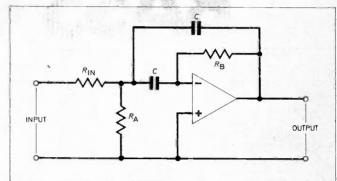
Fig. 1. Frequency

response of a reso-

nant filter.

back circuit.





Therefore, by varying  $R_A$ , the centre frequency can be swept across the audio spectrum. In the final design, RA is replaced by a light dependent resistor illuminated by an l.e.d. placed next to it.

Since  $f_0$  is also inversely proportional to C we can alter the frequency range swept by allowing different values of capacitance to be switched in. This not only changes the frequency but also affects the sharpness or Q (magnification factor) of the peak, thus allowing a greater variety of sounds to be produced.

#### CIRCUIT DESCRIPTION

The complete circuit diagram of the Envelope Shaper is given in Fig. 3. From the d.c. blocking capacitor C1, the signal

IC1a gives some gain and also performs a half-wave rectification. Placing the rectifying elements D1 and D2, in the feedback path of IC1a allows rectification of very small signals well below the diode's normal forward voltage of 600mV.

Capacitor C2 is charged via R3 to the instantaneous peak negative voltage at the input and this is amplified by IC1b. VR1 controls the unit's sensitivity by varying the gain of IC1b.

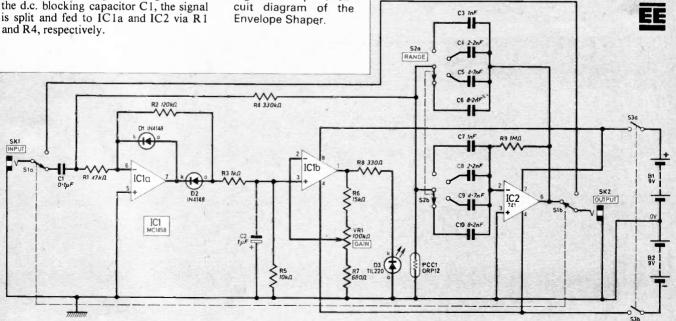
The l.e.d. D3 is driven from the output of IC1b via current-limiting resistor R8.

Fig. 3. Complete cir-

It is seen that the brightness of this l.e.d. varies with the envelope of the input.

The input signal is also taken, by R4, to IC2. The band-pass filter is built around IC2 which is wired in a multiple feedback configuration. Light dependent resistor PCC1 determines the filter's resonant frequency and is arranged so that it is only illuminated by the light from D3.

Switch S2 selects the value of capacitance in the feedback path of IC2 and thus alters the frequency range swept.



# ENVELOPE SHAPER BASS GUITAR

#### **COMPONENTS**

#### Resistors

R1  $47k\Omega$ R2  $120k\Omega$ R3  $1k\Omega$ R4  $330k\Omega$ R5  $10k\Omega$ R6 15k0 R7  $680\Omega$ R8  $330\Omega$ R9  $1M\Omega$ All 1W carbon ±5%

#### Capacitors

 $\begin{array}{lll} C1 & 0\cdot1\mu F \ polyester \\ C2 & 1\mu F \ polyester \\ C3,7 & 1nF \ polycarbonate (2 \ off) \\ C4,8 & 2\cdot2nF \ polycarbonate (2 \ off) \\ 4\cdot7nF \ polycarbonate (2 \ off) \\ C6,10 & 8\cdot2nF \ polycarbonate (2 \ off) \\ \end{array}$ 

#### Semiconductors

D1,2 1N4148 silicon (2 off) D3 TIL220 0 2in red I.e.d. IC1 MC1458 dual op-amp IC2 741 op-amp

#### Miscellaneous

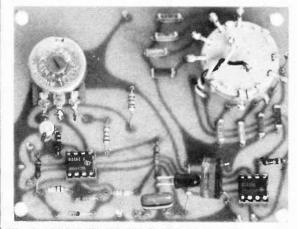
VR1 100kΩ lin carbon potentiometer
PCC1 ORP12 light dependent resistor
S1 d.p.d.t. foot switch
S2 2-pole, 6-way rotary
d.p.d.t. miniature slide

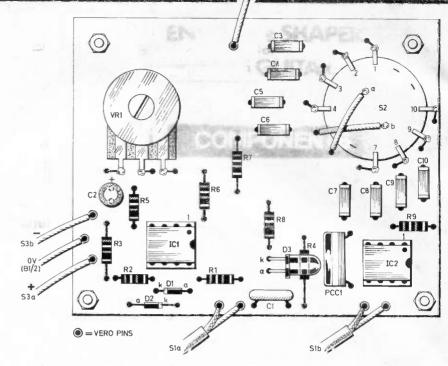
d.p.d.t. miniature slide SK1,2 0-25in mono jack (2 off) B1,2 9V PP3 (2 off) Single-sided printed circuit board,

 $95 \times 78$ mm; aluminium case  $150 \times 120 \times 50$ mm; 6BA fixings; 8-pin d.i.l. socket (2 off); rubber feet.

Approx. cost Guidance only

£10.00





SKI/SK2

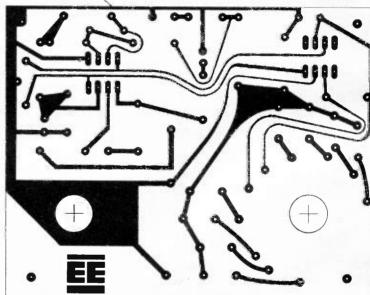
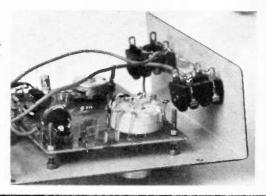


Fig. 4. Component layout and full size printed circuit board master for the Envelope Shaper.

(Left). Picture showing the components mounted on the printed circuit board.

(Right). Wiring details of front panel mounted components.



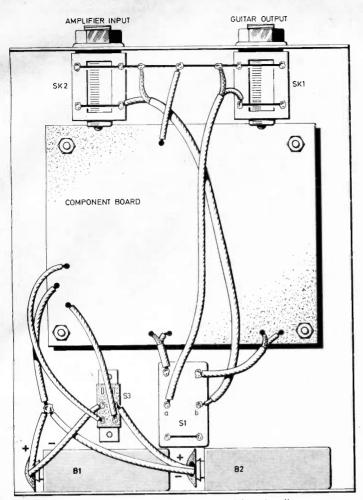
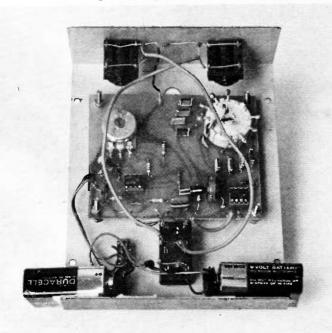


Fig. 5. Complete offboard interwiring details.

Picture showing the wiring details inside the case.



# 

#### CASE

The selection of a case to house the Envelope Shaper is largely a matter of personal choice, but a metal case is preferable as this will prevent excessive hum pickup. Any case which measures about 150 × 120 × 50mm should be suitable. Whatever housing is selected it must be completely light-proof or the circuit will not function properly.

#### COMPONENT BOARD

Construction is quite straightforward as most of the components are mounted directly on the printed circuit board. Etch and drill this in the normal way and then use the board as a template to mark out the mounting and control holes in the case (see accompanying photographs).

Next, solder the components to the board, paying particular attention to the orientation of the diodes, i.c.s, and electrolytic capacitor. VR1 and S2 should be mounted last as shown in Fig. 4. Note that D3 and PCC1 are mounted so that the l.e.d. shines directly on the sensitive

face of the photoresistor.

Remember also, that the use of i.c. sockets lessens the risk of damaging the devices through overheating during soldering. The use of Veropins is recommended for connection to the p.c.b. since they ensure a reliable contact. Crop the leads on the back (solder side) of the p.c.b. as short as possible to prevent them shorting out to the case.

Finally, mount the switches and jack sockets in the case and finish the wiring between them as shown in Fig. 5. Note that the screened lead used for these interconnections need only be earthed at one end. The batteries should now be clipped in place and the case assembled leaving

the unit ready for use.

#### "IN USE

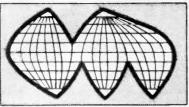
In operation, best results are obtained with the guitar bass, treble, and volume controls, all set at maximum. The range switch setting should be chosen by experimentation; noting that each range requires a different sensitivity. The optimum sensitivity is found by turning the control clockwise from minimum until the most pleasing effect is achieved.

Note that at some settings it will be necessary to turn down the guitar volume

when the effect is switched out.

Since the quiescent and peak currents are quite high it is recommended that high-power batteries are used and the unit is always switched off when not in use. Alternatively, any mains power pack supplying between  $\pm 7V$  and  $\pm 15V$  may be substituted.

# RADIO WORLD



#### BY PAT HAWKER G3VA

#### **Short-Wave Broadcasting**

For more than 50 years, most major countries have broadcast radio programmes on short-waves (h.f.) originally directed at expatriate audiences but more recently in the hope of influencing foreign citizens, either by crude propaganda or more subtly by presenting a favourable view of the local way-of-life. Such operations are not cheap—the British Government's "Grant-in-aid" to the BBC is heading towards £80 million per annum. The USSR not only spends money on external broadcasting but also incurs the expense of its large network of "jamming" stations.

There is little doubt that some of the overseas m.f. relays serve large audiences, and that in some parts; of the world listeners still depend on h.f. But in countries such as the UK the number of listeners who seriously listen to programmes on h.f. (excluding the DX enthusiasts who seek to log rare or distant transmitters) must be very small indeed.

It is sometimes said the h.f. broadcasting is really "governments speaking to governments". One notes that the BBC is currently seeking £13-million to add some new satellite "ears" to its Government-paid-for listening post at Caversham Park near Reading.

I recall industry's efforts to interest British listeners in "all-wave" sets back in the 1930s. Even today, from time to time, one reads of new receiver designs that will bring a boom in short-wave listening. But it never happens.

There are a number of reasons why listening to h.f. broadcasting continues to be a tiny, minority taste. Receivers that are easy to tune to a given frequency are available, but inevitably cost a lot more than medium and long-wave sets.

But the main deterrent is never likely to be overcome: the need for the listener to have access to a large amount of data on transmission schedules and frequencies and to understand the many variables that determine whether a given station will be heard at a given time in a given month on a given frequency. The h.f. broadcasters, including the BBC, do their best to advise listeners, through publications or programmes such as the World Service "Waveguide", which replaced the longrunning "World Radio Club" a couple of years ago.

It is usually only the DX enthusiast, or those interested in amateur radio as a hobby, who are prepared to absorb all the information needed to achieve consistent reception of a daily or weekly programme. This is assuming that they have a set that can be tuned to a given frequency, and they know the frequency they want.

The logical answer to world broadcasting

is not h.f. but space satellites in the form of Direct Satellite Broadcasting (DBS), though so far all attempts to establish DBS radio services on 26MHz or on microwaves during the past 15 years have floundered. The multi-channel digital sound systems to be used with television DBS are not a solution, as these will have "footprints" too limited for true intercontinental world coverage.

So it looks as though vast amounts of money will continue to be spent to broadcast, with limited success, on the 3-9, 6, 7, 9-5, 11-8, 15-3, 17-8 and 21-5MHz bands. And listeners will still need an up-to-date copy of *World Radio TV Handbook* to make sense of it all!

#### Teletext 10

With some one-million television sets containing teletext decoders installed in British homes, the Oracle and Ceefax services are now accepted as useful and well-established additions to television broadcasting.

It is surprising, even to those of us who were involved with the system in its early, experimental and "struggling" days, to recall that it is now over ten years since the

#### Sporting Ploy?

The use of two-way radio communications for sporting events is becoming ever more sophisticated and devious. This Year's British challenger for the America's Cup yachting event is even adopting military techniques to reduce the chances of giving away useful information to its American rivals.

The 12-metre yacht "Victory 83" and possibly other British entries will carry Racal-Tacticom's Clansman-type military equipment rather than standard marine equipment. Clansman is a frequency-synthesised system that can operate on virtually any frequency, and radio operators with military experience will be aboard.

However, they do not disclose whether high-speed "burst" data transmissions will be used to further confound eavesdroppers, nor whether the equipment will be authorised to use non-standard marine frequencies! But the Royal Burnham Yacht Club's "Victory Syndicate" are convinced that last summer their transmissions were constantly monitored by their rivals, who succeeded in obtaining vital performance intelligence.

first transmissions were made during broadcast hours, with "live" computer editing. These were based on the original Oracle system, and went out from the IBA's Crystal Palace transmitter to one or two prototype receivers!

The system, like the original Ceefax system, was indeed crude when compared to what became in 1974 the unified British teletext standard with its much higher data rate and far greater number of "pages". It was not until the beginning of 1977 that the first decoders reached the market in the form of a Labgear adaptor costing almost £400.

Teletext was basically what is called an engineer-led rather than a market-led development and it proved difficult for several years to interest the public in this new form of broadcasting cum information technology. Yet recent BREMA figures show that deliveries of teletext sets during 1982 reached 571,000 compared with 213,000 in 1981, about 80,000 in 1980, about 28,000 in 1979 and just 7,000 in 1978—an impressive growth rate for a British developed technology.

But, the most impressive industry figures are still those for video recorders, over 2-2 million deliveries in 1982 and 1 million in 1981. More videos sold or rented in the UK than even in the USA.

#### **Technology For Change**

The progress of telecommunications from its earliest days of the pre-Morse electric telegraph, line telegraphy and telephony to the later development of radio communications, broadcasting and television and the latest data transmission and optical fibre systems already spans some 150 years. A new permanent exhibition at the Science Museum in South Kensington, London, opened on March 15, 1983 by Prince Charles, emphasises that this is "a technology for change" and successfully brings together in lively displays an absorbing selection of "historic" components. equipments, publications.

In this case "historic" does not exclude

In this case "historic" does not exclude many items that will be familiar to most readers and some which are likely to recall vivid personal memories. For instance, it even includes a display of current amateur radio and citizens' band transceivers, though my eye was caught more by one of the wartime National HRO communications receivers on which I spent many hours listening and the firm's National One-Ten receiver which was a pioneering superregenerative design with plug-in coils covering 1 to 10 metres (30 to 300MHz), popular in the 1930s with amateurs using the old 56MHz and 112MHz bands.

Substantial financial support for the new gallery has come from STC, a firm which this year marks the centenary of the setting up in London of the first office of Western Electric, the original parent company of STC, in 1883. But this does not imply that many of the exhibits are STC company-oriented—in fact they are drawn from many British and foreign firms.

Any reader of EVERYDAY ELECTRONICS should regard a visit to the new gallery as a must if they live near or visit London. It is by no means "dead" history. There are buttons to press and even a chance to test your Morse-copying ability at speeds from very slow to very fast. And some fascinating photographs of the early days of the telephone with all those thousands of overhead wires converging on the first telephone exchanges.

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Other uses are as a "get you to sleep radio", you could even take it with you to use in the lounge when the rest of the family want to view programmes in which you are not interested. You can listen to some music instead.

Interested. You can listen to some music instead. Some of the features are: long wave band 115 – 270 KHz, medium wave band 525 – 1650KHz, FM band 87 – 108MHz, mono, stereo switch, AFC switch, luning meter to give you spot on stereo tuning, optional LED wave band indicator, fully assembled and fully aligned. Full wiring up data showing you how to connect to amplifier or head-phones and details of suitable FM aerial (note ferrite rod aerial is included for medium and long wave bands. All made up on very compact board. made up on very compact board.

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Things you can make include Multi range meter, Low ohns tester, A.C. amps meter, Alarm clock, Soldering iron minder, Two way telephone, Memory jogger, Live line tester, Continuity checker, etc. etc., and you will still have hundreds of parts for future projects, Our 10Kg parcel contains not less than 1,000 items - panel meters, timers, thermal trips, relays, switches, motors, drills, taps, and dies, tools, thermostats, coils, condensers, resistors, neons, earphone/microphones, nicad charger, power unit, multi-turn pots and data on the 50 projects.

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#### J. BULL (Electrical) Ltd.

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MAIL ORDER TERMS: Cash, P.O. or cheque with order. Orders under MALL UNDER LIEMAS: Lash, F.O. or cneduce with order, urders under £10 add 60p service charge. Monthly account orders accepted from schools and public companies. Access & B/card orders accepted day on night. Haywards Heath (0444) 454563, Bulk orders: write for quote. Delivery by return. Shop open 9.00 — 5.30, mon to Fri, not Saturday

#### 3 CHANNEL SOUND TO LIGHT

Now supplied with fully prepared You'll have it going in an evening.



Complete kit of parts for a three channel sound to light uni Complete kit of parts for a three channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an attractive two tone metal case and has controls for each channel, and a master on/off. The audio input and output are by W's ockets and three panel mounting fuse holders provide thyristor protection. A four pin plug and socket facilitate ease of connecting lamps, Special price is £14.95 in kit form or £25.00 assembled and tested. Case & metal Chassis No. Fully punched and prepared

#### **EXTRACTOR FANS**

Mains operated - ex-computer

- Mains operated ex-compt Woods extractor " £5.75, Post £1.25 6" £6.95, Post £1.25 5" Plannair extractor £6.50, Post £1.25, 4"x 4" Muffin 115v, £4.50, Post 75p, 4"x 4" Muffin 230v, £5.75, Post 75p,
- 10" American made £11.50, post £2.00. 12 volt 6%" extractor £6.90, post £1.50.



#### MILLIONS OF HOMES WILL BE BURGLED

Don't let yours be one of them. Install our burgar alarm. Install our burglar alarm. Complete kit includes 6" external alarm bell mains power unit control box with key switch. 10 window/doc switches. 100 yards of wire. With instructions £29.50.

#### COMPUTER DESK

Size approx 4"x 2"x 2"6" high. These were made for hard work, the top being formica covered. Suitable for housing instruments or for use as office desks. Beautifully made, these cost over £100 each, our price only £11.50 each, however, you must arrange to collect.



MINI MONO AMP on p.c.b., size 4"x 2" approx. Fitted volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amplifier. Brand new, perfect condition, offered at the very low price of £1.15 each, or 10 for £10.00.



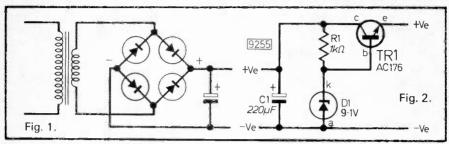
#### OTHER ROBERT AR DRO IECTS

OTHER POPULAR PROJECTS	
3 Channel sound to Light - with fully prepared metal case £14	4.95
Ditto - made up £2	5.00
Big Ear, listen through walls	9.50
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	3.99
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	6.75
	4.80
Mug Stop — emits piercing squark €	2.50
Morse Trainer - complete with key £	2.99
Drill control kit	3.95
Drill control kit made up	6.95
Interrupted beam Kit , £	2.50
Transmitter Surveillance Kit £	2.30
Radio Mike £	6.90
FM receiver kit — for surveillance or normal FM transmissions	3.50
	3.00
	4.00
	6.50
	7.95
	6.90
	2.95
Mixer Pre-amp — disco special with case £1	6.00
Aerial Rotator mains operated £2	9.50
Aerial direction indicator	5.50
40 watt amp $-$ hi-fi $-$ 20hz $-$ 20KHz $$ £	9.50
Microvolt multiplier – measure very low currents with ordinary multitester	3.95
Pure Sine Wave Generator £	5.75
Linear Power output meter	1.50
115 Watt Amplifier 5hz - 25KHz £1:	3.50
Power Supply for one or two 115 watt amps £1	7,50
Stereo Bass Booster, most items	8.95

# CIRCUIT

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.

#### STABILISER FOR USE WITH LOW COST BATTERY ELIMINATORS



Mains 9V battery eliminators are on sale for use with a wide range of electronic equipment. Although these devices are described as "9 volts" they are unstabilised usually consisting of simply a mains transformer, rectifiers and

electrolytic smoothing capacitor as shown in Fig. 1. With a simple circuit such as this the voltage varies with current drawn, at low currents the voltage can rise to 12 volts.

The circuit described and shown in

Fig. 2 can be used between the power supply and a 9V circuit. It was designed for use with circuits normally powered by a PP3 size battery. The transistor AC176 is a low cost germanium *npn* type (a BFY51 could be substituted).

If working with experimental circuits a 100 ohm resistor should be connected between the output of the stabiliser and the circuit to limit the current in the event of a short circuit. The stabiliser is suitable for low current only.

R. Soar, Denaby Main, Doncaster, Yorkshire.

RECORDER **CONVERTING A** MULTIMETER **MULTIMETER TO** FROM LSI OR RECORDING D1VR1 SOURCE A 'VU' METER 10kΩ INTERNAL 1NA148 MONITOR 4.7µF 63V SPEAKER

STRENGTH METER

THE circuit to be described can be used for comparing the strength of different persons; or rather as a "strength meter". Two hand grips (metallic rods) are held in the contestant's hands. As he squeezes the hand grips the l.e.d.s light up in sequence. The strength of the contestant is measured by the maximum number of l.e.d.s he can light up this way.

The hand grips are made of brass or aluminium tubes; 10cm long and 2cm diameter.

VR1 is adjusted with the hand grips gently placed in the contestant's hands until D1 is just "off". The strength at which each l.e.d. is lit up can be individually controlled using VR2, VR3, VR4 and VR5. These preset potentiometers should be adjusted so that D1 is

N more expensive audio devices, there may be a VU meter included in the unit. This can be very useful for recording to tell whether there is any overload.

In most portable, mono cassette recorders there is no such meter and as a simple alternative you can use your multimeter, set at the  $100\mu A$  (d.c.) range for recording. The diagram shows how it is set up, using just one diode, capacitor and potentiometer. The latter is adjusted to give f.s.d. at just below distortion.

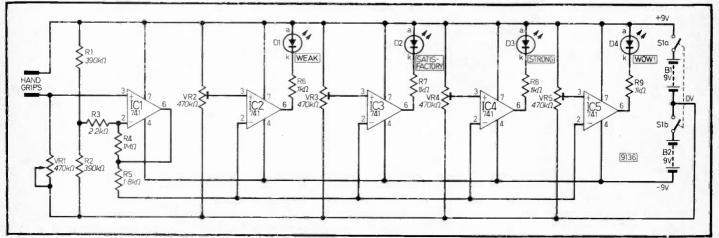
Alex Clark, Lichfield, Staffs.

the first to light and D4 the last.

. 1

The circuit connections for IC2 through to IC5 are similar and more stages can be added in a similar manner. Although the i.c.s are marked 741 in the circuit, IC2, IC3, IC4 and IC5 can be replaced by a quad-op-amp i.c.

J. Sreekumar, Cochin, India.



# PRODUGIS

#### VHS RE-RECORD TABS

With the increasing sales of video cassettes Bib Audio/Video Products have developed re-record tabs for use on VHS cassettes.

Some readers may not be aware that each video cassette has a safety tab, positioned at the rear of the cassette, which can be snapped out to avoid further recordings being made. This is a useful facility, particularly when precious recordings might be lent to friends, who may inadvertently erase the recording.



The Bib re-record tab enables further recordings to be made by taking up the space where the original tab was positioned. The new tab is re-usable and is removed by the use of a small screwdriver, or similar instrument.

The tabs are supplied in packs of 20, with fitting details printed on the pack. The recommended retail price of the Bib VHS Cassette Re-Record Tabs is £1.47, including VAT.

Bib Audio/Video Products Ltd., Dept EE, Kelsey House, Wood Lane End, Hemel Hempstead, Herts HP2 4RQ.

#### **PACKAGE DEAL**

NEW pack is being manufactured by Cartados Packaging, which has been specially designed to give protection to a wide range of electronic components during transit.

The pack consists of a white corrugated-board hinged carton, with profile foam on the inside of the lid and base. When the lid is closed and fastened into position, the foam sandwiches and holds the component firmly and accommodates all shapes and sizes of components.

This makes the cartons ideal for use as postal packs.

For more details and prices contact:

Cartados Packaging Ltd., Dept EE, King's Lane, Englefield Green, Surrey TW20 0TZ.

#### AUTORANGING CAPACITANCE METER

A HAND-HELD autoranging capacitance meter which features a degree of precision, range and flexibility normally associated with benchtop instruments, is now being marketed by Global Specialties.

The new meter, type Model 3002, which incorporates a  $3\frac{1}{2}$ -digit liquid-crystal display and measures only 193  $\times$  95  $\times$  44mm, provides direct readings of capacitance from 1pF to 19,990 $\mu$ F. Eight automatically selected ranges remove the need for manual switching, and a dual-threshold measuring technique ensures a claimed accuracy within 0-2 per cent ( $\pm$  one count) from 1pF to 199 $\mu$ F and 1 per cent ( $\pm$  one count) between 200 $\mu$ F and 19.99 $\mu$ F.

The dual-threshold measurement technique is claimed to eliminate reading errors caused by dielectric absorption, and the use of d.c. charging characteristics to determine true capacitance means that the instrument can be used for measurements on cables, switches and other components as well as on capacitors.

The Model 3002 operates from six AA nickel-cadmium or

alkaline batteries, and the maximum current consumption of 75mA ensures a long battery life. An optional a.c. adaptor/charger can also be used.

Global Specialties Corporation, Dept EE, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ.



#### **TALKING BOOKS**

THE company that first put speech into learning aids with "Speak and Spell" have just introduced books that talk. Called the Texas "Magic Wand Speaking Reader" the system uses bar codes coupled with speech synthesis microchips to produce an audible commentary.

Aimed at 4 year-olds and upwards, it's a true learning aid, adding excitement to a child's early attempts at reading. It guides the child's reading asking and answering questions prompted by coloured picture books.

As well as a story, books containing puzzles with multiple choice answers, simple spelling tests and early arithmetic are available. Sound effects and simple tunes are also included in the books.

A bar code reader or "wand" is connected to a lightweight

"talking computer" by means of a coiled flexi-cable. The wand is simply scanned across the bar codes and the computer proceeds to tell the story or ask questions.

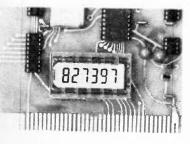
The Texas Instruments "Magic Wand Speaking Reader" is ex-

pected to sell in the UK at around £39.95, books about £7.95 each, and more details can be obtained from:

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



# DIGITAL COUNTER



o meet the need of designers for a counter which can be mounted in a confined space, Eurovector have marketed the Sub-Cub digital counter.

The Sub-Cub comprises a 6-digit (500kHz) l.s.i. counter chip, oscillator, Schmitt trigger and l.c.d. readout in a single dual-in-line type package that can be directly mounted on a printed circuit board. A supply voltage of 2 to 6V d.c. is required to power the unit, with supply current typically 15µA at a counting rate of 10kHz.

The display can be frozen at any time whilst the counter continues accumulating counts or is reset to zero in preparation for a new counting cycle. This allows it to be used as a frequency meter, tachometer and for period and pulse-width measurement.

Two modules are currently available; Sub-Cub I with 5mm

high digits and Sub-Cub II with 9mm digits. An optional bezel kit provides for panel mounting if required.

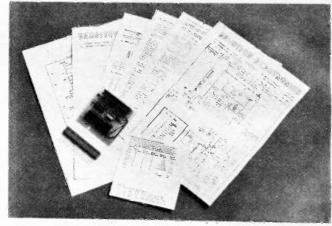
For further information con-

Eurovector Ltd., Dept EE, Wessex House, Silchester Road, Tadley, Basingstoke, RG26 6PX.

#### ZX81 INPUT/OUTPUT PORT BOARD KIT

THE RE98 I/O Port designed and available from **Redditch Electronics** provides bidirectional access for the ZX81 to the outside world. It thus provides a facility for monitoring and control of external equipment under software/keyboard control.

The unit is available in kit form and comes with full step-by-step



assembly instructions, test procedures and software test routines. Ideas for interfacing are also provided, such as using optosolators to receive information, filament lamp and relay driver circuitry and others. We are presently building the unit and

plan to publish a technical report and suggest some application circuit ideas. For further information contact:

> Redditch Electronics, Dept. EE, 21 Fernéy Hill Avenue, Redditch, Worcs. B97 4RU,

# INSTRUMENT CASE

THE range of all metal instrument cases produced by Boss Industrial Mouldings has been increased with the introduction of another size model in their Bim 3000 Series.

Available in two sizes of  $250 \times 167.5 \times 68.5$ mm high and  $250 \times 187.5 \times 78.5$ mm high, they incorporate a rigid matt black stove



enamelled 18 s.w.g. chassis to which red, grey or orange stove

enamelled 14 s.w.g. top and bottom covers are independently attached.

The chassis design includes integral brackets for supporting components, p.c.b.s and other assemblies and can be supplied with special ventilation slots, cutouts and punchings to individual customer requirements.

For more details and prices enquiries should be made to:

Boss Industrial Mouldings Ltd., Dept EE, James Carter Road, Mildenhall, Suffolk IP28 7DE.

#### F227 SMOKE DETECTOR FIRE ALARM

THE F227 Ionisation Smoke Detector Fire Alarm is a highly sensitive instrument designed to sense the visible and invisible combustion of a fire. This type of detector gives the earliest possible warning of a fire, responding to the initial stages of combustion; and thus before visible-smoke or heat detectors. The extra seconds gained can be vital in allowing persons to escape from a developing fire.

The sensor utilises a tiny, harmless amount of radioactive material of  $0.7\mu Ci$  which complies to international standards. The detector is powered by a single 9V alkaline battery which can last for more than a year. When the battery runs low, the detector will emit a bleeping signal to indicate that the battery needs replacing. A test button is provided. Actuation of this button will cause the alarm to sound,

thus checking all electronic circuitry, the sensor, the horn and the battery. A weekly test is recommended by N.F.P.A.

The detector is housed in a circular white plastic case. The cover is hinged and can be easily released, giving access to all parts, also to the keyhole slots provided for the fixing screws. Since heat rises, the aerosol products of combustions are always carried towards the ceiling. The detector should therefore be located on the ceiling as close to the centre of the room or hallway as possible.

Advice concerning the location of one or more smoke detectors in domestic premises is included in the owner's manual supplied with each instrument.

The F227 Smoke Detector Fire Alarm is manufactured by Gamma Electronic PTe. Ltd., Singapore, and is available (UK only) from:

R.T.V.C. Ltd., Dept EE, 21A High Street, Acton, London W3 6NG.

See Bargain Offer to EE readers on page 359 of this issue.



# LETTERS

#### Pen Pal

Sir—I am thirteen years old, I am interested in electronics and computing and I collect electronic valves, and I am looking for a penfriend. My address is:

Shaun Gander, 6 Deiaware Road, Winterbourne, Lewes, Sussex BN7 1LD.

#### Test Gear 83

Sir—I am building all the *Test Gear '83* projects in EVERYDAY ELECTRONICS. Unfortunately I cannot get hold of some of the components for the Power Supply. Please could you tell me where I can get them and how much they will cost?

The components are: KBL02 4A, 200V bridge rectifier (2 off);  $0.47\Omega$ , 3W wirewound resistor (2 off);  $470\Omega$ , 3W wirewound resistor (1 off);  $0.1\mu\text{F}$ , 160V Siemens type capacitor, (3 off; 2-pole, 6-way midget rotary with adjustable stop and the 1mA f.s.d. panel meter with 120 $\Omega$  coil type ML52.

P. Greenfield, Taverham, Norwich.

In reverse order, the ML52 panel meter is available from **Ambit International** for £5.98 and the stock number is 37 00521. They can also supply the midget rotary switch (stock number 53 21025) for 54p and the  $0.1\mu$ F Siemens capacitors (stock number 04 10407) at 13p each. Prices are exclusive of VAT and please add 60p for postage.

Maplin also stock a suitable panel meter, order reference RW94C (2in Pan Meter 1 mA), for £6.45 but this meter will require a slightly different cut-out in the front panel. The Maplin order reference for the switch is FF74R (Rotary Sw6B) at 70p, and the capacitors are ordered as WW41U (Carbonate 0 1μF) for 11p each. They also stock the 3W wirewound resistors as W0.47Ω (W/W Min  $0.47\Omega$ ) and W470Ω (W/W Min  $0.47\Omega$ ) and W470Ω (W/W Min  $0.47\Omega$ ) at 29p each.

These prices are inclusive of VAT and orders over £5 are postage free. Orders under £5 require an additional 50p for postage.

The KBLO2 bridge rectifier has been a little harder to locate. **RS Components** stock a suitable 4A, 200V "in-line" device which is equivalent to the KBLO2 and the stock number is 262–113. However, RS do not sell directly to the public as they only supply to account customers. But most component shops will have an account with RS and can obtain this item on your behalf if you quote the stock number and the price should be in the region of £2 again.

Ambit International are at 200 North Service Road, Brentwood, Essex CM14 4SG (telephone 0277 230909) and Maplin Electronic Supplies Ltd address is P.O. Box 3, Rayleigh, Essex SS6 8LR (telephone 0702 552911).

#### Pin Function Generator

Sir—Your help please! Could you advise me of the pin-out of a 14-pin d.i.l. LM318N (IC3, Function Generator, April 1983).

The major suppliers do not seem to stock the LM318 and although the circuit simply specifies an LM318, I am advised that there is an "H" and "N" version.

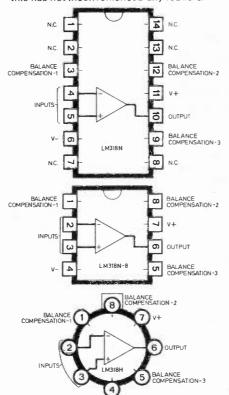
I was told that the N version was the correct one, but when supplied, turns out to be a 14-pin d.i.i. I have searched literally hundreds of other circuits and magazines but cannot find a single design that uses an LM318 (98 per cent use the 741) and suppliers seem reluctant to answer such queries by telephone, hence the request.

Please note that Fig. 6 (calibration scale) is also missing from the article. I still hope to finish this unit and eventually the future units in the *Test Gear 83* series.

R. S. Bareham, Tunbridge Wells, Kent.

Dealing with your last point first, Fig. 6, the calibration scale, was omitted from the text due to a lack of space and unfortunately the reference to it was left in. However, from the photographs showing the front of the Function Generator unit it can be seen that the scale runs from 1 to 10 around the travel of the potentiometer in an almost linear fashion.

It is not truly linear as the points are closer together at the beginning and end of the scale than they are in the middle but as it was not deemed to be important to achieve very accurate calibration, an estimation based on the photographs of the prototype model will be sufficient. We hope this has not inconvenienced any readers.



As far as the LM318 goes, it is available in many versions. The LM318N is the 14-pin d.i.l. plastic packaged type (a "J" in place of the "N" indicates that it is a 14-pin ceramic pack) and the LM318H is an 8-pin

TO5 metal can. The 8-pin d.i.l. variant is denoted the **LM318N-8** (again, a J signifies ceramic package). This suffix "8" was inadvertently omitted from the components' list

The pin-out diagrams given below show the pin functions of the three basic package types. Note that if pins 1, 2, 7, 8, 13 and 14 are ignored on the 14-pin version, the relative positions of all functions are identical to those on the 8-pin d.i.l. type.

It can also be seen that the pin numbers for both the 8-pin d.i.l. device and the 8-pin metal can are identical so that the LM318H could be preformed to the d.i.l. format to fit the p.c.b. layout.

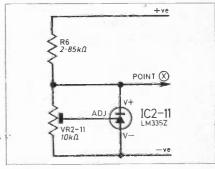
#### Greenhouse Monitor

Sir—The article on the *Beehive Temperature Meter* (February' 83) prompted me to make up the project and adapt it to monitor my greenhouse, frames, compost heap and solar heater. The *Shop Talk* feature suggested Maplin for the parts, but the Digitron meter (ME1) is not in their catalogue and nor can I find a local (Glasgow) supplier.

I made up the project on a breadboard and have got it working in the meantime with a digital multimeter in place of ME1. I had some bother as the millivolt readings were too high and I found the current through the LM335Z temperature sensor also too high until I altered the circuit more in line with the drawing given in the Maplin catalogue. This meant putting a 2.85 kilohm resistor between the positive supply rail and the positive terminal of the LM335Z. The schematic diagram (see also Fig. 2, page 83) of this modification is shown below.

If you can get me the address of the manufacturer of the Digitron meter I should be most grateful. I have taken your paper now for some five years.

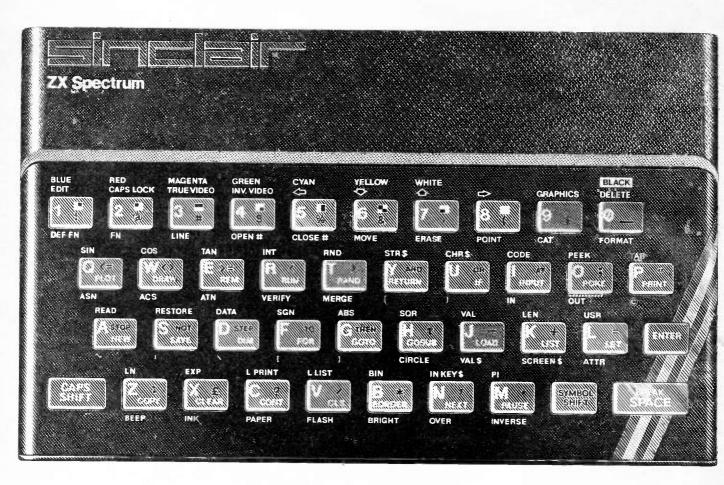
G. S. Wilton, Clarkston, Glasgow.



The Digitron 8000 meter is manufactured by Digitron Instruments Ltd., Merchant Drive, Mead Lane Industrial Estate, Hertford SG13 7BH. They can supply the meter used on the prototype Beehive Temperature Meter for £34.25 plus VAT plus £3.50 postage and packing (total £42.90). Please supply payment with order and specify that it is the Digitron 8000-01 digital voltmeter with 999mV full scale deflection that is required.

However, as this is an expensive component, a suitable alternative is to fit a pair of sockets in place of the meter and use a portable digital multimeter when measurements are required. The 2V range found on most d.v.m.s is ideal, remembering that 10 mV is equivalent to one degree Celsius. Therefore a reading of 270mV (or 0.27V) is equal to a temperature of 27°C.

# Sinclair ZX Spect



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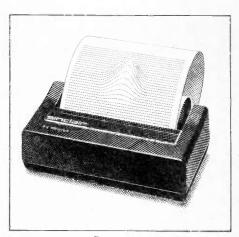
Partly because the sheer volume of Spectrums sold (over 300,000 so far) has brought down unit production costs.

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	Postage and packing: o	rders under £90	0028	2.95	
	0	rders over £90	0029	4.95	
Please t	ick if you require a VAT receip			_	
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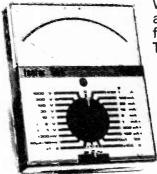
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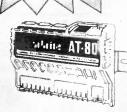
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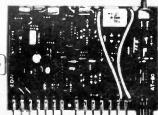
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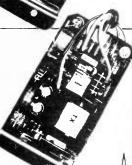
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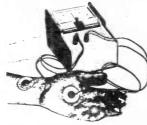
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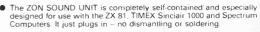
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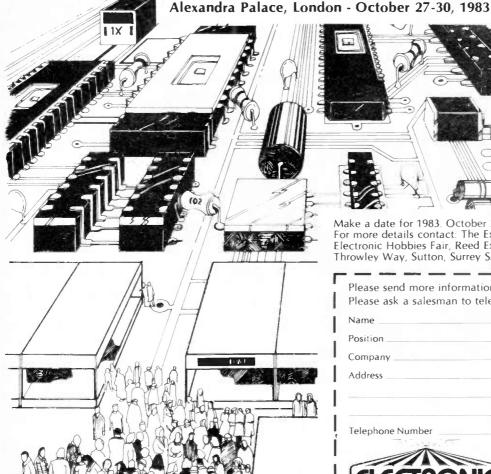
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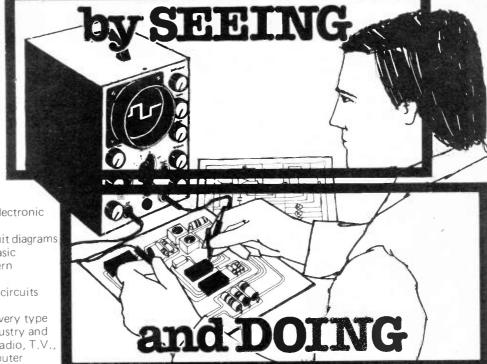
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#### **MULLARD SPEAKER KITS**

Purposefully designed 40 watt R.M.S. and 30 watt R.M.S. 8 ohm speaker systems recently developed by MULLARD'S specialist team in Belgium. Kits comprise Mullard woofer (8" or 5") with foam surround and aluminium voice coil. Mullard 3" high power domed tweeter. B.K.E. built and tested crossover based on Mullard circuit, combining low loss components, glass fibre board and recessed loudspeaker terminals. SUPERB SOUNDS AT LOW COST. Kits supplied in polystyrene packs complete with instructions. 8" 40W system — recommended cabinet size 240 × 216 × 445mm

Price £14.90 each + £2.00 P & P.

5" 30W system — recommended cabinet size 160 × 175 × 295mm Price £13.90 each + £1.50 P 8 P.

Designer approved flat pack cabinet kits, including grill fabric. Can be finished with iron on veneer or self adhesive vinyl etc. 8" system cabinet kit 88.00 each + £2.50 P & P.

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features: Three digit tape counter. Autostop. Six piano
features: Three digit tape counter. Main inputs plus
secondary inputs confered to the control of the control
secondary inputs.
Sensitivity: 100mV to 2V oppositive propositions. Input
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secondary inputs.
Sensitivity: 100mV to 2V oppositive for the control
secondary inputs.
Sensitivity: 100mA to 50mA.
Connections: The
fett and right hand stereo inputs and outputs are via
individual screened leads, all terminated with phono plugs
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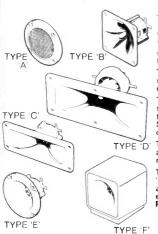
BASS GUITARI Die cast chassis, 2" aluminim voice coil, white cone with aluminim centre dome. 8 ohm imp., Res. Freq. 20Hz., Freq. Resp. to 2.5KHz., Se 97dB (As photograph). Price: £32.00

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8" 50 watt R.M.S. (HI-FI, P.A.) 1 ½"
aluminium voice coil. White cone. 8 ohm
imp. Res. Freq. 40Hz., Freq. Resp. to 6KHz.
Sens. 92dB. Also available with black cone
fitted with black metal protective grille. (As
photograph). Price: White Cone £8.90,
Black cone/grille £9.50 P6P£1.25.
12" 85 watt R.M.S. McKENZIE C1285GP (LEAD GUITAR, KEYBOARD, DISCO) 2"
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Resp. to 6.5KHz., Sens. 98dB. Price: £22.00 + £3 carriage.
12" 85 watt R.M.S. McKENZIE C1285TC (P.A., DISCO) 2" aluminium voice coil. Twin
cone, 8 ohm imp., Res. Freq. 45Hz., Freq. Resp. to 14KHz. Price £22 + £3 carriage.
15" 150 watt R.M.S. McKENZIE C15 (BASS GUITAR, P.A.) 3" aluminium voice coil.
Die cast chassis. 8 ohm imp., Res. Freq. 40Hz., Freq. Resp. to 4KHz. Price: £47 + £4
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TYPE 'D' (KSN1025A) 2" × 6" wide dispersion horn. Upper frequency response retained extending down to mid range (2KHz). Suitable for high quality Hi-fi systems and quality discos. Price £7.99 each.

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TYPE 'F' (KSN1057A) Cased version of type E'. Free standing satellite tweeter. Perfect add on tweeter for conventional loudspeaker systems. Price £10.75 each. P&P 20p ea. (or SAE for Piezo leaflets).



The very best in quality and value. Ported tuned cabinet in hardwearing black vynide with protective corners and carry handle. Built and tested. employing 10in British driver and Piezo tweeter. Spec: 80 watts RMS; 8 ohms; 45Hz-20KHz; Size: 20in × 15in × 12in; Weight: 30 pounds.

Price: £49.00 each. £90 per pair Carriage: £5 each, £7 per pair **KEYBOARDS** 

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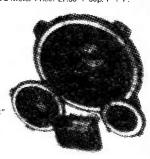
Power Amplifier Module complete with integral heat sink, toroidal transformer power supply and glass fibre p.c.b. assembly. Incorporates drive circuit to power a compati-ble LED Vu meter. New improved specification makes this amplifier ideal for P.A., Instrumental and Hi-Fi applications.

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