Hobby Electronics

JANUARY '82

60p

For A Down-To-Earth Approach To Electronics

Scaling The Hi-Fi Heights
New series starts this month

Five Easy Projects To Build

- ★ Simple Timer
- ★ Ni-cad Charger
- ★ Volume Expander
- ★ Intruder Confuser
- ★ Switch-Tuned Radio

HOW TO SUCCEED IN THE ELECTRONICS BUSINESS:

INVEST 60p AND MAKE £2.40 net profit

Available at your newsagent or direct for 60p p&p inc

Buy Ambit's new concise component catalogue and get £1 vouchers. Use them for a £1 discount per £10 spent. But even without this, you will still find WR&E offers the low prices, fast service and technical support facility second to none.

Here are some examples from the current issue:

I.C. SOCKETS

A range of high quality, low cost, low profile DIL sockets ideally suited for both the OEM and hobbyist. All types feature double sided phosphor bronze contacts, tin-plated for low contact resistance.

8 x 0.3"	12p	22 x 0.3"	20p
14 x 0.3"	13p	22 x 0.4"	20p
16 x 0.3"	13p	24 x 0.6"	22p
18 x 0.3"	18p	28 x 0.6"	25p
20 x 0.3"	19p	40 x 0.6"	35p
20 x 0.4"	19p	42 x 0.6"	38p

DISCRETES

		BC556	12p		
BC237	8p	BC550	12p	2SK168	35p
BC238	8p	BC560	12p	J310	69p
ZTX238	9p	BC639	22p	J176	65p
BC239	8p	BC640	23p	40823	65p
BC307	8p	2SC1775A	22p	3SK45	49p
BC308	8p	2SA872A	18p	3SK51	54p
BC309	8p	2SD666A	30p	3SK60	58p
BC413	10p	2SB646A	30p	3SK88	99p
BC414	11p	2SD668A	30p	MEM680	75p
BC415	10p	2SB648A	40p	BF960	99p
BC416	11p	BF256	38p	BF961	70p
BC546	12p	2SK55	28p	BF963	99p

VOLTAGE REGULATORS

78XX1A TO-220 pos	0.58
79XX1A TO-220 neg	0.60
78G 1A TO-220 adj pos	1.10
78G 1A TO-3 adj pos	3.95
78H5A TO-3 5v pos	4.25
78H5A TO-3 12v pos	5.45
78HG5A TO-3 adj pos	7.45
79HG5A TO-3 adj neg	7.45
LM317.5A adj pos	1.30
LM337.5A adj neg	1.75
78S401.5A adj pos sw reg	1.20

XTALS

1MHz	3.00
3.2768MHz	2.00
4MHz	1.70
4.194MHz	1.70
4.43MHz	1.25
5MHz	2.00
6.5536MHz	2.00
7MHz	2.00
8MHz	2.00
9MHz	2.00
10MHz	2.00
11MHz	2.00

Prices shown exclude VAT. Postage 50p per order (UK). ACCESS/BARCLAYCARD may be used with written or telephone orders - official MA details on application, and a special prize for those who read our ads carefully - a free 4 or 8MHz crystal filter with every CPU IC you buy - just clip out the paragraph and attach it to your order. E&OE.

CMOS

4000	0.13
4001	0.13
4002	0.13
4007	0.15
4008	0.70
4008AE	0.80
4009	0.30
4010	0.30
4011AE	0.24
4011	0.15
4013	0.32
4015	0.64
4016	0.30
4017	0.45
4019	0.38
4020	0.58
4021	0.68
4022	0.64
4023	0.15
4024	0.45
4025	0.15
4026	1.05
4027	0.50
4028	0.50
4029	0.75
4030	0.35
4035	0.75
4040	0.68
4042	0.58
4043	0.65
4043AE	0.93
4044	0.64
4046	0.69
4047	0.69
4049	0.30
4050	0.30
4051	0.65
4052	0.65
4053	0.65
4054	1.30
4055	1.30
4056	1.30
4059	5.75
4060	0.88
4063	1.15
4066	0.34
4067	4.30
4068	0.18
4069AE	0.18
4070	0.18
4071	0.18
4072	0.18
4073	0.18
4075	0.18
4076	0.60
4077	0.18
4078	0.18
4081	0.18
4082	0.18
4093	0.41
4099	0.93
4175	0.90
4502	0.79
4503	0.48
4506	0.63
4507	0.38
4508	1.95
4510	0.66
4511	0.66
4512	0.70
4514	1.45
4515	1.45
4516	0.75
4518	0.40
4520	0.75
4521	1.60
4522	0.89
4527	0.89
4528	0.78
4529	0.89
4531	0.85
4532	1.20
4534	5.30
4536	3.00
4538	0.97
4539	0.89
4543	1.05
4549	3.50
4553	3.20
4554	1.30
4555	0.48
4556	0.53
4557	2.30
4558	0.89
4559	3.80
4560	1.75
4561	2.18
4562	0.89
4566	3.80
4568	1.45
4569	1.50
4572	1.95
4580	3.25
4581	1.50
4582	1.65
4583	0.80
4584	0.45
4585	0.45
4702	4.50
4703	4.48
4704	4.24
4705	4.24
4706	4.50
4720	4.00
4723	0.95
4724	0.95
4725	2.24
40014	0.54
40085	0.99
40098	0.54
40106	0.69
40160	0.68
40161	0.69
40162	0.69
40163	0.69
40174	0.69
40175	0.69
40192	0.75
40193	0.75
40194	0.69
40195	0.69

TTL N

7400N	0.10
7401N	0.10
7402N	0.20
7403N	0.11
7404N	0.12
7405N	0.12
7406N	0.22
7407N	0.22
7408N	0.15
7409N	0.15
7410N	0.12
7411N	0.18
7412N	0.19
7413N	0.27
7414N	0.51
7416N	0.27
7417N	0.27
7420N	0.13
7421N	0.28
7423N	0.22
7425N	0.22
7426N	0.22
7427N	0.22
7430N	0.13
7432N	0.23
7437N	0.22
7438N	0.22
7440N	0.14
7441N	0.54
7442N	0.42
7443N	0.62
7444N	0.62
7445N	0.62
7446N	0.62
7447N	0.62
7448N	0.56
7450	0.14
7451N	0.14
7453N	0.14
7454N	0.14
7460N	0.14
7470N	0.28
7472N	0.27
7473N	0.28
7474N	0.28
7475N	0.35
7476N	0.30
7480N	0.26
7481N	0.20
7482N	0.75
7485N	0.75
7486N	0.24
7489N	1.05
7490N	0.30
7491N	0.55
7492N	0.35
7493N	0.35
7494N	0.70
7495N	0.60
7496N	0.45
7497N	1.40
74100	1.10
74104	0.62
74105	0.62
74107	0.26
74109N	0.35
74110N	0.54
74111N	0.68
74112N	1.70
74116N	1.98
74118N	0.85
74119N	1.20
74120N	0.95
74121N	0.34
74122N	0.34
74123N	0.40
74125N	0.40
74126N	0.40
74128N	0.65
74132N	0.50
74136N	0.65
74141N	0.45
74142N	1.85
74143N	2.50
74144N	2.50
74145N	0.75
74147N	1.50
74148N	1.39
74150N	0.79
74151N	0.55
74153N	0.55
74154N	0.55
74155N	0.55
74156N	0.55
74157N	0.55
74159N	1.90
74160N	0.55
74161N	0.55
74162N	0.55
74163N	0.55
74164N	0.55
74165N	0.55
74166N	0.70
74167N	1.25
74170N	1.25
74173N	1.10
74174N	0.75
74175N	0.75
74176N	0.75
74177N	0.75
74178N	0.90
74179N	1.35
74180N	0.75
74181N	1.22
74182N	0.70
74184N	1.20
74185N	1.20
74188N	3.00
74190N	0.55
74191N	0.55
74192N	0.55
74193N	0.55
74194N	0.56
74195N	0.55
74196N	0.55
74197N	0.55
74198N	0.85
74199N	1.00
74221N	1.00
74246N	1.50
74247N	1.51
74248N	1.89
74249N	0.11
74251N	1.05
74265N	0.66
74273N	2.67
74278N	2.49
74279N	0.89
74283N	1.30
74284N	3.50
74285N	3.50
74290N	1.00
74293N	1.05
74297N	2.36
74298N	1.85
74365N	0.85
74366N	0.85
74367N	0.85
74368N	0.85
74390N	.85
74393N	1.95
74490N	1.35

74LSN

74LS00N	0.11
74LS01N	0.11
74LS02N	0.12
74LS03N	0.12
74LS04N	0.14
74LS05N	0.14
74LS08N	0.14
74LS09N	0.14
74LS10N	0.13
74LS11N	0.14
74LS12N	0.15
74LS13N	0.28
74LS14N	0.45
74LS15N	0.14
74LS20N	0.13
74LS21N	0.15
74LS22N	0.15
74LS26N	0.18
74LS27N	0.14
74LS28N	0.19
74LS30N	0.13
74LS32N	0.14
74LS33N	0.16
74LS37N	0.15
74LS38N	0.16
74LS40N	0.13
74LS42N	0.33
74LS47N	0.39
74LS48N	0.65
74LS49N	0.59
74LS51N	0.14
74LS54N	0.15
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74LS74N	0.18
74LS75N	0.28
74LS76N	0.19
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74LS85N	0.70
74LS86N	0.18
74LS90N	0.32
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74LS93N	0.34
74LS95N	0.44
74LS96N	1.20
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74LS123N	0.55
74LS124N	1.80
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74LS126N	0.29
74LS132N	0.45
74LS133N	0.30
74LS136N	0.25
74LS138N	0.34
74LS139N	0.36
74LS145N	1.20
74LS151N	0.35
74LS153N	0.35
74LS154N	0.99
74LS155N	0.38
74LS156N	0.38
74LS157N	0.33
74LS158N	0.33
74LS160N	0.40
74LS161N	0.40
74LS162N	0.40
74LS163N	0.40
74LS164N	0.46
74LS165N	1.20
74LS166N	0.80
74LS168N	0.85
74LS169N	0.85
74LS170N	1.40
74LS173N	0.70
74LS174N	0.55
74LS175N	0.55
74LS181N	1.20
74LS183N	1.75
74LS189N	1.28
74LS190N	0.56
74LS191N	0.56
74LS192N	0.56
74LS193N	0.59
74LS194N	0.39
74LS195N	0.39
74LS196N	0.55
74LS197N	0.65
74LS200N	3.45
74LS202N	3.45
74LS221N	0.60
74LS240N	0.99
74LS241N	0.99
74LS242N	1.65
74LS243N	1.65
74LS244N	0.83
74LS245N	1.50
74LS247N	1.35
74LS248N	1.35
74LS249N	1.35
74LS251N	0.46
74LS253N	0.46
74LS257N	0.55
74LS258N	0.39
74LS259N	0.39
74LS260N	0.70
74LS266N	0.24
74LS273N	0.90
74LS275N	3.20
74LS279N	0.35
74LS280N	2.05
74LS283N	0.44
74LS290N	0.58
74LS293N	1.30
74LS295N	1.50
74LS298N	1.50
74LS365N	0.35
74LS366N	0.35
74LS367N	0.35
74LS368N	0.35
74LS373N	0.78
74LS374N	0.78
74LS375N	1.15
74LS377N	1.99
74LS378N	1.40
74LS379N	2.15
74LS384N	2.50
74LS385N	4.20
74LS386N	0.29
74LS390N	0.68
74LS393N	0.61
74LS395N	2.10
74LS396N	1.99
74LS398N	2.75
74LS399N	2.30
74LS445N	1.40
74LS447N	1.95
74LS490N	1.10
74LS668N	1.05
74LS669N	1.05
74LS670N	1.70

RAM

2102	1.70
2112	3.40
2114/2	1.49
4027	5.78
4116/2	1.59
4116/3	1.49
4864P	12.50
6116P-3	12.50
6116P-4	11.25
8264	12.50

74CXX

74C00	0.20
74C02	0.20
74C04	0.20
74C08	0.20
74C10	0.20
74C14	0.55
74C20	0.20
74C30	0.20
74C32	0.20
74C42	0.80
74C48	1.03
74C73	0.50
74C74	0.50
74C76	0.48
74C83	0.98
74C85	0.98
74C86	0.26
74C89	2.68
74C90	0.80
74C93	0.80
74C95	0.94
74C107	0.48
74C151	1.52
74C154	2.26
74C157	1.52
74C160	0.80
74C161	0.80
74C162	0.80
74C163	0.80
74C164	0.80
74C165	0.84
74C173	0.72
74C174	0.72
74C175	0.72
74C192	0.80
74C193	0.80
74C195	0.80
74C200	4.52
74C221	1.06
74C901	0.38
74C902	0.38
74C903	0.38
74C904	0.38
74C905	5.64
74C906	0.38
74C907	0.38
74C908	0.84
74C909	1.52
74C910	3.62
74C914	0.86
74C918	0.98
74C925	4.32
74C926	4.32
74C927	4.32

Processors

8080 series

8080AFC/2	3.11
8212	1.70
8214	3.50
8216	1.41
8224	1.85
8251	4.26
8255	3.97

6800/6809

6800P	3.75
68A00	4.25
68B00	4.75
6802	5.55
6809	15.00
6810	1.75
68A10	1.85
68B10	2.04
6820	1.95
6821	1.75
68A21	2.10
68B21	2.34
6840	4.25
68A40	4.55
68B40	4.75
6850	1.75
68B50	2.17
6852	2.47
68A52	2.75
68B52	2.95
68488	5.25

Z80 series

Z80A	4.99
Z80ADRT	7.50
Z80APIO	4.10
Z80ASIO/1	14.00
Z80ASIO/2	14.00
Z80ASIO/9	14.00
Z80CTC	4.00
Z80ACTC	4.50
Z8001	65.00

PROM

2708	2.00
2716	3.55
2532	8.50
2732	8.50

AMBIT international

TELEPHONE (STD 0277) 230909 TELEX 995194 AMBIT G POSTCODE CM14 4SG

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PROJECTS

FEATURES

SPECIALS

REGULARS

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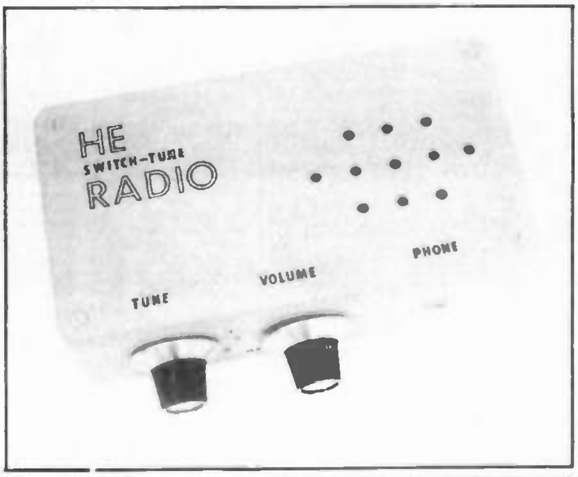

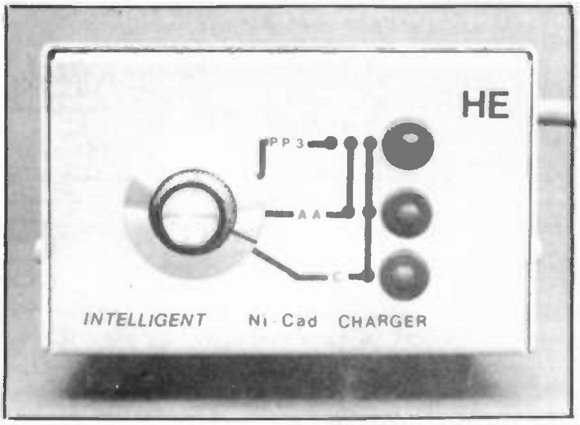

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I.C.s TRANSISTORS CAPACITORS · TOOLS RESISTORS HARDWARE · CASES KITS

MAGENTA ELECTRONICS LTD.

C106D	58p	2N5457	58p	BFY51	24p	**LINEAR I.C.s**		LM3917N	£2·27
TIC46	48p	2N5434	63p	BFY52	23p	555	32p	LM3900W	85p
OA47	11p	40673	98p	BFX88	32p	556	79p	LM3909N	79p
OA90	9p	AC128	29p	BRY39	48p	741	28p	LM3911N	£1·55
OA202	16p	AC141	38p	MPSA65	39p	748	55p	LM3914N	£2·89
WO05	33p	AC142	39p	RPY58A	£1·16	CA3080	£1·21	LM3915N	£2·98
W06	47p	AC176	37p	TIP31A	52p	CA3085A	£1·32	MC3340	£2·15
Z5J	£2·92	BC182	11p	TIP32A	83p	CA3130T	£1·12	TBA820	£1·05
IN4001	5p	BC182L	11p	TIP33A	94p	CA3140E	57p	TL064	£2·59
IN4005	6p	BC183	11p	TIP34A	99p	HA1388	£2·85	U237B	£1·69
IN4148	5p	BC184	11p	TIP121	£1·12	ICL7611	£1·04	ULN2283B	£1·47
IN5404	18p	BC184L	11p	TIP2955	69p	ICL8038CC	£3·52	ZN1034E	£2·19
IN5408	19p	BC212	11p	TIP3055	69p	ICM7555	£1·19	ZN414	£1·09
BF244	37p	BC212L	11p	TIS43	38p	LF351	58p	ZN419CE	£2·59
MPF102	69p	BC213	11p	TPSA13	35p	LF353	96p	ZN424E	£2·14
TIS88A	57p	BC214	11p	SN3053	25p	LF356	99p	ZN425E	£5·98
VN67AF	£1·21	BC214L	11p	2N3055	59p	LM301AN	39p	**CMOS**	
2N3819	28p	BD131	48p	2N3702	11p	LM309K	£2·99	4001	27p
2N3820	78p	BFY50	25p	2N3704	11p	LM317K	£3·56	4011	28p
						LM317T	£2·55	4013	55p
						LM324N	79p	4017	95p
						LM380N	99p	4020	£1·20
						LM381N	£1·98	4024	76p
						LM382N	£1·82	4069	31p
						LM386N	£1·04	4081	29p
						LM387N	£1·39	4093	89p
						LM389N	£1·29	4522	£1·79
						LM1830	£2·32	40174	£1·50

¼W CARBON FILM RESISTORS
E12 SERIES. 1R-10M .... 1½p each
MIN. HORIZ. PRESETS. 100R-4M7 .. 12p each
MIDGET POTS. LINEAR. 470R-4M7 37p each
LOG. 4K7-2M3 .... 38p each
SWITCHED POTS. 4K7-1M. LIN. 75p. LOG 76p

POLYESTER (C280) CAPACITORS, 250V
10nF; 15nF; 22nF; 33nF; 47nF 7p each. 68nF; 100nF 8p. 150nF; 220nF 12p. 330nF 15p. 470nF 20p. 680nF 28p. 1µF 33p. 1·5µF 49p. 2·2µF 65p.

SUB MINIATURE PLATE CERAMICS, 63V
Values in pF; 2·2; 3·3; 4·7; 5·6; 6·8; 8·2; 10; 15; 22; 33; 47 & 56pF 7p each. 68pF; 100pF 7p each. 150pF; 220pF; 330pF 11p each. 390pF, 470pF, 1000pF 5p each. 2200pF 6p each. 3300pF, 4700pF 7p each. 10nF 13p. 100nF 22p. 47nF 14p.

ELECTROLYTIC CAPACITORS
AXIAL Leads: 1µF/16V 11p; 1µF/63V, 1µF/100V 12p; 2·2µF/63V, 3·3µF/63V, 4·7µF/63V 12p; 10µF/16V 11p; 10µF/25V, 10µF/63V 12p; 22µF/10V, 22µF/25V 12p; 22µF/63V 15p; 33µF/40V, 47µF/25V 12p; 47µF/40V 15p; 47µF/63V 18p; 100µF/16V 12p; 100µF/25V 15p; 100µF/40V 18p; 100µF/63V 29p; 220µF/10V 15p; 220µF/25V 19p; 470µF/16V 29p; 470µF/25V 36p; 470µF/40V 55p; 680µF/16V 32p; 1000µF/10V 30p; 1000µF/16V 33p; 1000µF/25V 48p; 1000µF/40V 58p; 1000µF/63V 79p; 2200µF/10V 39p; 2200µF/25V 64p; 2200µF/63V £1·10.

SWITCHES
MIN. TOGGLE spst 59p; spdt 69p; dpdt 79p.
MIN. PUSH ON. 18p. **PUSH OFF.** 22p.
FOOTSWITCH & ALT. ACTION spco £1·39; dpco £1·88.
ROTARY SWITCHES. 1p 12 way, 2p 6w, 3p 4w, 4p 3w .... 69p each
12V 185R DPCO RELAY .... £2·98

OPTO
BPX25 .... £2·24
2N5777 .... 60p
ORP12 .... 99p
TIL32 .... 81p
TIL78 .... 74p
LEDS WITH CLIPS
3mm. Red 15p. Green 18p. Yellow 20p.
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GUITAR NOTE EXPANDER

From ETI April 81. Not just another Fuzz/Sustain Unit. This versatile project can produce overload effects which closely approach the sound of an overdriven valve amp.
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1. Overall overdrive
2. Overall compression (sustain)
3. H.F. compression for bass overdrive
4. Overall expansion for sustained overdrive
5. Mid frequency expansion
6. H.F. expansion for H.F. accentuation.

All (except overall overdrive) have variable effects control. Guitar Note Expander Kit £16.47, less case £11.26.

SOUND BENDER

From ETI Oct 81. A very effective 'Ring Modulator' sound effects unit. This design incorporates its own variable frequency oscillator with sine or triangular waveform, and a 4 quadrant multiplier circuit.
A mix control allows the modulated signal to be mixed with the straight through signal. Ideal for outer space, voice and music effects. Just connect a signal source and a power amplifier and speaker.
Sound Bender Kit £20.76, less case £15.76.

HAND CLAP SYNTHESISER

Adds a new interesting effect to your music. 6 controls enable wide variation of the clap sound to accompany different types of music. The 'clap' may be initiated by a push button switch or any external push to-make switch e.g. a footswitch. Alternatively triggering may be via a microphone input to the unit so that a signal from a mic placed near to a snare drum will initiate the clap.
Hand Clap Synthesiser Kit £29.98, less case £23.58.

Reprints of the Above 45p each

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An easy to follow book suitable for all ages. Ideal for beginners. No soldering. Uses a Bimboard 1 breadboard, gives clear instructions with lots of pictures. 11 projects based on integrated circuits —includes dice, two-tone doorbell, electronic organ, MW/LW radio, reaction timer, etc. Component pack includes a Bimboard 1 breadboard and all the components for the projects.
Adventures with Microelectronics £2·55. Component pack £29·64 less battery.

ADVENTURES WITH ELECTRONICS

by Tom Duncan

An easy to follow book suitable for all ages. Ideal for beginners. No soldering, uses an S-Dec breadboard. Gives clear instructions with lots of pictures. 16 projects—including three radios, siren, metronome, organ, intercom, timer, etc. Helps you learn about electronic components and how circuits work. Component pack includes an S-Dec breadboard and all the components for the projects.
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MONITOR

Pic Of The Bunch

THE EDITOR'S Choice for January shows Lisa Moss, Miss World America (left) and Michele Donnelly, Miss UK (right) climbing on board the CB Bandwagon (a Rola is hardly a bandwagon I know, but . . .)

Also in the picture, if you look closely, is Fidelity Radio's new CB 1000 FM rig. Priced at around £69, it will be available from most High Street retailers.

Microcomputers, Of Course!

SLOUGH COLLEGE of Higher Education is currently offering a Microcomputer Workshop for those who would like to become involved with microcomputers and who are seeking hands-on experience with this type of equipment. The workshop is project-oriented, with facilities and instruction provided for groups to explore projects of their choice. Projects include use of colour graphics, Pascal with animation tools, financial planning, forecasting, electronic diary, word processing, and other electronic office applications, linking micros to main frames, designing and building a flexible interface, etc.

Although the course began in September, the program is ongoing, with new projects continuously starting. The course fee is £25 and classes are held on Thursday evenings at the College from 6.30 to 8.30 pm.

Dr. Eva Huzan, co-author, with Lionel Carter, of "Microelectronics and Microcomputers" (Teach Yourself Books), and head of the Computing Division of Slough College is supervisor to the workshop.

The Slough College laboratory includes: PET, VIC, Apple, Dynabyte and RML 380Z microcomputers plus single board systems and test equipment for interfacing and engineering applications.

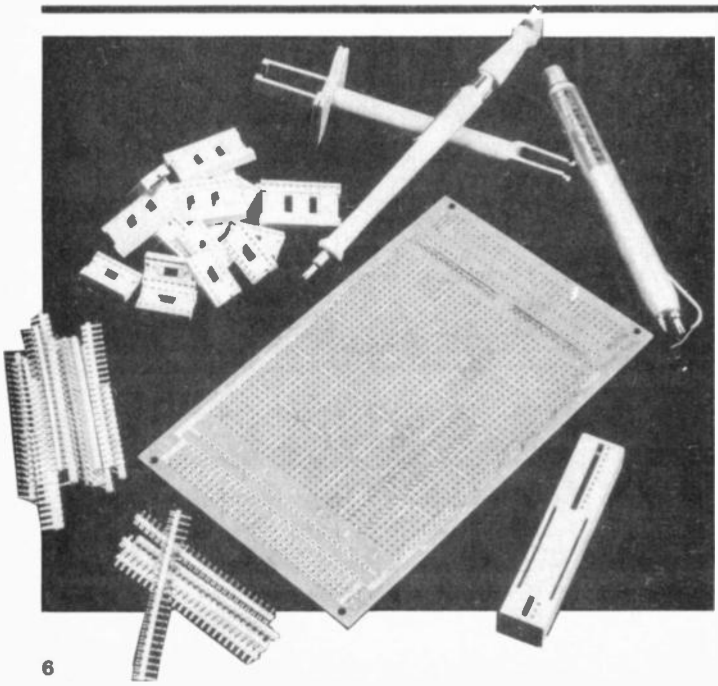
Other courses commencing this month are Elementery Basic Programming, Microprocessor Basic, Further Basic Programming, and Assembler—Machine Code Programming for Microcomputers, all at £30 per course.

For further information and registration procedure contact Slough College, Wellington Street, Slough SL1 1YG (0753) 34585.

BICOR!

ONE certain way to ensure good, solid bass response from a sound system is to use a pair of folded horn speakers. Unfortunately, they're a little too large for most living rooms; only a fanatically dedicated hi-fi nut would insist on a pair of speakers measuring around 6ft by 4ft by 3ft each!

The Lowther Loudspeaker BICOR 200 system is, therefore, something quite new. After deep and original research, during which "new mathematical formulae were arrived at and fundamental physics rediscovered" they have produced a pair of compact speakers of exceptional range and power. The system uses a single speaker unit — a Lowther PM6 — to drive a balanced double folded horn, achieving a frequency response that is flat from 40 Hz to 20,000 Hz and a transient response that is said to be ideal. This, plus power handling from 20 to 100 watts and a wide dynamic range from an enclosure measuring only 72cm high by 25cm wide by 33cm deep, make the BICOR 200 well worth checking out. You can do so at most major retailers and specialist stockists, or contact the Lowther Loudspeaker Co. Ltd, directly. Their address is P.O. Box 28, Bromley, Kent: Phone (01) 460 5225.



Experimenter's Delight

A NEW, fast and easy breadboarding system by the 3M Company will enable students, hobbyists, or even electronics engineers to convert their designs into prototype circuits in a fraction of the time it takes using conventional methods. The Scotchflex Breadboarding Kit owes its unique features to 3M developments in connector technology which eliminate the need for wire wrapping and crimping, and also reduce soldering to a minimum.

The hub of the system is a 24-contact strip which can be snapped off to any desired length, thus reducing the number of different components in the kit and which, in turn, reduces the problem of having to anticipate the lengths required when ordering. The plug strip on the underside of the board employs 'U' elements for quick networking of components. In addition, the system's IC sockets use a unique 'S' contact which ensures reliable electrical connections even after repeated insertion and withdrawal.

Included in the basic kit are a single height Eurocard board, a selection of dual sockets, plug strips, solder strips, universal breadboard tool, insertion tool, plug strip hand tool and 25 feet of 30 AWG wire.

For details contact Ken Adams, Electronic Products Group, 3M United Kingdom, 3M House, P.O. Box 1, Bracknell, Berks RG12 1JU. Phone Bracknell (0344) 58436.

You Can Take it With You . . .

WHAT weighs 4.9 kg, is compact, includes a battery pack and can help you analyse your golf swing? Answer — the new VT 6500 portable video system by Hitachi, of course!

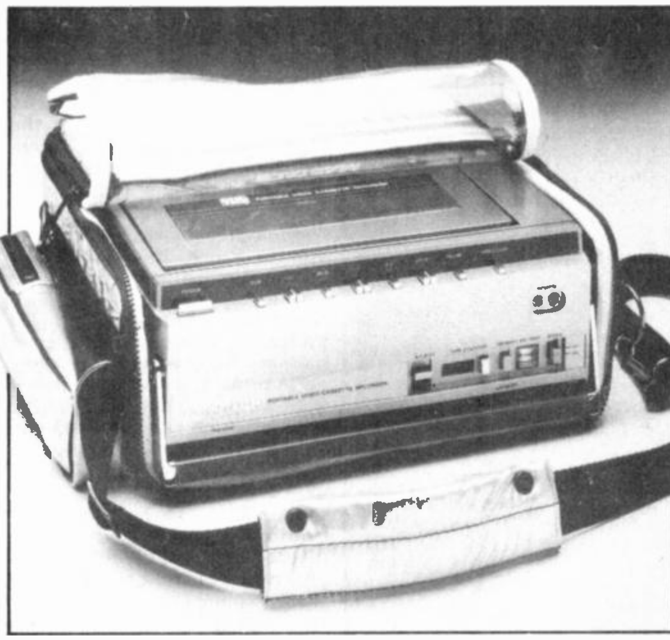
The VT 6500 is one of the lightest and most compact portables on the market. This was made possible by eliminating solenoids, introducing more efficient circuitry, manufacturing smaller direct drive capstans and cylinders and by developing a lighter, stronger chassis and circuit board.

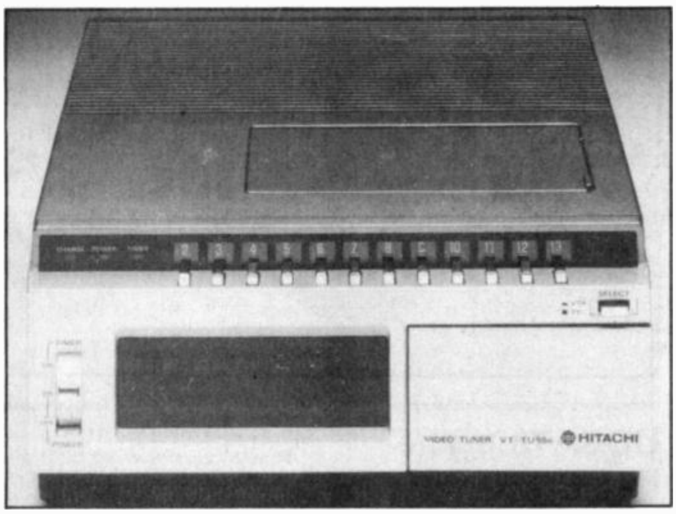
With this new portable it is now possible to electronically edit a recorded video tape with the assurance that scene changes and overlays are clean and in sync, with no distortion or electronic 'snow'. The pulse control editing system also allows titles or new material to be inserted. Audio edit facilities feature 'sound on sound', which enables the user to blend new sound material with the original track without necessarily replacing it.

The full-function remote unit features 13 operating modes including a visual search button which speeds up the tape (five times in either direction) for quick location of recorded items. Speed isn't everything, and a still-frame control and frame advance with variable slow motion from 1/5th normal speed to a still-frame has been incorporated, enabling precision pinpointing of scenes.

VT 6500 power consumption is low — only 5.5 watts — and the battery pack takes only one hour to recharge using either the VT TU 65 tuner/timer (see below) or AV 60 power adaptor.

The VT 6500 comes complete with remote control unit, RF cable, earphone, cassette tape, shoulder bag and battery at £677 (inc. VAT).





. . . Or Leave It At Home

HITACHI's VT 65 Tuner/Timer complements their new portable recorder. It enables 8 different programmes to be recorded over a 21-day period and features a microcomputer memory which retains information for up to an hour in the event of a power failure or accidental unplugging. Another interesting feature is the "auto-channel lock" which prevents changing channels when in 'record' mode. The VT TU 65 is priced at £179, including VAT.

The Best Ideas . . .

YOU'LL get quite a charge from NiTech Ltd's new X-Cell Plus rechargeable batteries; in fact, you'll get at least 300 — possibly 3000 — complete charge/discharge cycles for around 1/10 of a pence a time.

The X-Cell Plus is a direct replacement for six Volt Type 996 dry cell lantern batteries. The remarkable thing is that the unit contains all the electronics needed for recharging; it simply plugs into the handiest mains supply. Recharging from car, boat or lorry batteries is also possible as the X-Cell Plus is polarity protected and cannot be overcharged. It is virtually indestructible — leak proof, shock proof, vibration proof and weather-proof — and is guaranteed for three years. Shelf life, from any state of charge, is indefinite.

The X-Cell Plus will be available from February at a cost of £19.95. The lighter duty X-Cell Regular, designed for household use, is rechargeable from mains supplies only and will retail for £14.95.

NiTech Ltd, a small Sussex-based firm who now look set to move into the big league, tell us that they have one or two other ingeniously original products in the pipeline, too. Watch this space.

Mail Order Made Easy

SWITCHES, suppressors, filters, alarms, batteries, LEDs, connectors, indicators, accessories, transformers, displays, and a wide range of non-active components — in other words, everything your heart desires and your projects require — and much more besides, are available through Stotron Ltd, the new mail order division of the Roxburgh Electronics Group. Their new catalogue is due out early this year.

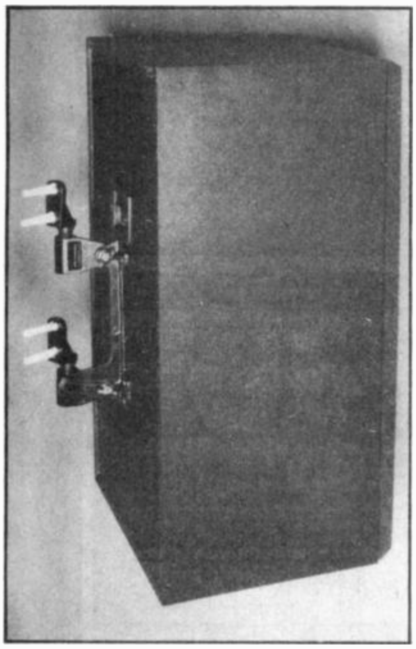
Emphasis in this operation is on small quantities for the small user, with a guaranteed 24 hour delivery.

A distribution facility has been opened at Greenwich, SE London, with a Sussex-based centre at Stotron (Haywards Heath) Ltd. Bases in Coventry and central Scotland will be added soon, while other locations are being considered.

Full technical back-up is provided by Roxburgh's central technical division which offers service, stocking and technical information for all customers.

For a look at the goodies on offer contact Stotron Ltd, 22 Winchelsea Rd, Rye, East Sussex TN31 7BR. Phone Rye (079) 735815.

MONITOR



Hang-Ups

ONE OF THE MOST convenient ways to keep hi-fi speakers from cluttering up the living room is to hang them on the walls. The problem, until now, has been the bulky, unsightly brackets or builder's scaffolding needed to support them.

Fidelity Fastenings would like you to know that they have solved that problem.

Their Multi-angle Wall Mounting Speaker Hinges (Model FF4) look a lot better hanging on the wall than they do in print. They feature special light-weight glass-filled nylon hinges which can be tilted and swung to point the speaker anywhere in the room. Best of all, they support up to 22 kg — that's 50 lb. Each pair comes complete with everything needed to install them, and they are available from most hi-fi or record shops in your high street for around £8.99 a pair, including VAT.

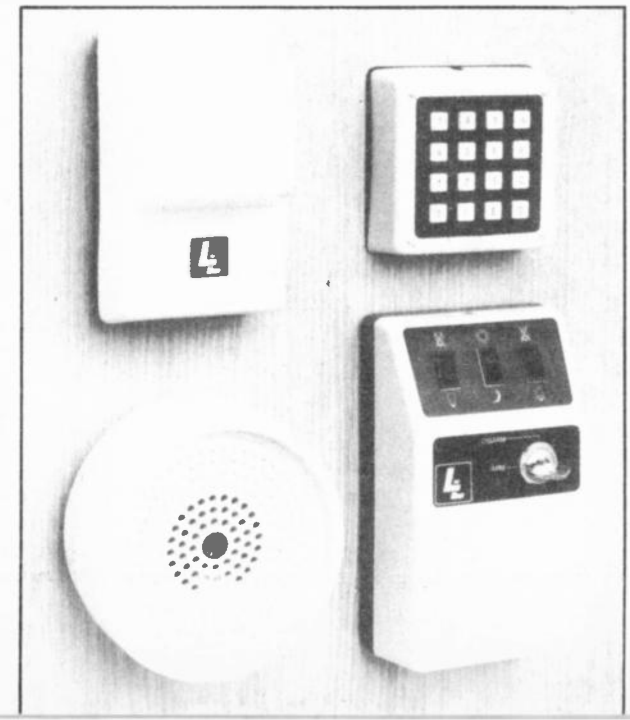
Alarming New DIY Kit.

THE NEW radar-based Supa-Gard by Loadpoint Ltd., is a security system developed for use both indoors and outdoors, is reasonably-priced, easily installed, and doesn't require multitudes of experts to get it working. Used as an intruder-detector, Supa-Gard's range and sensitivity can be adjusted to detect movement in an area with a frontal range from 1ft to in excess of 35ft, and uses a very loud noise (100db SPL) to deter the uninvited guest.

The system also has a second, less aggressive nature — it can be used as a doorman, greeting guests with a welcome bath of light. Any existing lights or bells can be incorporated if desired, making it one of the most versatile kits available.

A key-operated control unit serves as the brain of the system; it includes a keypad with a unique 3-digit entry code whch, when operated correctly, disarms the radar for a set period, enabling entrance into the protected area. Lights can be controlled by a timer, to illuminate an area for security and safety for a specific period of time and then turn off again. The access code can easily be set or cancelled and all units include an anti-tamper switch.

The kit can be assembled with the minimum of bother by a 'reasonably competent DIY enthusiast,' or by an electrical engineer. Even with the added cost of having it installed by a professional (£184, incl. VAT), the Supa-Gard is extremely economical. Ask Mark Sweet of Loadpoint Ltd, Chelworth Industrial Estate, Cricklade, Swindon, Wilts SN6 6HE (Phone 0793 751160) for the details.



Again & Again

IF YOU USE batteries then it could be worth your while digging into your savings to buy a set of rachargeable cells and a recharger. Although capital outlay is initially higher than the outlay for a new set of alkaline or similar cells, it should be remembered that once alkaline cells are 'flat' (wot shape should they be?) they *remain* 'flat'. Rechargeable cells, however, are — you guessed it — rechargeable and can be used between 100 and 200 times. The *overall* cost is therefore much less.

Gould Battery Division announce a complete rechargeable battery system called 'Agein & Again', which consists of single universal charger (ie, it will recharge any of the cells in a particular range) and a selection of cells. The user simply buys the charger and whichever cells are required. The cells are available in AA (HP7), C (HP11), D (HP2), and 9 V, (PP3) sizes, and the charger can recharge up to four cylindrical batteries or two 9 V batteries at a time. An overnight charge will restore full power to cells, and cells can be charged indefinitely without harm. Gould Battery Division, Raynham Road, Bishop's Stortford, Herts.

UOSATing The Pace

BRITAIN'S scientific and educational satellite is flying high, orbiting the earth once every 95 minutes at a height of about 340 miles and travelling at around 17,000 mph. All systems activated so far appear to be working well. Already it has detected a major magnetic storm in the upper atmosphere and signals have been received by amateur and professional ground stations all over the world. In fact anyone with a standard ameteur FM receiver (covering 145.825MHz, the primary beam frequency) should be able to pick up a broadcast from the satellite during one of its three or four daily passes over the UK. The on-board speech synthesiser, based on National Semiconductor's "Digitalker", has been activated and tested. It is programmed to give orbit information, operating schedules and other information that will enable amateurs to make the best use of the satellite. Alternatively, this information is available from a phone-in bulletin service provided by the University of Surrey on Guildford 61202.

The University, who built and now operate the satellite, have been coping with non-stop enquiries (particularly from schools) about the unit needed to decode signals from the spacecraft's TV camera so that they can be displayed on a domestic TV receiver. As yet, the TV system has not been tested and no attempt will be made to activate it until the spacecraft has settled into a fully stable attitude. This will take some time, though, as many other systems must first be brought into operational condition and tested. However, details of the TV decoder module will be released as soon as the system has been tested and it is seen to be working correctly.

Meanwhile, UOSAT is exciting enormous interest all over the world. The BBC World Service has received more letters following its broadcast about UOSAT than for any other scientific or technology item broadcast last year, while AMSAT-UK, the organisation serving amateurs who make use of satellites, has been swamped with applications for membership!

HE

SCALING the HI-FI HEIGHTS

All you ever wanted to know about Hi-Fi but didn't know how to ask.

A BUYER'S FIRST foray into a hi-fi shop, laden with cash or plastic card, can be a daunting experience. The lamps are brightly highlighting the chrome-fronted bank-breakers and a pack of salesmen is closing in across the carpet, dorsal fins swishing lightly through the deep-pile . . .

Fear is the immediate reaction. Either the guy turns tail and runs for the pub next door, or he goes under and gets his bank balance badly damaged. If, in the process, he has obtained a system he can be happy with — fine. If not, then all too soon it will be back to the high street and off the deep-end once more.

One of the most common complaints from first-time buyers is that salesmen (and magazines) use too many technical terms, too many times per second. This leads into the 'numbers-game' where anything from 20 W to 100 W can be made to sound earth-moving and desirable.

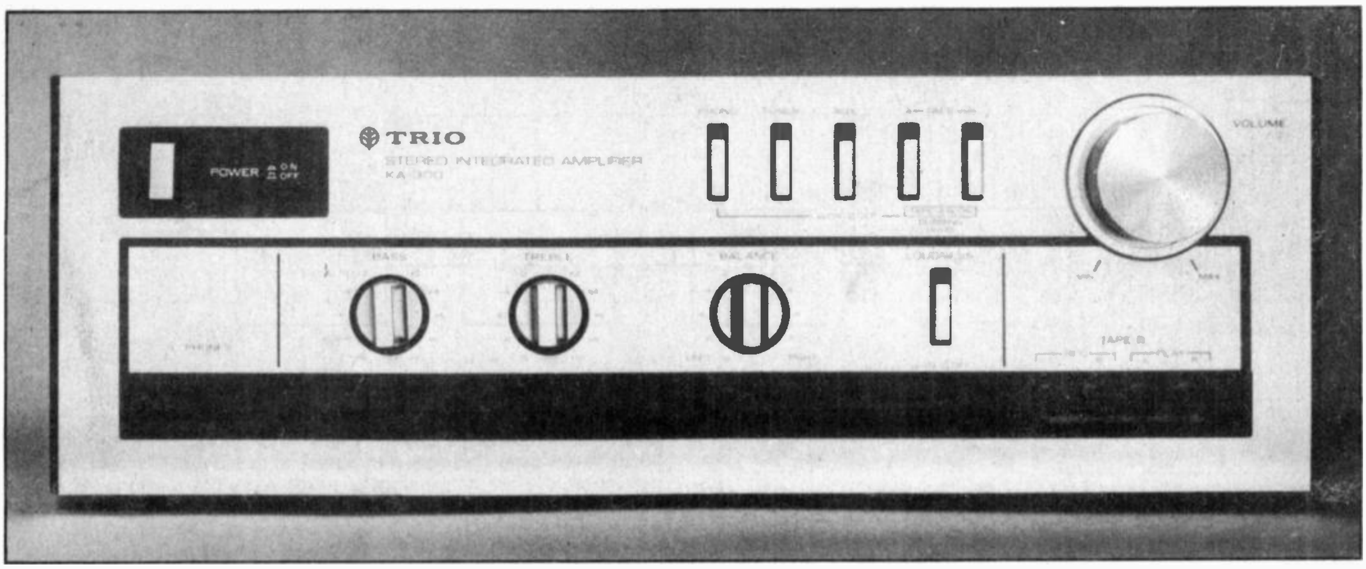


Figure 1. Low budget amplifiers, such as this KA-300, are often bare of all but the essential features. There are few extras, so choose the ones you need carefully. For example, "loudness" controls add nothing to the sound — except excessive bass.

The purpose of these articles is to remove some of the confusion that surrounds specifications quoted both in the salesroom and in printed matter, be it advertising blurb or whatever. An important part of this will be to point out which specifications are actually relevant and which are sheer bluff. In every case we will try to give some idea of the numbers which matter and how to interpret them.

The Way In

The general text of this feature is designed to offer a logical method for selecting and setting-up a hi-fi system, starting from nothing more than a wish to hear music in the home, and finishing up with how to install the system once you have it.

In addition, special sections will deal with disc players, amplifiers, tuners, tape machines and loudspeakers; discussing briefly the method of operation, the parameters which dictate performance levels — pointing out those which don't — and explaining the interpretation of these specifications in terms of sound quality. At the end of each section some suggested starting points will be given for various budget levels, beginning at £400 which is probably the lowest feasible total these days for serious sound pursuit.

These recommendations should be taken simply as that — somewhere to start. No one but *you* can decide which hi-fi is suitable for your home and only after you've been and listened to the alternatives should you decide to part with your hard-earned cash.

Listen to everything you buy *before* paying for it and be sure it is what you want. Always have the demonstration (as far as possible) set up with as much of your intended final system as can reasonably be arranged. And don't be put off by claims that ". . . it's too difficult". Parting company with £400+ is a serious matter, so make sure the sales staff take your request seriously, too.

Take It On Spec?

Hopefully once you've read this feature you will be confident enough to tackle the task of sorting out the valid claim from the exaggeration, or the double-talk from the helpful advice, but if you're not — ask! It is better to wade through excessive verbage than to remain shrouded in doubt. Don't be afraid to question what you've been told and mistrust anything which can't be explained to your satisfaction. This is probably bluff!

So, once armed with an understanding of the jargon and healthy scepticism, where do we start?

Room For Improvement

First things first. Do you know the size of the room in which the hi-fi will be operated? If you don't, out with the tape measure and find out! This will give you the volume of the air which must be moved to generate your music. In turn, this will tell you the minimum amplifier power output which is necessary for your room. We'll come back to this in a moment or two.

Secondly, decide your budget figure; how much you'd *like* to spend, and how much you will go up to if pushed. Having set this maximum, *stick to it at all costs!* It is far too easy to be swayed in the shop with 200 W of Pink Floyd in your ears, stars in your eyes . . . and the salesman's pen in your hand. Feasting on bread and water for a month is not worth the extra 20 W per channel!

For the reason that it makes least audible difference to the final sound, I always suggest that a system buyer chooses an amplifier first. The technology of the modern amp is an order of magnitude closer to perfection than either the turntable or loudspeakers and thus differences between them, within limits, are less detectable. Hence, deciding on the amp first allows for more flexibility later on when choosing either the turntable or loudspeakers.

As a basic minimum, 25 W per channel is a safe bet. With the cost of power coming down all the time, there is no point in selecting an amp with less capacity than this, since naught is gained (save frustration) later.

To relate this to your living room, add on 10 W for every 1000 cu. ft. of volume. For example:

Room size 10 x 10 x 8 ft. = 800 cu. ft.: Power needed = 25 W
Room size 15 x 12 x 8 ft. = 1440 cu. ft.: Power needed = 35 W
Room size 25 x 17 x 10 ft. = 4250 cu. ft.: Power needed = 65 W

For now we'll assume these are nice, clean, honest RMS watts — the section on amplifiers will deal with power rating more fully, but for the time being we have our guideline and that will suffice.

. . . But I Know What I Like!

When listening to a piece of hi-fi in a shop or at an exhibition (or anywhere else come to that), remember that the specs and jargon don't matter a jot. If you like the sound and it fits your requirements for price, etc, then that is all that matters. Ignore the salesmen, the nice new model for £30 more, the advice from a friend, neighbour or budgie and buy it! After all, it is you who has to live with it, not the Joneses or the salesmen. Don't be swayed — following the audio fashion is an expensive diversion!

Finally, always try to arrange for the dealer to demonstrate three or four different units to you, using the same cartridge, the same music and the same loudspeakers. If he can't (or won't) do this, then remember that once any other part of the chain is altered you cannot be certain that the differences in sound you hear are due to the amplifier.

Budget Balance

At this point we have a set budget figure and a required power for the amplifier. From this it is possible to draw up a shortlist of amps which possess the facilities you need — how many tape inputs, for example? Do you *really* want LED power meters or flashing lights to tell you what the hi-fi is doing? Remember,

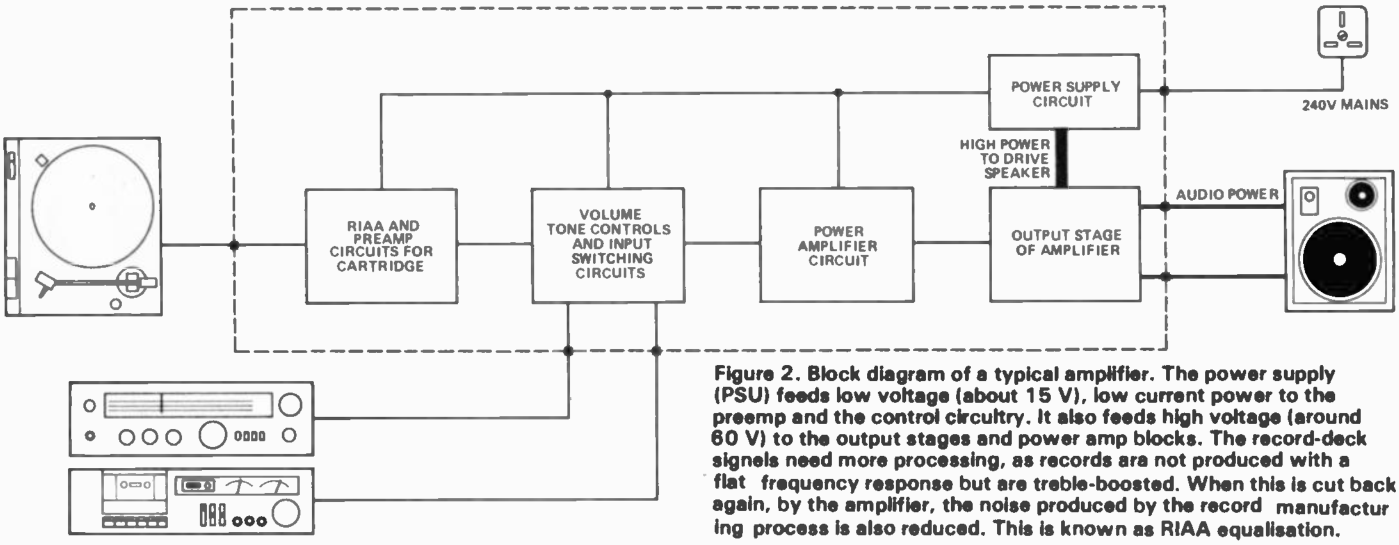


Figure 2. Block diagram of a typical amplifier. The power supply (PSU) feeds low voltage (about 15 V), low current power to the preamp and the control circuitry. It also feeds high voltage (around 60 V) to the output stages and power amp blocks. The record-deck signals need more processing, as records are not produced with a flat frequency response but are treble-boosted. When this is cut back again, by the amplifier, the noise produced by the record manufacturing process is also reduced. This is known as RIAA equalisation.

these extras all add to the basic cost without helping the sound,so be sensible and keep things a simple as possible.

Make a preliminary trip down to the hi-fi dealer and choose the unit from your shortlist of possibles, but try to spend no more than 35 percent of your total budget on the amp (you'll need the rest!). Choosing the amp first is not only logical, it is also the easiest starting point. For reasons which I hope will become clear, we'll take the record player next month. In the meantime, let's have a closer look at the amplifier — what it-should do and why.

The Amplifier Considered

The basic task for an amplifier is to make use of the small signals provided by the record player, tape machine, or tuner, to control the larger voltage available from the power supply and to apply this to the loudspeaker. This is done in such a way that what the speaker 'sees' is an enlarged version of the original signal; it is then up to the speaker to reproduce this enlarged signal (hopefully) accurately.

The power amplifer can thus be considered as a sort of valve, controlled by a preamplifier. The task of a preamp is to bring all the inputs to a common level and to provide some control over them — usually in the form of volume, tone controls etc — before passing the now modified inputs to the power amp.

In doing all this the amplifier as a whole should, itself,change the original signal as little as possible (ie distortion must be low). It must respond equally to all frequencies presented to it — have a flat frequency response — and have sufficient power available to deliver realistic levels in the living room.

Pay particular attention to the following specs when considering amplifiers, as they alone dictate the basic performance of the unit.

Power Output: There are many ways of specifying it, but few are more relevant than the old reliable RMS method. This is the power the amp can deliver continuously into a speaker, usually quoted for an eight-ohm unit — that is, most loudspeakers on the market. 'Burst' power, or peak delivery, shows you how much the power supply has in reserve to cope with crescendos in the music, or an enthusiastic drummer hitting the bass drum too hard. A peak of this sort will require anything up to 100 times the average level of power if it is to be reproduced without distortion. Look for an RMS rating at least as high as that dictated by your room size, with a peak or 'burst' power at least 1.5 times larger. Mistrust DIN, Music Power or any other wierd specification of power. Always take in conjunction with . . .

Power Bandwidth: Put simply, this is the range of frequency across which an amp is capable of delivering at least half it's quoted output. Normally it is given as two frequencies, ie 3 Hz — 40 kHz; This means that a 50 W unit would deliver 25 W at three cycles per second and at least that much all the way to forty thousand cycles. As the range of audible sound is approximately 20 Hz — 20 kHz, this particular unit is well specified. Beware of catches, though. Consider this:

Figure 3. At the top-end of the hifi tree, things are often less than simple! Compare the panel of this Carver preamp with that of the Trio KA-300 on the previous page. The S-4000 contains a circuit called a "Sonic Hologrem Generator" which creates a 3-D sound effect, claimed to be more like listening in a concert hall, than listening to an amplifier.

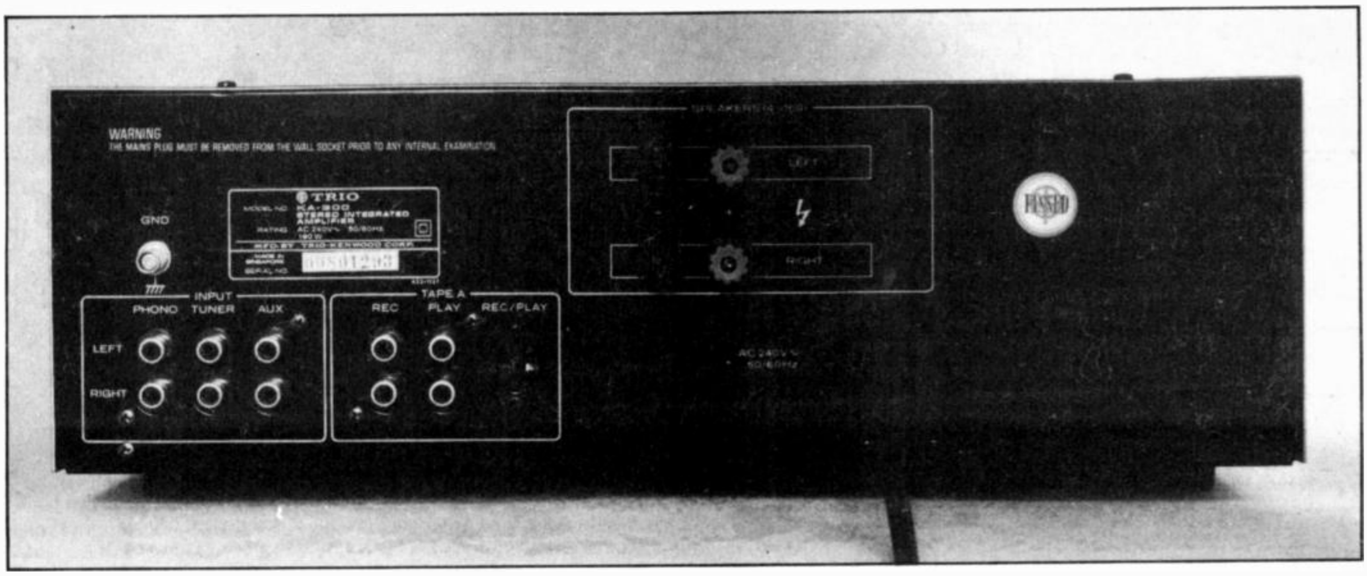


Figure 4. These phono sockets are fairly universal nowadays and you can buy ready-made leads to connect up almost any type of equipment. But, as they are identical, be careful when 'plugging in', and NEVER do so when the power is on.

Amp. A
Output: 50 W RMS (at 1 kHz)
Bandwidth: 40 Hz — 20 kHz

Amp. B
40 W RMS from 10 Hz — 20 kHz

At first glance Amp A is more powerful, but consideration of the bandwidth shows that, at low frequencies, it runs out of power pretty quickly. At 40 Hz it is delivering only 25 W, while Amp B is still capable of 40 W — and thus better bass! The larger spec is not necessarily the most honest. Look for a bandwidth of at least 20 Hz — 20 kHz and mistrust figures of more than 50 kHz as they are not only unnecessary, they are probably detrimental.

Frequency Response: A measure of how evenly, or otherwise, an amp will respond to different frequencies. The nearer the graph is to a straight line the better. If a number is quoted, it will be of the form "10 Hz — 20 kHz ± 3 dB" The 'dB' figure shows the amount of deviation from the straight line; plus or minus 1 dB is excellent, 2 dB mediocre and anything more is unacceptable! Look for 20 Hz — 20 kHz ± 1 dB as an ideal. Discount any figure that doesn't give a dB limit — it's meaningless.

Signal-To-Noise Ratio: You'll find this in several places throughout the specification. What it tells you is how much hiss or hum or other unwanted noise that particular circuit will add to the signal. All circuits add *some*, but what constitutes a good figure depends on which part of the amp is under scrutiny.
Look for . . . .
Disc Input: 65 dB or more
Tuner/Tape/Aux: 80 dB or more
Power Amp: 80 dB or more
Accept less if you dare, because if you play your music loud, lower figures will prove obtrusive. A figure quoted as 'weighted' means that it has been 'adjusted' to account for the noise frequencies which are most annoying. This method gives larger numbers, so check carefully. It is, however, a valid adjustment so don't necessarily mistrust it — but do be aware of it.

THD, IM and TIM: These are all forms of distortion and they tell you what percentage of the output signal is being generated by the amplifier itself. THD stands for Total Harmonic Distortion, IM for International Distortion, and TIM for Transient Intermodulation Distortion. With modern techniques, distortion figures are becoming irrelevant, as all amps these days should produce figures of less than one-hundreth of a percent. So long as the quoted figure is less than 0.1 percent, it can be regarded as sufficient and of no further value for judging how an amp will sound.

Damping Factor: The ratio of the output impedance of the amplifier against impedence of the speaker; irrelevant as long as it is more than 40. Mistrust anything less and if frequency of measurement is quoted, the lower it is the better. Practically, it is a measure of how well the amplifier can control the loudspeakers. A basic spec but, again, one which is easy for the manufacturers to get right.

Input Sensitivity: Sensitivity is the amount of signal required, at the input, to produce full power at the output. In other words, if a disc input has a sensitivity of 2 mV an the amp is rated at 80 W then with 2 mV coming in and the volume full up, 80 W of power is delivered into the speaker cable.
Record players will produce, on average, around 5 mV to 50 mV if they are standard moving-magnet types and anything from 0.5 mV down to 0.1 mV for low output moving-coil designs. Quite often an overload figure is also quoted and, if it is, it should be 100 mV or more, as this is the input level at which audible deterioration sets in and the higher this is the better! A competent design will realise a figure of 120 mV with little trouble. Look for figures somewhere near. . . Disc: 2 mV — 3 mV
Tuner/Tape/Aux: 100 mV — 200 mV
Anything too far away will prove unsatisfactory; either you won't have enough volume or you'll have far too much, and have virtually no level control at all.

Crosstalk: A measure of how much one channel affects the other, within the amplifier. Power supplies are the major cause of problems and any amp with separate supplies for each channel has an edge on the opposition. In any case, a well designed amp should easily exceed 60 dB.

Slew-Rate and Rise-Time: This is a measure of how fast the amplifier can charge its output level in following a signal. Measured in volts per microsecond (V/uS) and mathematically similar to Rise Time, the time taken for the output voltage to go from 10% to 90% of its final value. Both these measurements are becoming more fashionable lately, but their importance is questionable at best. They are related to frequency response, and the faster the Rise-Time, the wider the response. If a figure is given, the higher the better; 60 V/us is, for example, very good.

Class A, B, AB, etc: Or Sigma-Drive or Super-Feedforward or Clean Drive or Super-A or whatever. Ignore the lot! They *all* describe the circuit technique used in making the amplifier and are all *totally irrelevant*. If the other figures are right and the amp sounds good, then regardless of what class it is or whether it current-dumps or feeds forward, its a good amp! Methods of operation are interesting reading but, where a first-time buyer is concerned, not relevant to his choice.

NEXT MONTH: We continue with our ascent, choosing a turntable for the system and taking an in-depth look at the specifications. HE

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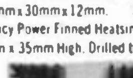

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Switched-Tuned Radio

Tired of playing 'Find the Station'? Six pretuned channels make life much easier

ALTHOUGH A RADIO capable of receiving only a small number of stations might at first appear to be of limited use, for most people it will prove more convenient than a radio having the ordinary, continuous dial tuning scale. This is due to the fact that people generally only listen to two or three of the stations available to them anyway. This makes switch-selection of stations an easy and convienient method of obtaining the few of them required to serve the many.

There is nothing new about the idea of push-button tuning, and apart from the use of such tuning in TV sets and FM receivers, this has also featured in a few AM sets over the years. However, whereas FM receivers have tended to use varicap (variable capacitance) diodes in the tuning system, AM designs have used more old-fashioned methods, such as a number of pre-set tuning capacitors. This tends to be more expensive than varicap tuning — where the set is tuned to the desired frequency by applying the appropriate voltage to the diodes. Here the tuning circuit consists of little more than the switch itself and a few inexpensive preset potentiometers.

Until recently the option of AM varicap tuning was not available, due to the lack of diodes with a wide enough capacitance range. The first of these devices, which appeared several years ago, were not widely adopted as they had a few major drawbacks, the main one being the need for a tuning voltage range of around 1 to 30 V. (This could not be easily obtained from the 6 or 9 volt supply normally employed with portable AM radios.)

The latest varicaps have been greatly improved and can give a wide enough capacitance swing for an ordinary AM receiver, using a maximum tuning potential of just a few volts.

Varicap Theory

A varicap diode is 'tuned' by applying a reverse bias to the device and, in fact, any semiconductor diode will give the effect! Varicaps differ from ordinary diodes in that the capacitance obtained at a given voltage is guaranteed to be within quite small limits, and they are designed to give good efficiency when used in this manner.

When a diode is reverse biased a 'depletion layer' is formed at the junction of the two pieces of semiconductor material and it is this layer which insulates the pieces of semiconductor from one another, thus preventing a significant current flow. Since a capacitor is merely two pieces of conductive material separated by an insulating layer (the dielectric), this is what is now formed in the diode. The pieces of semiconductor act as the conductive material and the depletion layer as the dielectric.

The capacitance can be raised and lowered by decreasing or increasing the width of the dielectric. In a varicap the width of the depletion layer varies in sympathy with the applied bias voltage such that a high capacitance value is obtained with a low voltage, and a small capacitance value is produced by a high bias.

Our simple varicap design gives

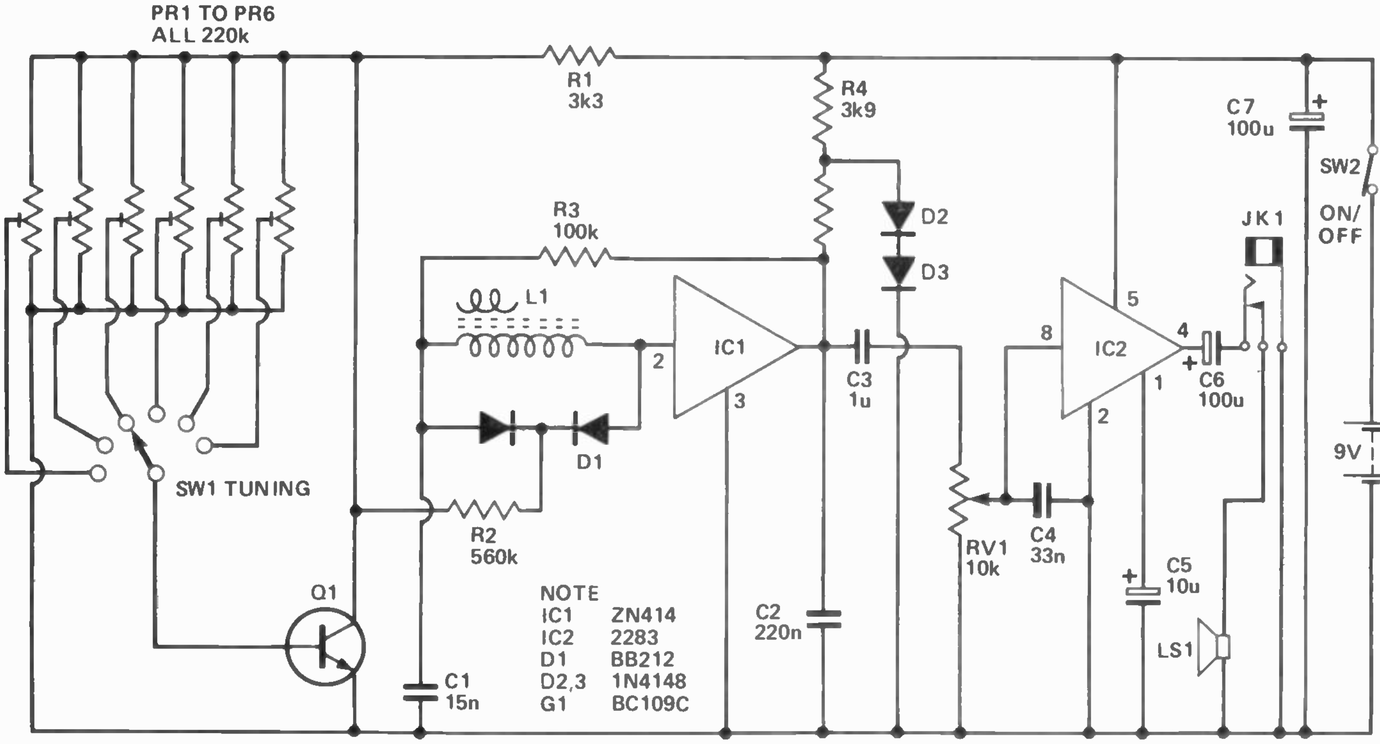


Figure 1. The circuit diagram; Varicap diode, D1, is a dual type.

reasonable sensitivity with sufficient volume from the internal loudspeaker and can have up to six switch-selected stations. Covering the full medium waveband, it is completely self-contained with an internal ferrite rod aerial and 9V (PP3 size) battery. There is also provision for a crystal earphone and the loudspeaker is automatically muted when the earphone is inserted. The unit is very easy to construct and does not need any complicated aligment.

Construction

Cut out a small piece of Veroboard, having 44 holes by 20 strips, then drill two mounting holes for the board plus another two for the aerial. **Figure 2** gives full details of the component panel, including the positions of these holes (which are 3.2 mm diameter and accept 6BA fixings.)

Next make the required breaks in the copper strips and solder the components and links into place, leaving the semiconductors until last.

Make sure that the electrolytics and semiconductors are fitted on to the board the right way round — it is too easy to connect them incorrectly.

Complete the board by fitting and wiring the aerial. It is mounted in two special plastic clips, fixed to the board using a couple of ¼ in. 6BA bolts. Only the larger winding of the aerial coil is used, and a quick visual check will show which two tags should be connected to this coil.

We used a plastic case measuring about 150 x 100 x 50 mm for our prototype, which is about the smallest size that will comfortably accomodate the components. The case must be made of a non-metallic material in order that it does not screen the aerial and prevent any signal being picked up.

The general layout can be seen from the photographs and it is advisable to adhere fairly strictly to this. The aerial coil and loudspeaker must be kept a reasonable distance apart or stray feedback between the two could cause a loss of performance or instability. It is also a good idea to have the battery reasonably well separated from the aerial to prevent even partial screening. The layout must also permit access to the six tuning presets (R1 to R6). The wiring then needed to complete the unit is shown in **Figure 2**.

The receiver needs L1 positioning correctly on the ferrite rod before the tuning presets are adjusted to their final setting. This is accomplished by first turning RV1 fully clockwise and adjusting SW1 to select PR1 (SW1 fully anticlockwise).

L1 is adjusted to bring the set to the low frequency limit of the medium waveband. If a suitable RF signal generator is not available to assist with this, simply make sure that L1 is moved close enough to the end of the rod to

Parts List

RESISTORS (all ¼ W 5%)

PR1 to PR6	220k horizontal preset
R1	3k3
R2	560k
R3	100k
R4	3k9
R5	680R

POTENTIOMETER

RV1	10k log with switch (SW2)

CAPACITORS

C1	15 nF polyester
C2	220 nF polyester
C3	1 uF 63 V electrolytic
C4	33 nF polyester
C5	10 uF 25 V electrolytic
C6	100 uF 10 V electrolytic
C7	100 uF 10 V electrolytic

SEMICONDUCTORS

IC1	ZN414
IC2	ULN2283B
D1	BB212
D2,3	1N4148
Q1	BC109C

MISCELLANEOUS

SW1	6 way 2 pole rotary switch
LS1	40 to 80 ohms min. speaker
JK1	3.5 mm jack socket
L1	Medium wave ferrite aerial coil type MWC2

0.1 in. Veroboard
Control knobs
Plastic case
140 x 9.5 mm F14 ferrite rod
Mounting clips for aerial
PP3 battery and connector to suit
Wire, solder, etc.

permit all the desired stations to be received, without RV1 having to be rotated fully anticlockwise. Glue or tape the coil in position once a suitable position on the rod has been found.

It then only remains to adjust each preset to the appropriate station. If you do not require all six tuning positions, leave out the unnecessary pots and wiring to SW1, setting the end stop of the switch to correspond with the number of presets in use. The set has a fairly wide bandwidth and so the tuning is reasonably easy using ordinary miniature presets. Multiturn types or high quality presets are an unnecessary expense in this application.

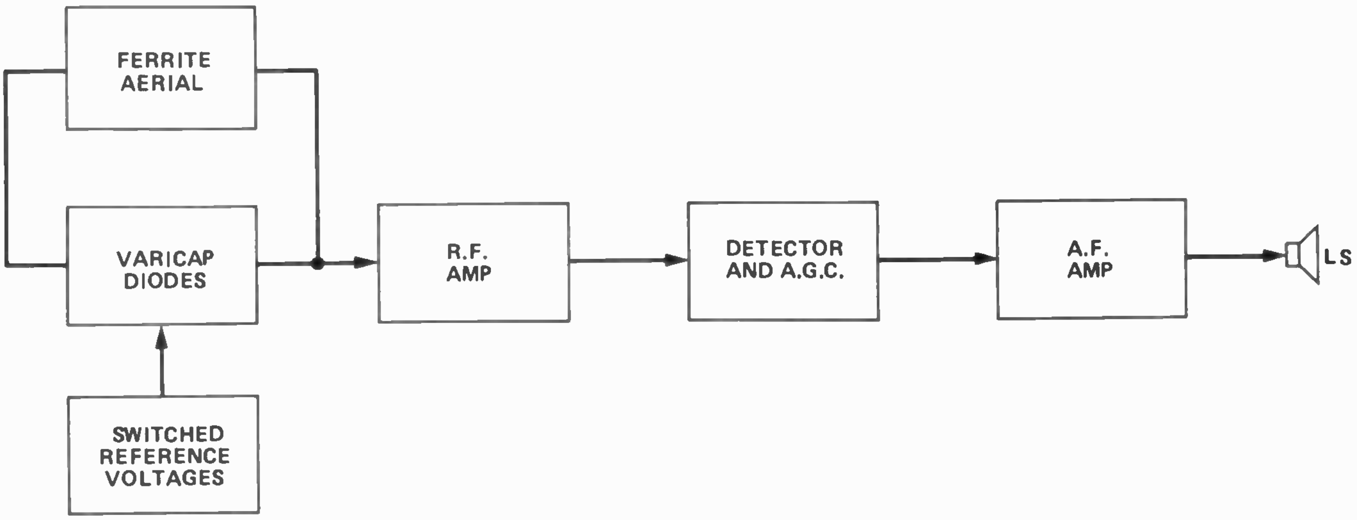
The unusual components in this project are the ferrite rod, plastic mounting clips for the rod, the aerial coil (L1), the BB212 varicap, and the ULN2283B audio IC, all available from Ambit International. The cost of this project, excluding the above components and the case, should be around £15.

How It Works

Basically the unit is a conventional TRF (tuned radio frequency) set covering the standard medium waveband. A TRF is a very simple type of receiver, where the signal from the aerial is amplified and demodulated by a detector stage in order to recover the audio. This is amplified before being fed to a loudspeaker or earpiece.

Sets of this type cannot equal the more sohisticated superhet type in performance but good results are nonetheless obtained. In this design the RF amplifier and detector stages are based on one IC, which has the refinement of an AGC (automatic gain control) giving a consistent volume level from stations of various strengths. The AF amplifier circuit uses a second IC to give a high quality output.

An unusual aspect of the circuit is that it uses switched tuning, accomplished with a varicap (variable capacitance) diode. This is a semiconductor component which uses a control voltage to alter the value of capacitance in the circuit. It is used in place of a conventional capacitor and is tuned by switched reference voltages to give preselected stations.



The Circuit

The circuit diagram of the receiver is shown in **Figure 1**. The heart of the unit is the ZN414 (IC1). This device contains the RF amp, AGC and detector circuitry thus requiring few discrete components. R3 is used to bias IC1 by way of L1 which is the ferrite aerial. C1 provides a signal path to earth. There are actually two coils on the aerial; the tuned winding and a smaller coupling coil. But as the ZN414 has a high input impedance, it can take the signal direct from the aerial without any impedance matching and the coupling coil is therefore unused in this circuit. R5 is the load resistor for the detector and AGC of IC1, and C2 is the RF filter capacitor. The ZN414 has no positive supply connection, recieving its positive supply via the load resistor R5. A supply voltage of about 1V3 is needed, obtained from the main 9 V supply using a shunt stabiliser circuit (R4, D2, and D3).

C3 couples the audio output signal of IC1 to volume control RV1. The latter also biases the input of the audio amplifier IC2, a ULN2283B device with a fixed voltage gain of nominally 43 dB — enough to drive high impedance loudspeaker. C4 provides RF filtering at the input of IC2 and C5 decouples the supply to the input stages of this device. Both these components are needed to prevent the audio stages becoming unstable.

D1 is the varicap tuning diode, and is actually a dual type, the tuning component being formed by the series capacitance of the two sections. With no bias applied, the diodes exhibit a capacitance value of a few hundred picofarads which tune the set to the low frequency end of the medium waveband. With a reverse bias of about 6V, a few tens of picofarads are produced tuning to the high frequency end of the waveband.

Intermediate voltages give intermediate reception frequencies and an appropriate voltage can tune the set to any desired frequency. Note that the anodes of D1 are biased about 0V8 above the negative supply rail by R3, but in practice this simply means that the tuning voltages are all raised by about 0V8 volts in order to compensate.

The tuning voltages must be stabilised and this is achieved by Q1. SW1 selects the six tuning potentiometers, and can then be adjusted to give a stabilised potential of between about 0V65 (with the wiper at Q1 collector) and 7V (with the wiper at the other end of the track.) The upper limit is set by the supply voltage available.

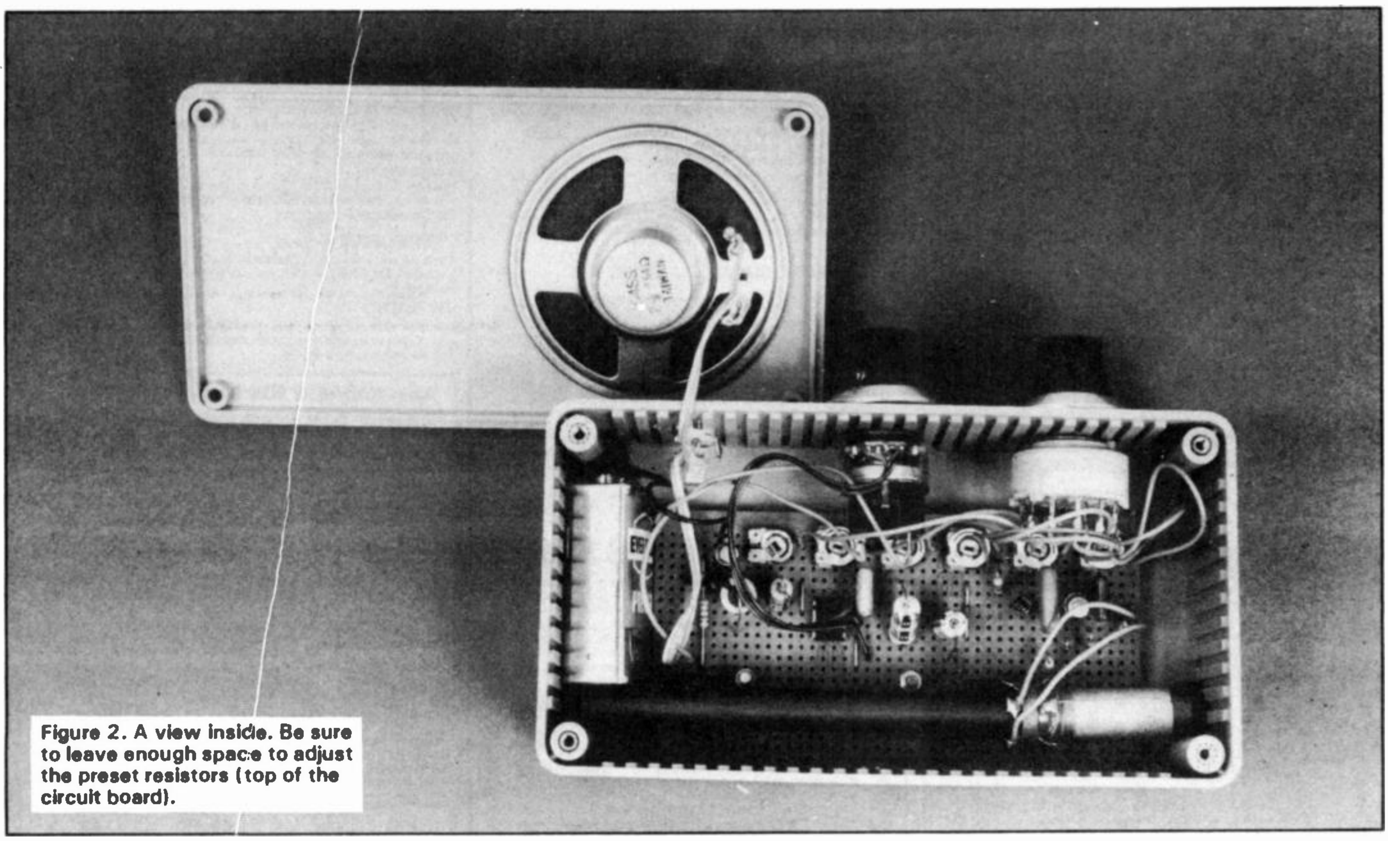


Figure 2. A view inside. Be sure to leave enough space to adjust the preset resistors (top of the circuit board).

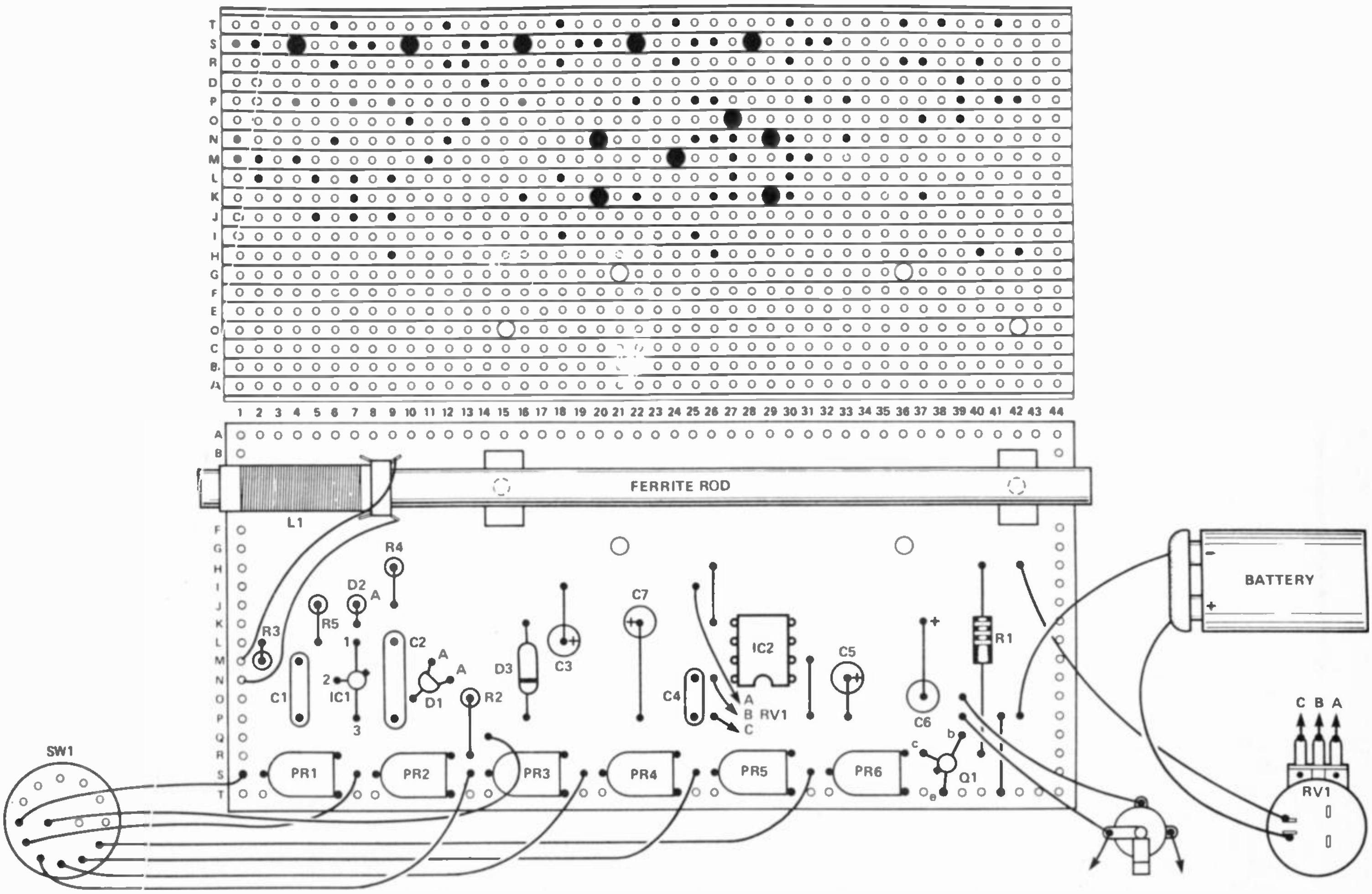


Figure 3. Component layout, with external wiring, and bottom view of the stripboard.

HE

YOUR LETTERS

The Editor answers a selection of your letters

Deaf-Aids Revisited

Dear Sir,
I am a regular reader of Hobby Electronics and an absolute beginner in electronics. However, I was appalled at the attitude of your reply regarding help required by Mr. Tate who, in his letter (Your Letters, HE November 1981), *asked for hearing-aid circuits and was bluntly cut-off with the comment "Our hands are tied".*

My three year old son is profoundly deaf in both ears and uses a radio link hearing-aid; one of the vital requirements for this, as for any hearing-aid, is the batteries that power it, in my son's case, 6V NiCad batteries. The peripatetic teacher who attends each week is desperately in need of a battery checker with simple reliable service, similar to a 12V car battery checker. Can you help?

As Mr. Tate said, there is scope for quite a few projects and this is one.
B.C. Goodman,
Newmarket, Suffolk.

What Hugh Davies said, in his reply to Mr. Tate, is that deafness is a medical condition — and we are not at all qualified to advise on purely medical problems. Consider the possibility, as we must, that a partially deaf person could further damage his or her hearing through misuse, whether by accident or by ignorance, of a hearing-aid device published in our magazine. Heart-beat monitors and suchlike are harmless enough, but any gadget intended to correct an actual medical condition must, we're sure you'll agree, be designed, constructed and operated under strict medical supervision.

As to a NiCad battery checker, it is not practically possible to design such a circuit. NiCad's have very flat discharge curves; simply, they appear to be either charged or discharged. The charge does not fall-off gradually, as with car batteries.

Fortunately, the Intelligent NiCad Charger in this issue should solve the problem, although you may need to shorten the charge period to avoid over charging the battery.

Books For Basics

Dear Sir,
I would be obliged if you can recommend a good basic electronics book for a boy, aged 13, who is very interested in the above.
Lawrence Noone,
Dublin, Eire.

We can indeed — our own "Electronics, It's Easy" is an excellent starting point for anyone approaching the subject for the first time. Another good 'starter' is "Beginner's Guide to Electronics" by Owen Bishop, now in its fourth edition. It is published by Newnes Technical Books, Borough Green, Sevenoaks, Kent TN12 8PH, but should be available from any good technical bookshop. Some other suitable publications are listed on our Bookshelf page.

Astronomy Dominie, OK

Dear Sir,
I am interested in both astronomy and electronics. A friend and I recently came up with the idea of building a radio telescope. Could you help? Perhaps a circuit . . . ?

Also, is it possible to get back issues, and Hobby Prints?
Robin Cartley,
Vice-Chairman, Crofton Astronomical Society,
Fareham, Hants.

Our first reaction to this query was along the lines of " . . . you've got to be joking"! On second thoughts, though, it occurred to us that a small-scale radio astronomy project — something a little less grand than Jodrell Bank — might be possible. We'll let you know.

Hobby Prints have been discontinued but most of the old ones are still available from our Reader Services Department. Your other question is answered below . . .

Specials and Back Numbers

Dear Sir,
While looking through some old copies of HE the other day I noticed several references to your "Electronics Digest" Volume 1, Number 1. For some reason or other I failed to purchase a copy of this most interesting publication and would very much like to get hold of a copy.

I know it might be a slim chance but I wondered if perhaps you might have the odd left-over copy lying around, which I could purchase.
E. Weeks,
Godalming, Surrey.

Electronics Digest Vol.1 No.1 is still available from our Reader Services Department (Specials) for £1.80 including p&p within the UK. Incidentally, Vol.2 No.3 was published in November 1981, so get it while you can!

Back issues of Hobby Electronics are £1 from the Back Numbers Division of Reader Services, subject to availability. You should allow 21 days for delivery.

Bouquets . . .

Dear Sir,
I have recently become interested in electronics and am at present following a course in the subject at school.

I have started receiving your excellent magazine on a regular basis and would like to take this opportunity to praise the high standard it maintains and the superbly explained and illustrated projects.

As a project for the above-mentioned school course, I am hoping to construct a "multimeter" which would be of practical use both in research and other construction projects. Therefore, I was hoping that your magazine may have carried some articles relating to the construction of such a project.

I would be very grateful if you could help.
Francis Bailey,
Benson, Oxon.

High praise indeed! Unfortunately, though, we are unable to help with your project as we have not, in the past, published such a circuit. It is actually cheaper, these days, to buy one "ready made"; that's another part of the Shogun Inheritance.

. . . And Brickbats

Dear Sirs,
I have cancelled my order for Hobby Electronics and suggest that you change your title to BBC.

*The amount of **repeat** projects that you churn out i.e. 1981 issue, four out of five are reprints; November 1981 issue, four out of four are reprints.*

*All this suggests to me is that your technical department concentrates on the best way to change existing projects so that you can do **another reprint**.*

I suppose that this letter will be consigned to the rubbish bin.
Yours in disgust,
R. Dixon,
Leeds.
P.S. I have taken HE from the first issue but enough is enough.

Every specialist magazine has this problem. In our case it is perhaps true that we have not always met the challenge of devising new but still simple projects, as well as we'd like. There are, after all, a limited number of clever things you can do with one or two transistors or ICs. Inevitably, a certain number of projects are recycled, but this is entirely for the benefit of new readers — new to HE and new to electronics; it is not just for our convenience, or because we're lazy.

Perhaps it's time you moved on to more complicated projects, ones with a higher "degree of difficulty". You might find more of a challenge in the pages of our sister magazine, Electronics Today International.

Meanwhile, we'd like to assure our readers that, while a certain number of projects and even feature material — the popular "Building Site" series, for example — will be repeated from time to time, we are always investigating new applications and, we hope, exciting new ideas to extend this fascinating hobby of ours.

HEBOT

The popularity of this little beast continues to amaze us, so it is with regret that we must announce (again) that most of the parts for HEBOT are no longer available. HEBOT is dead, deceased and gone before; Resting, we hope, In Peace.

Dedicated Robo-maniacs are directed to the September and October issues of Electronics Today International. ETI is planning a series of articles and projects covering all aspects of robotics. The series starts with a Robot Arm project, descibed in the issues mentioned above.

Electronic Organ

Dear Sir,
I hope you will forgive me for adding to the list of letters saying how much we, the readers of HE, appreciate it and those who produce it.

I'm sure that, at times, it must be difficult to devise projects and I would like to make some suggestions for you to consider. The Organ Project (HE, May 1981 onwards) *was first-class and surely worth some extension. How about some voices, individual preset boards with genuine instrument sounds — oboe, trumpet, cello etc — and, of course, a reverberation unit.*

Also, as more and more computers are sold, how about a good power supply with the facility for powering dynamic RAMs as well as overvoltage protection. Most computers seem to have on-board regulation with inadequate heatsinking, and the shortcomings certainly show up if any expansion is planned.

Apart from the reverb, I haven't seen any of the above in any electronics mag. I do hope that these ideas are of some help.
G. Bobtridge,
Leamington Spa, Warwicks.

You are forgiven! We never become tired of compliments — or of complaints (they keep us on our toes . . .).

Your suggestions regarding the Electronic Organ have been passed, along with several other enquiries on the subject, to the designer. Thank you for the other suggestions, too. We will give them some thought.

Components

We have received a number of requests about components — the strange markings on capacitors, the importance of the different types (polyester, electrolytic etc), resistor ratings and so on. In general, these topics are covered by Ian Sinclair's series "Into Electronic Components" and also in his book, "Understanding Electronic Components".

However, because of the number of requests for this sort of information we will publish, soon, a quick reference guide that will answer most of the difficult questions.

Thanks to P. Payne of Oxford, W. Haynes of Tattershall, Lincs, and M.A. Barrett of Kings Lynn, Norfolk, for their suggestions.

Parts Past

Dear Sir,
I want to build the Shortwave Receiver,featured in September 1981 Hobby Electronics, but cannot find a supplier for the 40673 Dual Gate MOSFET.

Can you help?
P. Winards,
Manchester.

The 40673 appears to have been discontinued — such is life!
Try the MEN616 (Ambit catalogue) or a 3N140 (Watford Electronics).

Letters Acknowledged

Letters have also been received from: J.B. Day of East Barnet, Herts; D.C. Hodgkins of Burnham-on-Sea in Somerset; Edwin Coruth of Leeds; R.B. Ridley Martin of Brockenhurst, Hants; P.H. Smith from Oadby, Leics; William Buckley from Maudlen, Beds; David Jarrard of Welwyn Garden City, Herts; Kevin Salisbury from Exeter in Devon and lastly, from further afield, Jason Lee, who wrote from Province Wellesley in West Malaysia.

We regret that we are unable to answer these letters, as neither time nor space permit.

Oops!

We seem to have collected quite a file of technical enquiries, many of them related to errors, or possible errors, in projects. Rather than try to answer these letters one at a time, we will try to gather them together and dispose of them all at once.

Famous Names

Dear Sir,
In your otherwise excellent (and very welcome!) feature on Campbell-Swinton in Hobby Electronics December '81, you have omitted to draw attention to what was probably his greatest flash of insight — his ennunciation of the so-called "storage principle". This was to become crucial in the realisation of high-definition television 25 years afterwards. He realised that each element of the picture mosaic should store up its photoelectric current for the whole period of the "frame" time (one-tenth of a second as he suggested, one-twentyfifth of a second as eventually realised) asnd deliver the accumulated charge as a picture signal at the moment when the scanning electron beam discharged the element.

All other systems, mechanical and electronic, only delivered a picture signal proportional to the photoelectric current at the instant of discharge, which was lower by a factor of the order of 10,000 (for a 405-line system).

As you say, Campbell-Swinton hadn't the technical means to realise his vision; this had to wait until Zworykin constructed his "Iconoscope". But there is no doubt that Campbell-Swinton had the right idea many years before.
B.M. Crowther,
Dorking, Surrey

Dear Sir,
Re. the rather sketchy article by Mr. Ted Jennings in the November issue.

Once again, Edison has been credited with the first use of wax for recording; not so.

Edison was the first to record and replay articulated speech in 1870, but this was on tin foil wrapped tightly around a spiral grooved cylinder. The stylus, attached to the diaphragm, embossed the tin foil over the groove, to a depth varying with the modulations of the voice. The recording could be played back only two or three times; the soft unsupported metal had, by then, been pressed to the bottom of the groove. It was little more than a laboratory novelty and Edison abandoned it for 10 years while developing the carbon filament lamp and the 3-core cable for mains electricity.

A nephew of Bell (the inventor of the telephone) and Tainter made a machine with removable wax coated cardboard cylinders. The recording was cut or engraved in the wax and replayed with a ball-shaped Saphire stylus. The improvement was offered to Edison, who rejected it. They transposed the word Phonograph and called their machine the GraphOphone.

Edison quickly redesigned his Gramophone to take cylinders of wax, which could be shaved and re-used, but he had to pay royalties to Bell and Tainter.

The "war" between cylinder and disc raged from the 1890s to 1916, when imports were barred for the duration of the war. Entertainment cylinders faded out in 1929 but the Office Recorders, Ediphone and Dictaphone, continued in use until the 1960s and the advent of magnetic recording.

The City of London Phonograph and Gramophone Society and its branches, exists and thrives for those of us who collect and treasure these old historical machines.
N. George,
Rushden, Northants.

HE

QUICK PROJECT:

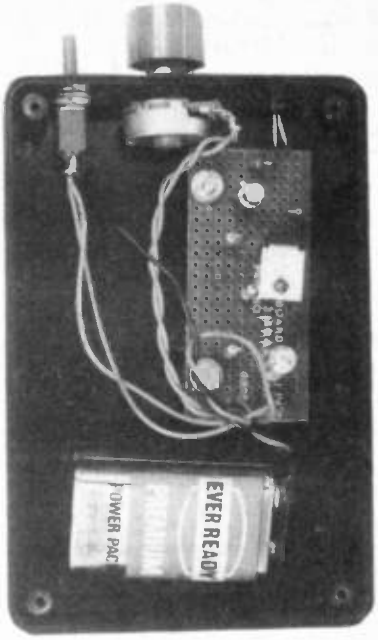
SIMPLE TIMER

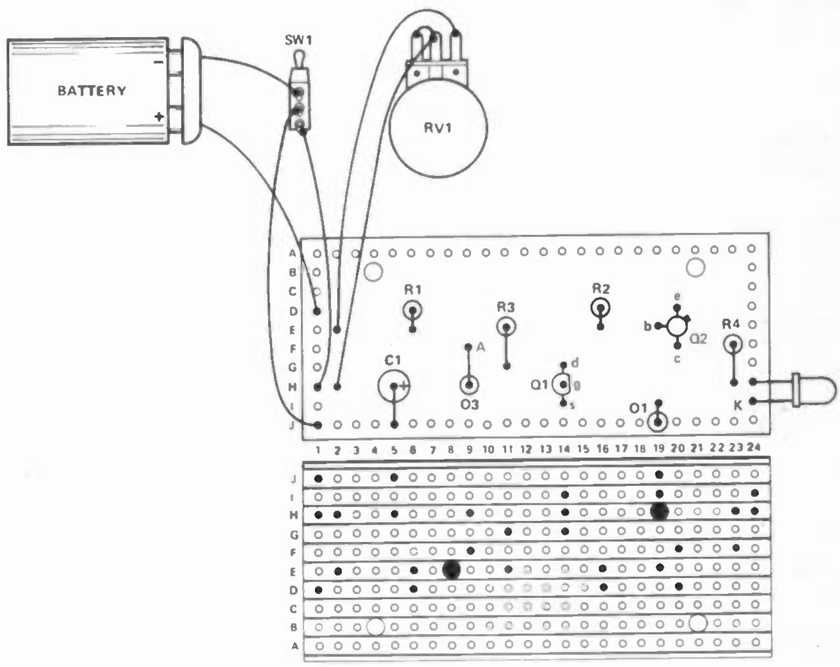
THIS *VERY* SIMPLE timer unit turns on an LED between two and five minutes after switch-on. The time delay is continuously variable within these limits. To start a new timing run the unit is simply switched off, then on.

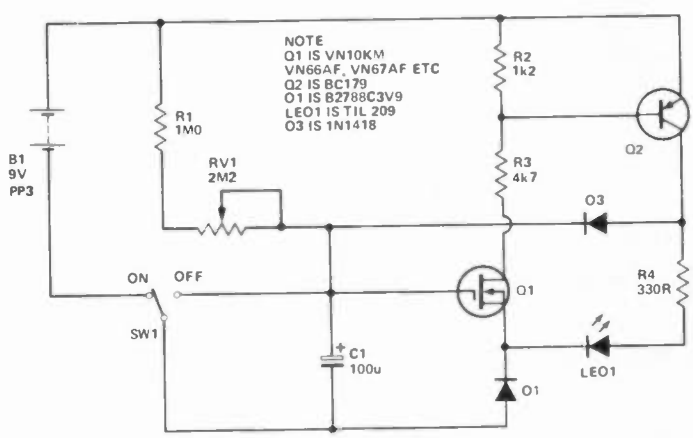
At switch-on, Q1 will be cut off because C1 is uncharged and will take Q1's gate to the negative supply potential. Therefore, Q2 receives no base current and is also cut off. C1 will charge from the supply line by way of RV1, R1; the rate of charge can be varied by means of RV1. After a time the charge on C1 will be sufficient to bias Q1 and D1 into conduction: D1 is used to raise the gate threshold voltage of Q1 so that fairly long time delays can be obtained using practical resistance and capacitance values. A VMOS device is used for Q1 as they draw insignificant input current and there is, therefore, no significant leakage of the charging current.

When Q1 starts to switch on, Q2 also starts to conduct and passes additional charge current to C1, via D3. This results in both Q1 and Q2 rapidly switching hard on and D2 lights up due to the current flow through Q2, R4, D2, and D1. The regenerative action of D3 ensures that D2 switches on cleanly and rapidly. When SW1 is switched to the 'off' position, it discharges C1 so that a new timing run can commence.

C1 must be a low-leakage electrolytic or tantalum type, otherwise leakage through it will greatly extend the delay time and could prevent D2 from switching on at all. Q1 can be any N-channel VMOS device (VN66AF, VN67AF, etc).



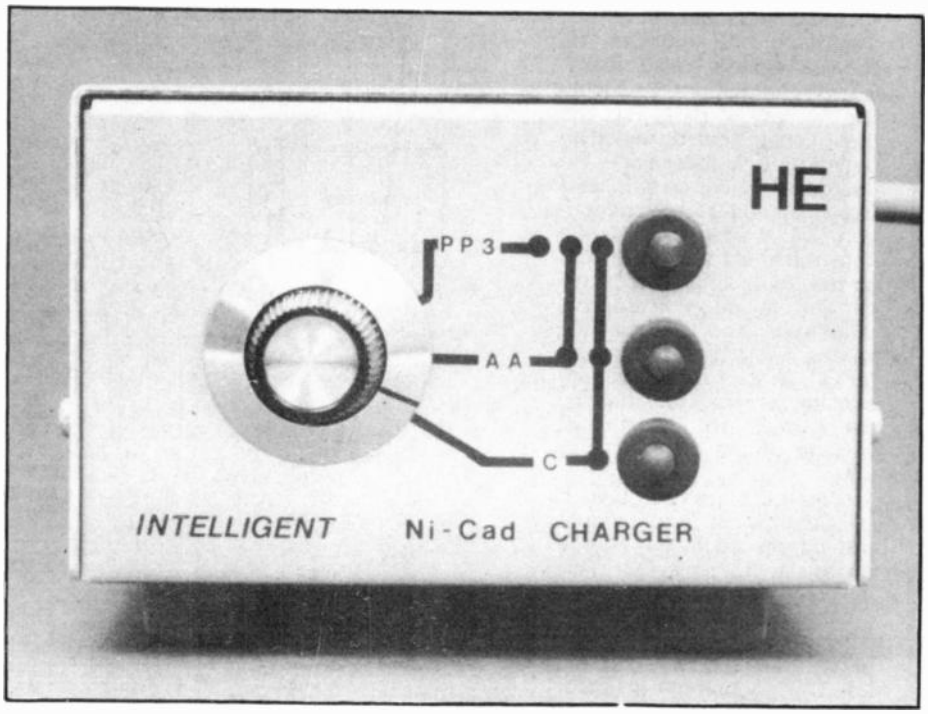




HE

INTELLIGENT NICAD CHARGER

It does the thinking for you



The advantage of using NiCad batteries in equipment such as flashguns, electric models and cassette recorders is that they are considerably less expensive, in the medium to long term, than ordinary (non-rechargeable) batteries. One drawback, however, is the bother of keeping track of how long they have been on charge. Most NiCad manufacturers claim that overcharging cells does not do them any harm, so that it does not matter if they are left too long on charge. The real problem tends to be that the cells are not left on charge long enough, so that they fail prematurely. Another problem is that, in order to achieve their full lifespan, NiCad cells should go through full charge-discharge cycles, since partial charging can reduce operating life.

What is needed is a charger that knows when to switch itself off — but does not cost a fortune. The Intelligent NiCad Charger fits these requirements precisely. It has a built-in timer which cuts off the output approximately 15 hours after switch-on (normally NiCads require 14 to 16 hours to fully recharge) and uses a simple circuit that requires few components.

NiCad cells must be charged from a source which limits the charge current to a safe level as they are likely to be damaged if this current is exceeded. This charger uses a constant current source that gives switched, nominal output currents of 11 mA, 50 mA, and 180 mA. These currents are suitable for PP3, AA (HP7), and C (HP11) size NiCad cells respectively. The unit can charge at one time, either one PP3 size battery or up to six AA cells, or up to four C size cells.

Timer

The normal choice these days, for practically any timing application, is the 555 IC; but not in this case. The Old Faithful is unsuitable here because of the impractically high component values (such as a 54 megohm resistor and a 1000 microfarad capacitor!) required to give a timing run of 15 hours. While this is quite feasible in theory, in practice the leakage current though the capacitor would be such that the timing pulse would, almost certainly, never end! An alternative form of timer is one that uses a counter circuit fed by an oscillator. The output pulse usually lasts for a certain number of oscillator cycles.

The ZN1034E, the device used in this circuit, is a counter-timer IC of this type. It requires 4095 (internally generated) oscillator pulses before the counter changes state, and this enables quite long output times to be obtained using fairly low RC timing component values. In fact, the output time of around 15 hours is obtained even without having to use an electrolytic capacitor in the timing circuit.

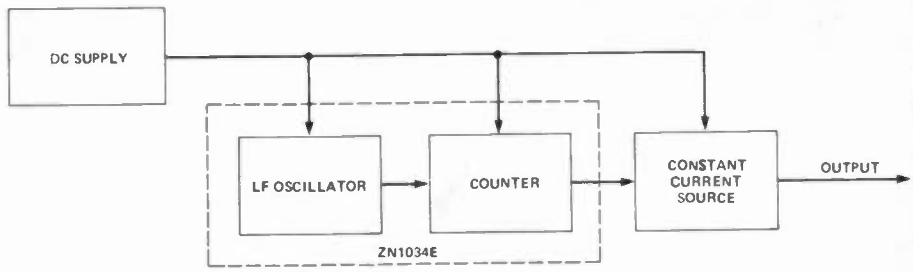
In Use

AA or 'C'-sized cells must be fitted into a plastic battery holder which has a PP3-type connector to fit directly onto the output connector of the charger. The cells must be connected in series and the plastic holders ensure this, but be sure to fit the batteries into the holder with the correct polarity! Of course, a PP3 NiCad simply connects directly with the output connector. Remember to set SW1 for the appropriate charge current before connecting the cells. Due to the tolerances of the components, it is possible that the charge time might be somewhat outside the required 14 to 16 hour range. If necessary, the value of R1 can be raised or reduced and this will give a degree of control over the charge time. However, if the error is only small, it is probably not worthwhile bothering with.

How It Works

The charger is powered from the AC mains supply and gives a DC output suitable to charge NiCad batteries. It is essential that NiCad batteries are charged at a low current or they may become damaged; the output is therefore supplied by a constant current source, which sets the charge current at a safe level.

A counter circuit is used to control the charge time and at switch-on it enables the current source to function normally. After the counter has received 4095 pulses from the oscillator (which takes around 15 hours) the counter output changes state so that the current source is switched off and the battery no longer receives any charge current.



The mains supply is converted to a smoothed, low voltage DC supply by means of conventional full wave power supply circuit, T1, D1, D2 and C1. No on/off switch is used as, presumably, the unit will be unplugged when not in use.

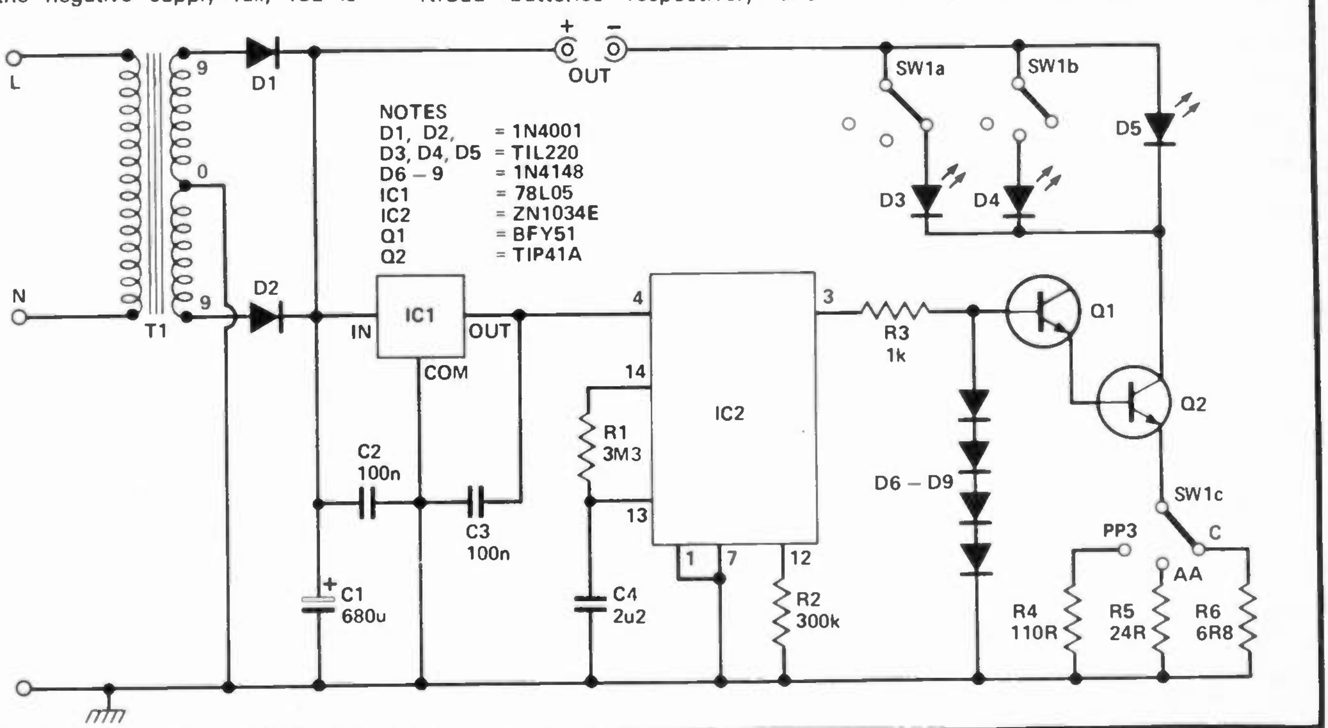
IC2 is a precision timer device which contains an oscillator, 12-stage binary counter, and control logic circuitry. It requires a stabilised 5 volt supply and has an internal 5 volt shunt regulator, but this can easily be damaged by excessive current so an external 5 volt monolithic voltage regulator (IC1) has, therefore, been used. C2 and C3 are supply decoupling capacitors which prevent IC1 from becoming unstable.

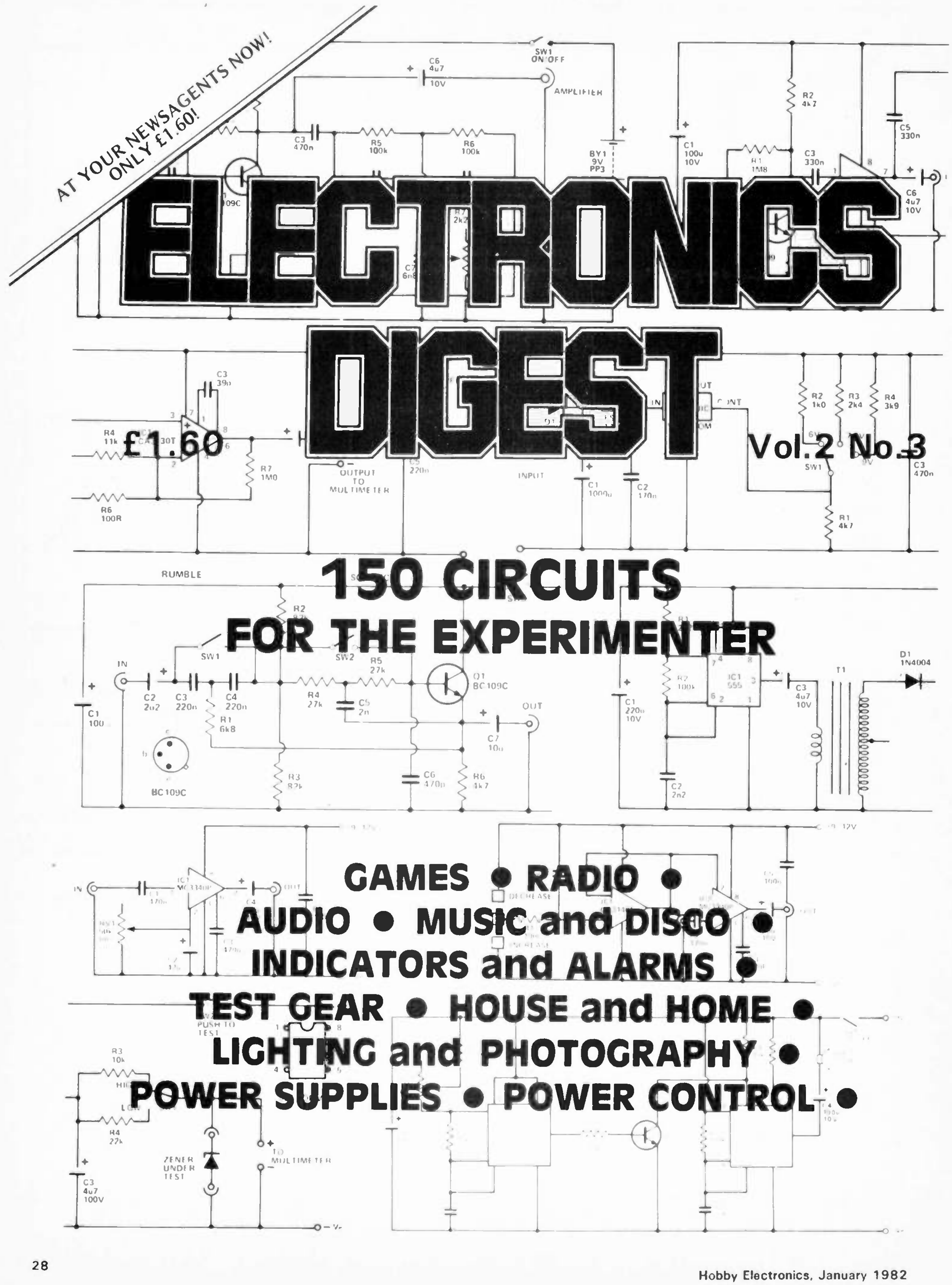
Pin 1 of IC2 is the trigger input and, as it is taken low by being connected to the negative supply rail, IC2 is triggered as soon as the unit is connected to the mains supply. At the same time, the Q output at pin 3 goes high, to approximately +5 volts. The time for which the Q output stays high is determined by calibration resistor, R2, and timing components R1 and C4. With R2 at the specified value, the timing components give nominal output pulse length of 7500 RC, that is, 54450 seconds (15 hours and 7½ minutes).

R3 plus D6 to D9 form a simple shunt regulator circuit that gives potential of about 2.4 volts at the junction of R3 and D6. D6 to D9 are ordinary silicon diodes, forward biased and give a voltage drop of about 0.6 volts across each (4 x 0.6 volts = 2.4 volts). This voltage is used to drive Q1 and Q2 which are connected in the Darlington configuration and form the basis of the constant current generator circuit.

There is a drop of about 1.2 volts from the base of Q1 to the emitter of Q2, leaving 1.2 volts across whichever emitter resistor is selected by SW1. This gives an emitter current of roughly 11 mA with R4 in circuit, 50 mA with R5, and 180 mA with R6. These are the appropriate charge currents for PP3, AA, and C sized NiCad batteries respectively and provided a suitably low resistance path is present in the collector circuit, the collector current will be virtually equal to the emitter current. By connecting the NiCad cells in the collector circuit of Q1/2, therefore, these cells can be charged at the appropriate current.

The charge current always passes through LED indicator D5 and this shows whether or not the battery is properly connected to the unit and is charging. It also shows that the charge period has ended since, after 15 hours approximately, the Q output of IC2 goes low, switching off Q1 and Q2 and cutting off the charge current. With SW1 in the "AA" position, D4 is switched in parallel with D5 and in the "C" position both D3 and D4 are switched in. There are two reasons for doing this; one is simply that the LED display makes it very clear which charge current the unit is switched to (one LED for the PP3 mode, two for the AA mode, and three for the C mode) so that there is little risk of charging a cell at the wrong rate. It also keeps the current through the LED indicators to an acceptable, though high, level when the unit is used at the highest charge current. A secondary role of the indicator diodes is to prevent the NiCad cells discharging through the charger.

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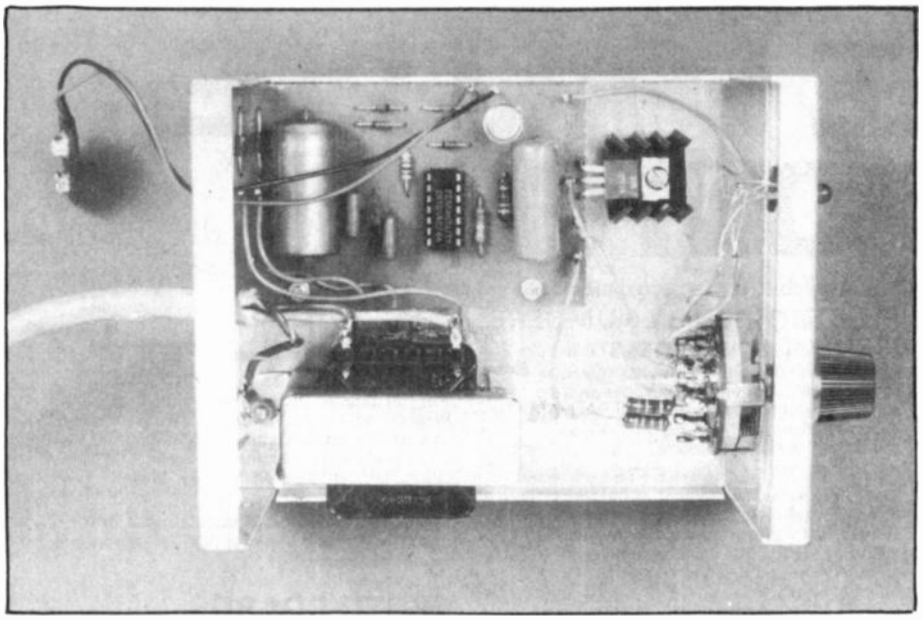


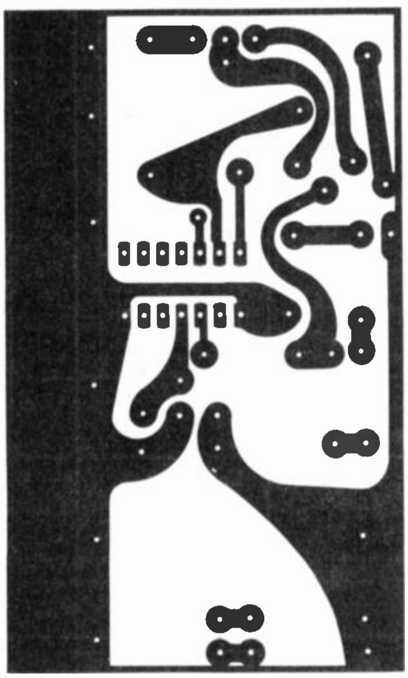


Figure 1. PCB foil pattern of the Intelligent Charger.

Construction

The prototype was built in to an inexpensive aluminium case measuring 133 x 102 x 64mm, but any metal case of similar dimensions should do. SW1 is mounted on the left side of the front panel, with D3, D4 and D5 fitted in panel holders on the right. Use large (0.2in.) LEDs and also three LEDs of *exactly* the same type (*not* different colours) or, due to differing LED voltages, one or two of the indicators may not work. *(The design is a little unusual in that it allows the LEDs to draw so much current — 60 mA each, in the 'C' position — however, no problems arose during repeated tests in our workshop. Ed.)*

A soldertag should be fitted to one mounting of T1 in order to provide a chassis connection point for the mains earth lead. Be sure to use a three-core mains lead and earth the case securely. Drill two holes in the rear panel, one for the output lead and one for the mains cable, and fit them with grommets to protect the cables.

The output connector is an ordinary PP3 battery connector — remember to thread the leads through the hole in the rear panel before soldering them in place!

Finally, connect the mains lead, and give the wiring a thorough check before switching on. **HE**

Parts List

Resistors (all ½ watt 5%)

R1	3M3
R2	300k
R3	1k
R4	110R
R5	24R
R6	6R8

Capacitors

C1	680uF 25V electrolytic
C2,3	100nF polyester (C280 series)
C4	2u2 polyester (C280 series)

Semiconductors

IC1	78L05 (5V, 100 mA) regulator
IC2	ZN1034E
Q1	BFY51
Q2	TIP41A
D1,2	1N4001
D3,4,5	TIL220 (0.2 in. red LED)
D6,7,8,9	1N4148

Miscellaneous

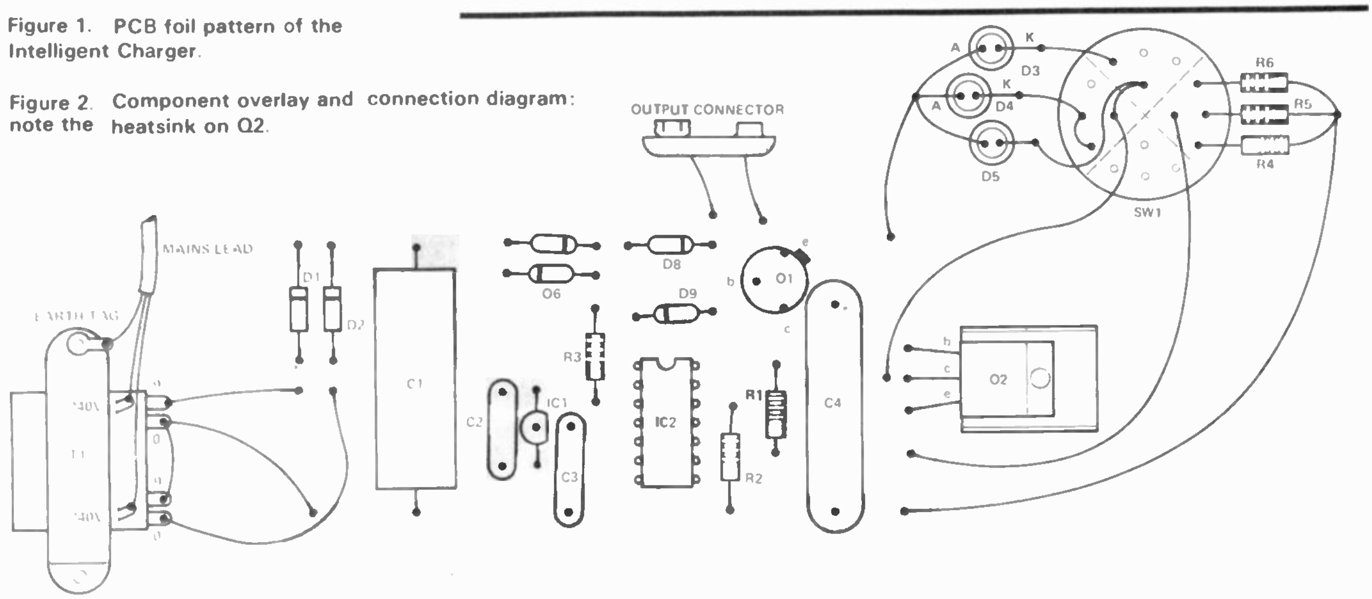
SW1	3 way, 4-pole rotary
T1	Standard; 9-0-9 volt, 500 mA secondaries

PP3 connector, case, PCB control knob, panel holders for LEDs, finned heatsink for Q2, mains lead, wire, solder, etc.

Buylines

There should be no problems in obtaining the components for this project. Total cost, including case and heatsink, should be about £12.

Figure 2. Component overlay and connection diagram: note the heatsink on Q2.



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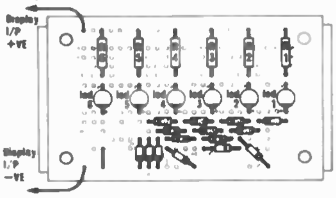
The suspense and excitement of the casino in your own home. Just press the button, the circle of lights go round and there is the sound of the roulette wheel as well, both gradually slowing down to reveal the winning number.

No. 12 EGG TIMER
How do you like your eggs done, hard or soft, just set the timer and it will sound when the egg is done to your liking. Long battery life because it switches itself off automatically. So get cracking now!

Want to get started on building exciting projects, but don't know how? Now using EXPERIMENTOR BREADBOARDS and following the instructions in our FREE 'Electronics By Numbers' leaflets, ANYBODY can build electronic projects. For example, take one of our earlier projects, a L.E.D. Bar Graph;



You will need; One EXP 300 or EXP 350 breadboard 15 silicon diodes 6 resistors 6 Light Emitting Diodes
Just look at the diagram, Select R1, plug it into the lettered and numbered holes on the EXPERIMENTOR BREADBOARD, do the same with all the other components, connect to the battery, and your project's finished. All you have to do is follow the large, clear layouts on the 'Electronics by Numbers' leaflets, and ANYBODY can build a perfect working project.

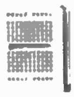
For full detailed instructions and layouts of Projects 10, 11 and 12, simply take the coupon to your nearest GSC stockist, or send direct to us, and you will receive the latest 'ELECTRONICS BY NUMBERS' leaflet.

If you have missed projects, 1, 2 and 3, or 4, 5 and 6, or 7, 8 and 9, please tick the appropriate box in the coupon.

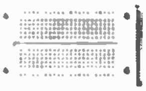
EXPERIMENTOR BREADBOARDS

No soldering modular breadboards, simply plug components in and out of letter number identified nickel silver contact holes. Start small and simply snap lock boards together to build a breadboard of any size.
All EXP Breadboards have two bus bars as an integral part of the board, if you need more than 2 buses simply snap on 4 more bus bars with the aid of an EXP 4B

EXP 325 £1.60 The ideal breadboard for 1 chip circuits. Accepts 8, 14, 16 and up to 22 pin ICs. Has 130 contact points including two 10 point bus bars



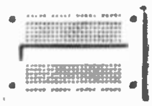
EXP 350 £3.15 Specially designed for working with up to 40 pin ICs perfect for 3 & 14 pin ICs. Has 270 contact points including two 20 point bus bars



EXP 300 £5.75 The most widely bought bread board in the UK. With 550 contact points, two 40 point bus bars, the EXP 300 will accept any size IC and up to 6 × 14 pin DIPS. Use this breadboard with Adventures in Microelectronics

EXP 600 £6.30 Most MICROPROCESSOR projects in magazines and educational books are built on the EXP 600

EXP 650 £3.60 Has ·6" centre spacing so is perfect for MICROPROCESSOR applications



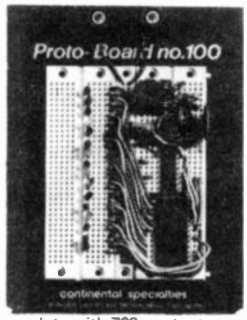
EXP 4B £2.30 Four more bus bars in "snap on" unit

The above prices are exclusive of P&P and 15% VAT

PROTO-BOARDS

The ultimate in breadboards for the minimum of cost. Two easily assembled kits.

PB6 Kit, 630 contacts, four 5-way binding posts accepts up to six 14-pin Dips.
PROTO-BOARD 6 KIT £9.20



PB 100 Kit complete with 760 contacts accepts up to ten 14-pin Dips, with two binding posts and sturdy base. Large capacity with Kit economy
PROTO-BOARD 100 KIT £11.80

THE GSC 24 HOUR SERVICE TELEPHONE (0799) 21682

With your Access, American Express, Barclaycard number and your order will be in the post immediately

GLOBAL SPECIALTIES CORPORATION

GSC

G.S.C. (UK) Ltd, Dept. 5T
Unit 1, Shire Hill Industrial Estate,
Saffron Walden, Essex CB11 3AQ.
Tel: Saffron Walden (0799) 21682
Telex: 817477

IT'S EASY WITH G.S.C.

TO RECEIVE YOUR FREE COPY OF PROJECTS 10, 11 and 12

Just clip the coupon

Give us your name and full postal address (in block capitals). Enclose cheque, postal order or credit card number and expiry date, indicating in the appropriate box(es) the breadboard(s) you require.

For immediate action

The GSC 24 hour, 5 day a week service. Telephone (0799) 21682 and give us your Access, American Express or Barclaycard number and your order will be in the post immediately.

EXPERIMENTOR BREADBOARDS	CONTACT	IC CAPACITY 14 PIN DIP	UNIT PRICE INC P&P & 15% VAT	Qty req
EXP 325	130	1	£ 2.70	
EXP 350	270	3	£ 4.48	
EXP 300	550	6	£ 7.76	
EXP 600			£ 8.39	
EXP 650	270	use with 0.6 pitch Dip's Strip Bus Bar	£ 5.00	
EXP 4B	Four 40 Point Bus Bars		£ 3.50	
PROTO BOARDS				
PB6	630	6	£11.73	
PB100	760	10	£14.72	

NAME ....
ADDRESS ....
....
....

I enclose cheque/P.O. for £ ....
Debit my Barclaycard, Access, American Express card No. ....
.... Expiry date ....

If you missed project No's 1 to 9 tick box. ☐
For Free catalogue tick box ☐

G.S.C. (UK) Ltd., Dept 14TT Unit 1, Shire Hill Estate, Saffron Walden, Essex CB11 3AQ.
Tel: Saffron Walden (0799) 21682. Telex: 817477.

GREENWELD

443F Millbrook Road, Southampton, SO1 0HX

All prices include VAT @ 15% — just add 40p post

AMAZING! COMPUTER GAMES PCBs FOR PEANUTS!!

A bulk purchase of PCBs from several well-known computer games including Battleships, Simon, Logic 5 and Starbird enable us to offer these at incredible low prices:

STARBIRD

Gives realistic engine sounds and flashing laser blasts — accelerating engine noise when module is pointed up, decelerating noise when pointed down. Press contact to see flash and hear blast of lasers shooting. PCB tested and working complete with speaker and batt clip. (needs PP3). PCB size 130 × 60mm. **Only £2.96**

COMPUTER BATTLESHIPS

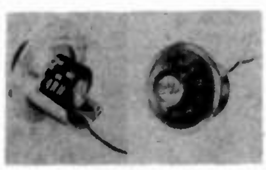
Probably one of the most popular electronic games on the market. Unfortunately the design makes it impractical to test the PCB as a working model, although it may well function perfectly. Instead we have tested the sound chip, and sell the board for its component value: SN76477 sound IC; TMS1000 u processor; batt clips, R's, C's etc. Size 160 × 140mm. **Only £1.60**
Instruction book and circuit 30p extra

LOGIC 5

The object is to find the number held in the memory with as few entries as possible. PCB contains u-processor chip and 10 leds, and is linked to a membrane type keyboard. Overlay for keys and instruction provided. PCB sizes 95 × 80 & 85 × 70mm. Supplied tested and working — PP3 required. **Only £2.50**

MICROVISION CARTRIDGES

These are a small PCB with a micro processor chip, designed to plug in to the microvision console. Only snag is, we don't have any consoles!! However, they can be used as an oscillator with 4 different freq. outputs simply by connecting a battery and speaker. Tested and working (as an osc) with pin out data. PCB size 72 + × 60mm
DNLY 25p each!!



ELECTRO DIAL

Electrical combination lock — for maximum security — pick proof. 1 million combinations!! Dial is turned to the right to one number, left to a second number, then right again to a third number. Only when this has been completed in the correct sequence will the electrical contacts close these can be used to operate a relay or solenoid. Overall dia. 65 × 60mm deep **Only £9.95**

DEVELOPMENT PACKS

These packs of brand new top quality components are designed to give the constructor a complete range so the right value is to hand whenever required. They also give a substantial saving over buying individual parts.

K001. 50V ceramic plate capacitors, 5%. 10 of each value 22pF to 1,000pF, total 210. **£4.80.**

K002 Extended range 22pF to 0.1. Values over 1000pF are of a greater tolerance. 10 of each value 22 27 33 39 47 56 68 82 100 120 150 180 220 270 330 390 470 560 680 820 1000 1500 2200 3300 4700 6800 .01 .015 .022 .033 .047 .1. **PRICE: £7.08.**

K003 C280 or similar Polyester capacitors. 10 each of the following: .01, .015, .022, .033, .047, .068, .1, .15, .22, 33 and .47µF. **PRICE: £5.40.**

K004 Mylar capacitors. Small size, vertical mounting 100V. 10 each of the following: .001, .0012, .0015, .0018, .0022, .0027, .0033, .0039, .0047, .0056, .0068, .0082, .01 Total 130 capacitors. **PRICE: £4.70.**

K007 Electrolytic capacitors 25V working small physical size axial or radial leads. 10 each of the following: 1, 2.2, 4.7, 10, 22, 47, 100µF. Total 70 capacitors. **PRICE: £3.59.**

K008 Extended range, as above, also including 220, 470 and 1000µF all at 25V. Total of 100 capacitors. **PRICE: £8.36.**

K021 CR25 resistors or similar, miniature ¼ watt carbon film 5%, as used in nearly all projects. 10 of each value from 10 ohms to 1M, E12 series. Total 610 resistors. **PRICE: £5.95.**

K041 Zener diodes 400mW 5%. 10 of each of all the values from 2V7 to 36V. Total 280 zenners. **PRICE: £15.95.**

K051 LEDs — pack of 60, comprising 10 each red, green and yellow 3mm and 5mm, together with clips. **PRICE: £8.95.**

CAPACITOR BARGAINS

2200uF 100V cans 77 × 35mm dia **75p**; 10/**£6.60**.
220uF 10V axial **5p**; 100 **£2.30**; 1000 **£16**.
400 + 100uF 275V 102 × 44mm dia. **75p**; 10 **£5.60**.
200uF 350V, 100 + 100 + 50uF 300V can. 75 × 44mm dia. **40p**; 10/**£3**; 100/**£20**
100uF 25V axial 100/**£3**.

1N4002 DIODES

Lowest ever price!! — full spec by Motorola. Pre formed leads for horiz. mntg., 10mm pitch. 100V 1A rating. 100 **£1.75**; 500 **£7.50**. 1k **£14**, 5k **£65**.

TOROIDAL TRANSFORMER

110mm dia. × 40mm deep. 110/240V pri., sec. 18V 4A, 6.3V 1A, 240V 0.3A. Ideal for scopes, monitors, VOUs etc. **Reduced to £5.96**

1,000 RESISTORS, £2.50

We've just purchased another 5 million preformed resistors, and can make a similar offer to that made two years ago, **at the same price!!!** K523 – 1,000 mixed ¼ and ½W 5% carbon film resistors, preformed for PCB mntg. Enormous range of preferred values. 1,000 for **£2.50**; 5,000 **£10**; 20k **£36**.

200 ELECTROLYTICS, £4

K524 Large variety of values/voltages, mostly cropped leads for PCB mntg. 1-1000uF, 10-63V. All new full spec. components, not chuck-outs!! 200 **£4**; 1,000 **£17.50**.

CHEAP CHIPS

76477 Sound IC	£1.25
2102A RAM 8 for	£3
MK4027 shift reg. 8 for	£6
uA78MG + volt reg	£1.00
uA79MG — volt reg	£2.00

FILAMENT DISPLAYS

Z653 7 seg display 12.5mm high. Ideal for TTL operation, taking 5V 8mA per seg. Std 14 DIL package. Only **£1** each, 4 for **£3.00**. Data supplied.

RELAY

24 ac coil, but works well on 6V DC. 2 × 10A. c/o contacts Ex-equip, only **£60p**

OPTO/REGS/OP-AMPS

FNA5220 2 digit ½" 7-seg. display on PCB. CC. With data, £1.50
7-seg. displays: FND360, 367, 501, all **50p**; 530, 847, 850, all **£1.50**.
Regs, TO3 case: 7924 **120p**, 7885 100p, 7808 **100p**, 7912 **100p**, 78CB **230p**. Others on B/L 13.
Op-Amps: uA4136 130p; uA776 **145p**; uA777 **300p**; uA318 **245p**.
Isolators: FCD831, IL15, TIL118, all **60p**.
TIL311 Hexadecimal display with decoder, 0-9 and A-F. With data, **£3.50**.

COMPONENT PACKS

K503 150 wirewound resistors from 1W to 12W, with a good range of values **£1.75**
K505 20 assorted potentiometers, all types including single ganged, rotary and slider **£1.70**
K511 200 small value poly, mica, ceramic caps from a few pF to .02uF. Excellent variety **£1.20**
K514 100 silver mica caps from 5pF to a few thousand pF. Tolerances from 1% to 10% **£2**
K520 Switch Pack, 20 different, rocker, slide, rotary, toggle, push, micro, etc. Only **£2**.
K521 Heatshrink Pack, 5 different sizes each 200mm, **50p**

PANELS

Z521 Panel with 16236 (2N3442) on small heatsink, 2N2223 dual transistor, 2 BC108, diodes, caps, resistors, etc. **60p**
Z482 Potted Oscillator Module works from 1.20V, can be used as LED flasher (3V min.) Supplied with connection data, suitable R, C & LED **£1**
Z527 Reed relay panel – contains 2 × 6V reeds, 6 × 2S030 or 2S230, 6 × 400V rects + Rs **50p**
Z529 Pack of ex-computer panels containing 74 series ICs. Lots of different gates and complex logic. All ICs are marked with type no. or code for which an identification sheet is supplied. 20 ICs **£1**; 100 ICs **£4**.
A504 Black case 50 × 50 × 78mm with octal base. PCB inside has 24V reed relay, 200V 7A SCR, 4 × 5A 200V rects, etc. **60p**

RELAY/TRIAC PANEL

Z537 PCB 100 × 75mm containing a wealth of components:
2 × 12v OPCD min. relays, 2 × 47uf 16v tants, SC146E 10A 500v triac, C112d 8A 400v SCR, 555 timer, 10 × IN4001 diodes, 2N5061, 2 × 3mm leds 3 × 2N3704, also R's and C's.
Amazing value!! — if bought separately parts would cost around £8!! — Price for the panel just **£2.00**.

1W AMP PANELS

A011 Compact audio amp intended for record player on panel 95 × 65mm including vol control and switch, complete with knobs. Apart from amp circuitry built around LM380N or TBA820M, there is a speed control circuit using 5 transistors. 9V operation, connection data supplied **ONLY £1.50.**

VU METERS

V006. Very attractive 55 × 48mm scaled 20 to + 5dB 250uA movement. Only **£1.75** or **£3** pr

VEROBLOC BREADBOARD

New from Vero, this versatile aid for building and testing circuits can accommodate any size of IC. Blocs can be joined together. Bus strips on X & Y axis – total 360 connexion points for just **£4.15**.

REGULATED PSU PANEL

Exclusive Greenweld design, fully variable 0-28V & 20mA-2A. Board contains all components except pots and transformer. Dnly **£7.75**. Suitable transformer and pots **£6**. Send SAE for fuller details

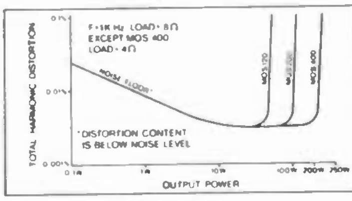
WHY AN ILP MOSFET POWER AMP?

Because ILP MOSFET power amps give you ultra-fi performance without costing big money. Performance you thought you couldn't afford at a price you know you can.

All ILP modules are compatible with each other — you'll find many more in other ILP ads in this magazine. Choose ILP MOSFET power amps when you need the fastest possible slew rate, low distortion at high frequencies, better thermal stability. MOSFET power amps work with complex loads without difficulty and without crossover distortion. Connection is simple — via 5 pins. With other ILP modules you can create almost any audio system, whatever your age or experience.

ILP MOSFET power amps are now available with integral heatsink (no extra heatsink required), or ready for mounting on to your own heatsink or chassis. Full dissipation detail on data sheet, available on request. Each carries a 5 year no quibble guarantee and comes with full connection data.

Send your order FREEPOST today on the coupon at the foot of this ad.



Load impedance, all models, 4 ohm — infinity
Input impedance, all models 100K ohm
Input sensitivity, all models, 500 mV
Frequency response, all models 15Hz-50kHz-3db

MOSFET Ultra-Fi, with heatsinks

Model No	Output power Watts rms	DISTORTION T H D Typ at 1kHz	DISTORTION I M D 50Hz/7kHz 4 1	Supply voltage Typ/Max	Size mm	Wt gms	Price inc VAT	Price ex VAT
MOS 120	60w/4-8Ω	<0 005%	<0 006%	+45+50	120 × 78 × 40	420	£29 76	£25 88
MOS 200	120w/4-8Ω	<0 005%	<0 006%	±55±60	120 × 78 × 80	850	£38 48	£33 46
MOS 400	240w/4Ω	<0 005%	<0 006%	±55±60	120 × 78 × 100	1025	£52 20	£45 39

MOSFET Ultra-Fi without heatsinks

MOS 120P	60w/4-8Ω	< 0 005%	< 0 006%	±45±50	120 × 26 × 40	215	£26 82	£23 32
MOS 200P	120w/4-8Ω	< 0 005%	< 0 006%	±55±60	120 × 26 × 80	420	£32 81	£28 53
MOS 400P	240w/4Ω	< 0 005%	< 0 006%	±55±60	120 × 26 × 100	525	£44 75	£38 91

Protection:
Able to cope with complex loads, without the need for very special protection circuitry (fuses will suffice).

Ultra-fi specifications:
Slew rate 20Vµs. Rise time 3µs. S/N ratio 100db. Frequency response (−3dB) 15Hz-100kHz. Input sensitivity 500mVrms. Input impedance 100k. Damping factor (8Ω/100Hz)>400.

How to order Freepost:
Use this coupon, or a separate sheet of paper, to order these products, or any products from other ILP Electronics advertisements. No stamp is needed if you address to Freepost. Cheques and postal orders must be crossed and payable to ILP Electronics Ltd: cash **must** be registered. C.O.D. — add £1 to total order value. Access and Barclaycard welcome. All UK orders sent post free within 7 days of receipt of order.

Please send me the following ILP modules ____________

Total purchase price ____________

I enclose Cheque ☐ Postal Orders ☐ Int. Money Order ☐

Please debit my Access/Barclaycard No. ____________

Name ____________

Address ____________

Signature ____________

Post to: ILP Electronics Ltd, Freepost 2, Graham Bell House, Roper Close, Canterbury CT2 7EP, Kent, England
Telephone (0227) 54778 Technical (0227) 64723 Telex 965780

HE 3/1

ILP ELECTRONICS LTD

STAY AHEAD. STAY WITH US

1981 INDEX

PROJECTS

QUICK PROJECTS

SHORT CIRCUITS

FEATURES

SERIALS

READER'S SURVEY

Once again the January issue rolls around and it's time to ask Hobby readers what they think of our efforts over the past year. Not only does this give us the chance to collect lots of stamps, but it means we can try to please more of our readership more of the time by giving *you* what you want — as far as possible, that is.

By filling in the questionnaire overleaf you'll be helping us to plan Hobby in the months to come. If you feel moved to take up pen and postage stamp, then remember we appreciate honest comments. Philately will get you nowhere.

FOLD HERE

POSTAGE STAMP REQUIRED

HOBBY SURVEY,
ARGUS SPECIALIST PUBLICATIONS LTD,
145 CHARING CROSS ROAD,
LONDON WC2H 0EE

FOLD HERE

Surveys *do* make a difference — last year about 90% of you told us to put it in the centre pages, so we have. So that we don't have to cope with everything from staples to Sellotape and sealing wax, we've made things a little easier this year. Simply fold along the dotted lines, and tuck the small bit into the big bit!

1) Please rate the following articles on a scale of 1 (awful) to 9 (brilliant). If you didn't read the feature, please score 0.

	SCORE	READ FULLY	SCANNED OVER	COMMENTS?
GRAPHIC EQUALISER				
AUDIO SIGNAL GENERATOR				
MEDIUM WAVE RADIO				
GUITAR FUZZ BOX				
POWER/PREAMPLIFIER				
CAR ELECTRONICS				
RADIO 1/2				
HOW TO USE AN OSCILLOSCOPE				
ELECTRONICS IN MEDICINE				
UOSAT REPORTS				
MONITOR				
GADGETS, GAMES AND KITS				
O LEVEL Q AND A				
FAMOUS NAMES				

Asterisk the best single feature in your estimation.
In addition please make any comments you would like to in the space provided. (Go on — don't be shy!)

ISSUE ISSUES

2) Do you consider yourself a regular reader? Yes/No
If yes — how long?

Six months or less/1 year/2 years/3 years/longer.

3) If you've been a reader for longer than a year, how does Hobby compare now with Hobby a year ago? Circle appropriate comment.

Much better Slightly better No different Slightly worse Much worse Oh my God!

4) How long do you keep your past copies of Hobby?
1 month 3 months 6 months 1 year longer

5) How did you become a reader of Hobby?
By accident Friend's copy Impulse buy Advertisement Other (please specify)

6) How many people read your copy?

PROJECTS

7) Have you ever built a project from Hobby? Yes/No
If yes, which did you construct in the last year — please list

1.
2.
3.
4.
5.
6.

VIDEO

26) Do you own or rent a videocassette recorder? Yes/No

27) If not, do you intend owning or renting a VCR within the next year? Yes/No

HOME COMPUTING

28) Do you own a home computer or microprocessor system? Yes/No

29) If yes, which one?

CB

30) Do you own a CB radio? Yes/No
31) If not, do you intend to buy a CB radio within the next year? Yes/No

READER PROFILE

These are personal questions which you may find objectionable. Please feel free to tell us to mind our business in that case. Answering them would help us greatly, however, and your co-operation would be appreciated. All info treated strictly as statistics and in confidence.

32) How old are you?

33) Sex (Male/Female/Undecided)

34) What is your marital status? Married/Single

35) Total annual income (if in full time employment) £

36) What is your job title?

37) Do you work in the electronics industry? Yes/No

38) Do you authorise/recommend the purchase of electronic equipment/components? Yes/No

39) Do you hold any of these credit cards?
Barclaycard Access American Express

40) To what level were you in full time education?
CSE 'O' Level 'A' Level ONC HNC Degree

41) Are you a home owner? Yes/No

42) Are you a car owner? Yes/No

43) What do you like about Hobby?

44) . . . . and dislike?

45) Any suggestions for improvement?

46) Any comments to make? (Please include separate sheet if necessary!)

8) Are there any you intend to build from this issue? Yes/No
If yes, which?

9) Is there anything you would especially like to see as a project in Hobby? Yes/No
Please specify.

10) In general, if there is a kit available for a project would you purchase that rather than assembling the components yourself? Yes/No

11) Do you construct using PCBs? Yes/No
If yes, do you etch your own? Yes/No

12) In general again, do projects constructed from Hobby work first time? Yes/No

13) Which of Hobby's special offers did you purchase in the past year?

Is there anything you'd like to see appear as an offer in Hobby?
If yes, please specify Yes/No

14) Have you ever bought any goods from Hobby through mail order? Yes/No
If yes, how was the service you received?
Good Fair OK Poor Bad Atrocious

Any problems? (Please specify below)

ADVERTISING

15) Do you read advertisements in Hobby?
Frequently Occasionally Never

16) Do you find the advertisements in Hobby useful when purchasing goods?
Yes No Neither

17) Have you ever purchased goods from mail order advertisements in Hobby? Yes/No

18) If so:-
(a) Approx. how many times in the last year have you ordered goods from a mail order company?
(b) How many mail order companies have you used during that period?

19) Approx. how much have you spent on electronics in the last year? £

20) Approx. how much of this amount was spent as a direct result of seeing an advertisement in Hobby? £

21) Approx. how much do you plan to spend on electronics in 1982? £

AUDIO

22) Do you own a stereo system? Yes/No

23) If yes, how much did your present system cost? £

24) Approx. how much do you plan to spend on audio equipment in 1982? £

25) Please list your present system

47) The competition. (Otherwise known as the Bad Guys!)

On an arbitrary scale of 100 with Hobby scoring 50, please rate the competition against us.

	READ REGULAR	READ SOMETIMES	USED TO	NEVER	RATING
WIRELESS WORLD					
PRACTICAL WIRELESS					
PRACTICAL ELECTRONICS					
ELEKTOR					
EVERYDAY ELECTRONICS					
CITIZENS' BAND					
CB RADIO					
CB WORLD					
ELECTRONICS AND MUSIC MAKER					
RADIO AND ELECTRONICS WORLD					
ELECTRONICS AND COMPUTING					
PRACTICAL COMPUTING					
COMPUTER PRINTOUT					
PERSONAL COMPUTER WORLD					
COMPUTING TODAY					
COMPUTER AND VIDEO GAMES					
TELEVISION					
WHICH VIDEO					
VIDEO TODAY					
WHAT VIDEO					
VIDEO REVIEW					
HI-FI ANSWERS					
WHAT HI-FI?					
PRACTICAL HI-FI					
HI-FI FOR PLEASURE					
HI-FI NEWS					
HOBBY					50

Thank you for your time and patience!

Name

Address ____________________

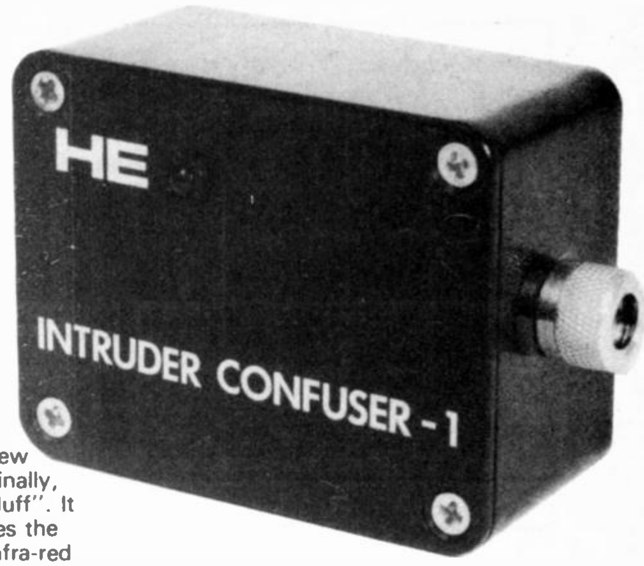
____

____

OCCASIONAL SERIES

REGULARS

INTRUDER CONFUSER



The simplest security system imaginable.

THIS OSTENTATIOUS DEVICE is intended to puzzle a would-be intruder or other unwanted visitor, and make him decide that it is safer, after all, to leave your premises untouched and try elsewhere.

All it does, actually, is to flash the LED steadily, day and night, and *pretend* to be something complicated, such as an infra-red beam projector. The case has a dummy barrel on the outside through which infra-red rays *might* be seen emerging, if you *could* see infra-red rays. On the other side of the room you can place a reflector, as if deflecting the beam to a receiver. The purpose of the flashing LED is to attract attention to the device. Simple, innit? Dead cunning!

Preferably, it is placed just inside a window so that it can be seen by the intruder before he tries to break in. This device is akin in spirit to those objects, seen in department stores, that look like flying saucers and *could* by TV cameras scanning the shoppers, but *probably* are not. Like the Confuser, they are an effective deterrent, yet cost much less than the real thing.

In some ways the Confuser is better than a real alarm system. For one thing it doesn't give false alarms (nobody pays the slightest attention to them anyway). On the other hand a few Confusers around the place will suggest that an alarm system really is in action, or if you have genuine system you can advertise the fact by installing a few Confusers as window dressing. Finally, there is the deadly "wild goose bluff". It works like this: The burglar notices the Confuser, thinks it *might* be an infra-red system, steps carefully over the imagined beam — straight on to a carefully positioned pressure-mat!

Construction

The circuit is assembled on a piece of strip-board as shown in Figure 2 and mounted inside a small case. It is advisable to purchase a case for this project rather than use the legendary tobacco-tin; a professional appearance makes the deception more likely to succeed. Building the circuit presents no problems. The leads of the LED are bent and it is mounted to protrude through the hole in the lid. If the LED doesn't light you have probably soldered it the wrong way round! Apart from this, the circuit should work immediately the battery is connected. The simplest way of making contact to the cell is by solder-tags; these are held against the terminals by a wide rubber band while the battery itself is held by a 'sticky fixer' or 'Blu-tak'.

The device should look as if it projects infra-red rays — or perhaps some hitherto unknown type of radiation! The barrel used for the prototype was the casing of a coaxial plug and it looked suitably imposing, but any suitable scrap item that is to hand will do the trick. The Confuser should be positioned so that it is "beaming" rays across a region of the room. Do not, for example, place it on the sill pointing at a potted plant! Also, it should be placed so that it *could* have wires leading to it, wires which are, of course, invisible from outside.

How It Works

The circuit is extremely simple, using only 3 components. It is based on the LM3909 LED flasher, a versatile low-cost integrated circuit. When connected as shown in **Figure 1**, the LED emits a bright flash of light about once a second. The "C"-sized dry cell lasts at least 7 months, running continuously. There is little point in fitting a switch. The device is quick to build and costs little, making it feasible to have three or four to be set at strategic points about the house.

Parts List

SEMICONDUCTORS

IC1	LM3909 LED flasher
LED1	0.2" LED, any colour but red is the most 'threatening'

CAPICATORS

C1	470u, 10V electrolytic

MISCELLANEOUS

0.1" matrix board, 24 strip x 22 hole
LED panel clip
2 x terminal pins
Case, 62mm x 78mm x 37mm
Rubber band and 'Blu-Tak'
Wire, solder
Coax plug or round scrap object
2 x solder tags
1 x C-size battery

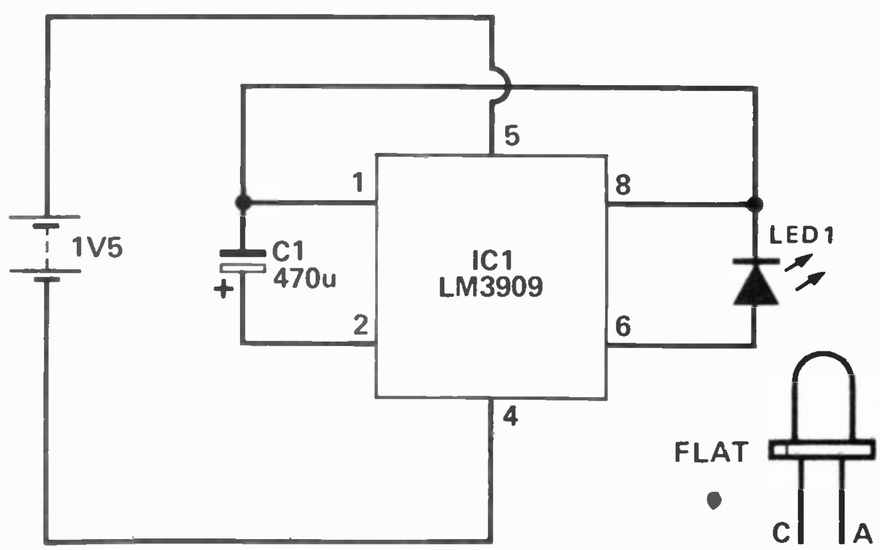


Figure 1. Circuit diagram of the Intruder Confuser.

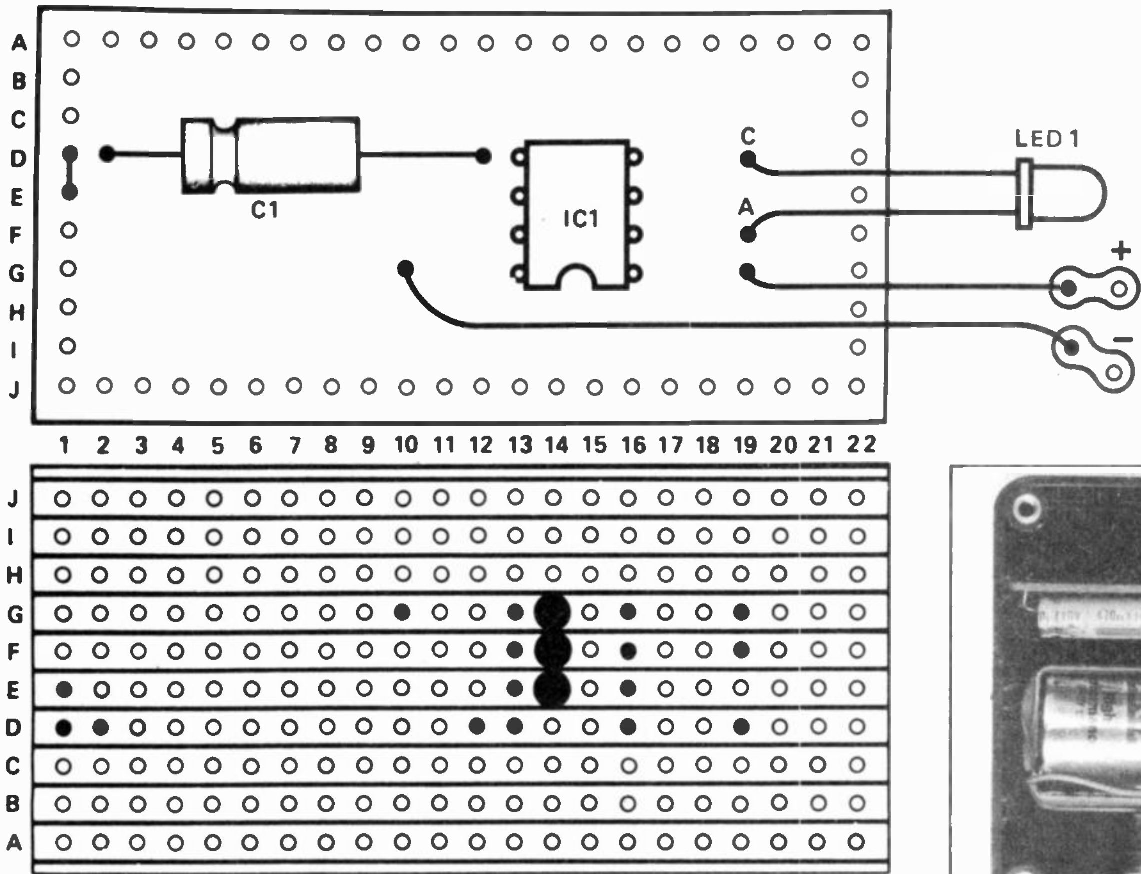
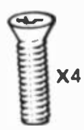


Figure 2. The matrix-board layout, top and bottom views.



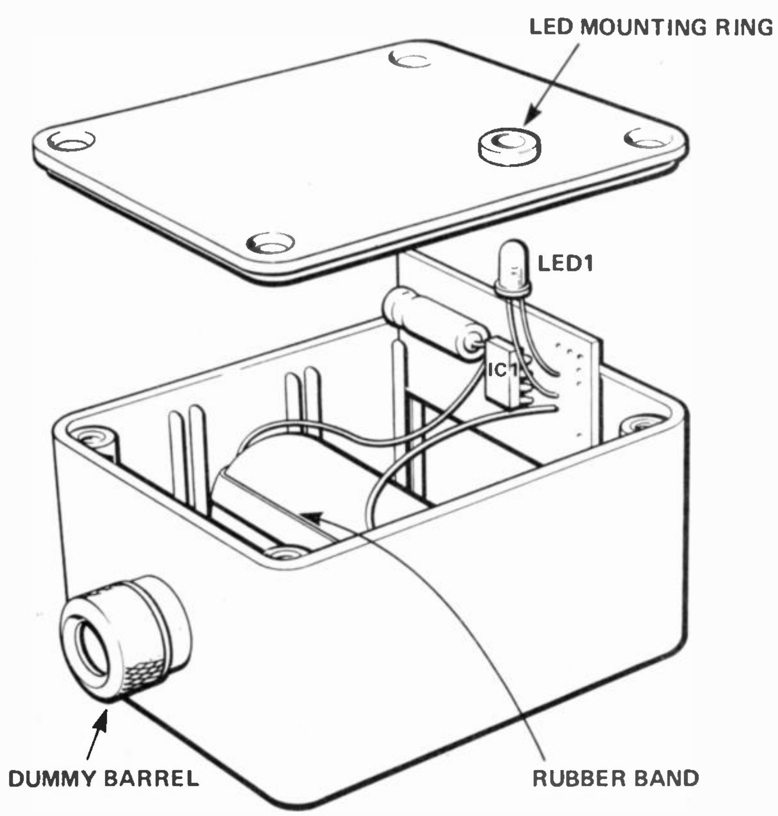


Figure 4. The rubber band is NOT the power source!

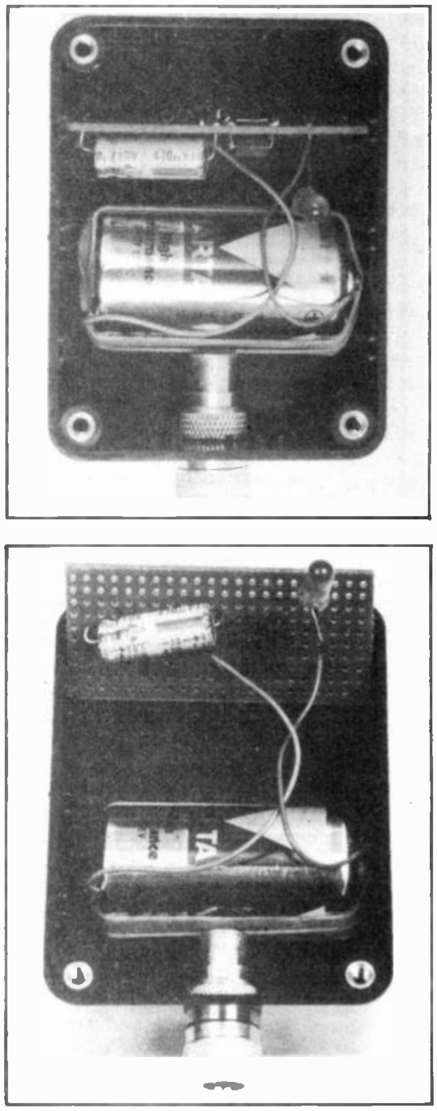


Figure 3. The internal workings — not a lot of it!

Buylines

All parts for this project are easily obtainable from most of the mail order companies advertising in HE. Approximate cost of the components, excluding case and battery, is £2.50.

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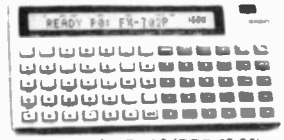

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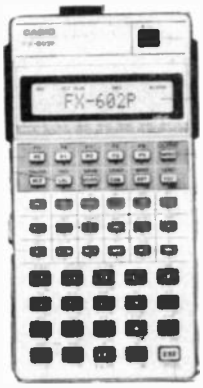

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INTO ELECTRONIC COMPONENTS

Part Six, this month, investigate various types of Diodes.

WE GET so accustomed to the importance of Ohm's law that we sometimes forget that the most important electronic components are the ones which do *not* obey Ohm's law. Diodes are some of these components and since knowing about diodes is a good lead-in to transistors and IC's, we're spending this article on the diode and its odd little ways.

A diode starts life as a chunk of germanium or silicon. Now there's nothing particularly rare or odd about these elements; germanium is found in coal and silicon in sand, and we're not really short of either. What makes the germanium and the silicon in transistors and diodes so unusual is its purity, because neither is any use in an impure state. Before modern methods of purifying these elements were invented, germanium and silicon were a bit of a mystery because the resistance of a standard sample depended on purity of the material. This isn't so for most materials, and before this point was understood, many worthy researchers got quite heated about whose measurements were more precise. We now know that these elements, silicon particularly, are almost insulators at room temperature when they are really pure, but conduct quite well, either when they are impure or when they are heated; which is why they are called semiconductors.

It's unusual enough that we can make these materials conduct better by deliberately adding impurities, but what is more unusual is that we can even control the way in which they conduct. By adding one type of impurity we can make the silicon or germanium conduct like a metal — by the movement of the negative bits of atoms called electrons. When the pure material has been treated ('doped') in this way, we call it N-type. We can also add another form of impurity, however, which will cause the semiconductor (silicon or germanium) to conduct mainly by the movement of positive particles called holes, which appear only inside the crystal of a semiconductor. A semiconductor which has been treated in this way is called P-type. By controlling the quantity of impurity, we can make a sample of a pure semiconductor into a conductor with high, medium, or low resistance according to how much impurity we have added.

The real action starts when we have both types of impurity in a single crystal of the semiconductor. If you have ever hung a small crystal of blue copper sulphate in a jar of copper sulphate solution and watched the crystal grow, keeping its basic shape unchanged, you'll understand that it's possible to grow extra layers onto a crystal of germanium or silicon — though by cooling them in a jar filled with vapour rather than in a solution. We can grow either P-type or N-type in this way, so that it's easy to have a layer of N-type material on the surface of a P-type crystal. Where these opposite types meet is a layer called a junction, and when we make conducting contacts to the two different materials, we have a junction diode. The P-type part of the diode is called the anode, and the N-type part is called the cathode.

From Replete to Deplete

Now we can't actually *see* what happens when we grow one type of semiconductor layer over the top of another, but we have plenty of evidence about what happens. Where the two layers touch, positive holes meet negative electrons and combine, leaving nothing behind except a bit of heat. The junction then becomes a no-man's land where particles, which can move freely in the rest of the material, are not nearly so free. This no-man's land is called a depletion layer. 'Depletion' means draining, and calling this layer depleted means that it has been drained of all the particles which could move and thus conduct electricity.

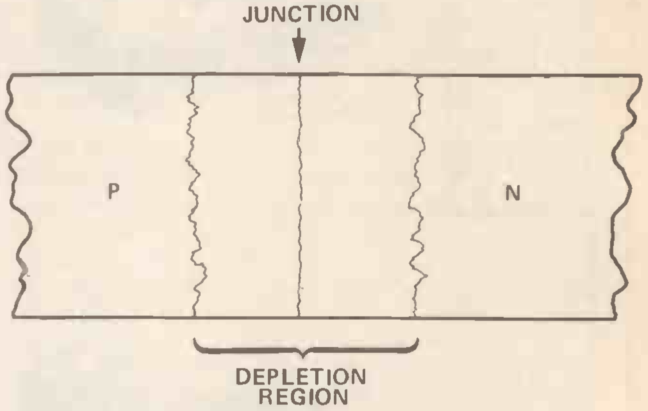

Figure 1. A depletion layer, with no particles capable of moving, appears between a layer of P-type and a layer of N-type semiconductor in contact on the same crystal.

On this basis, we could expect that the arrangement of a P-layer and an N-layer would not conduct an electric current — and we would be half-right. Try it out for yourself with a silicon diode — the popular 1N4148 or any of its equivalents will be suitable — using the circuit of **Figure 2**. The potential divider, R1 and R2, reduces the 9V battery voltage to under half a volt, which is enough to push half a milliamp through 1k and to be detected by the HE Meter. Make the potential divider circuit, with the meter connections and the battery connections as shown, and set the meter to the 5mA range. Now connect a silicon diode between line 5A and line 10A in **Figure 2**. It doesn't matter which lead of the diode is in which line, as long as there is one lead in each. See any trace of current? Now try the diode connected the other way round, using the same lines. Any current this way? Just as we expected — the depletion layer stops current from flowing.

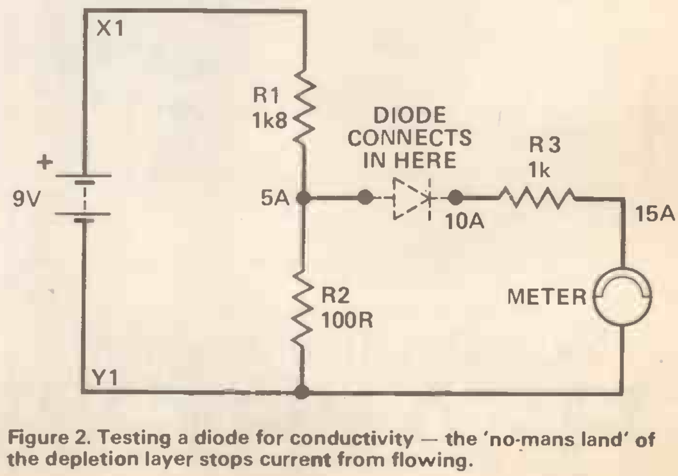

Figure 2. Testing a diode for conductivity — the 'no-mans land' of the depletion layer stops current from flowing.

But does it? Rewire the circuit, so that it looks the same as in **Figure 3**, and try the readings again. This time you find that the diode *does* pass current one way round, though not the other way round. It's a one-way street. Why? The answer, as you might suspect, is in the depletion layer, along with the laws of electric forces that we have known for centuries. Positive and negative electrical charges are like magnetic poles — two of the same type repel each other, two of the opposite type attract. When you connect the positive end of a battery to the N-type part of a diode, and the negative end of the battery to the P-type part of the diode, the battery pulls the P and N charges away from the juction. That way it becomes more depleted and definitely not a good conductor, except for a very few 'minority' carriers. Minority carriers are the few P particles in the N-type material or the few N particles inthe P-type material that will move across the junction when the voltages are arranged this way round, but because there are so few of these minority carriers, the current they produce doesn't amount to much. This type of connection is called reverse bias.

Things are quite different if we reverse the connections so that the positive end of the battery is connected to the P-type material and the negative end of the battery is connected to the N-type material. Now the action of the battery is to force the charges across the depletion layer — and the amount of force depends on the voltage. For a germanium diode, about 0.4V is enough to get the particles crossing, but for a silicon diode more than 0.5V is needed — and that's why we found that a silicon diode appeared to be an insulator when we used a low voltage. These voltages for conduction, incidentally, depend on the material, not on how it's prepared; but they will vary with the temperature of the material.

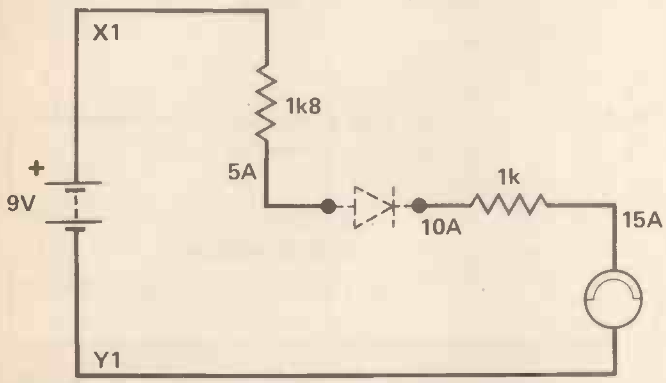

Figure 3. Testing for conductivity with a higher voltage — the results are very different.

The Lawless Lot

When current flows through the diode because of the normal movement of particles across the junction, we call the voltage which is applied across the diode 'forward bias' — positive on the anode, negative on the cathode. Now it's here that we find Ohm's law being completely disregarded. Just to refresh our memories Ohm's law means that if we take a resistor, pass 1 mA current through it and get a voltage of 0.6V across it, then passing 10 mA through it will produce a voltage of 6.0V across the resistor (ten times the current needs ten times the voltage). You can try this out on a diode, using the circuit shown in **Figure 5.** The circuit, which uses an 8k2 resistor to limit the current, will pass about 1 mA and the circuit which uses a 1k resistor will pass about 10 mA. With the HE Meter switched to the 2.5V range, measure the voltage across the diodes — across 5A and Y1 for D1, and across 10B and Y1 for D2. If Ohm's law held good, the second voltage reading would be around ten times as much as the first one. It's not, because the diode simply doesn't obey Ohm's law.

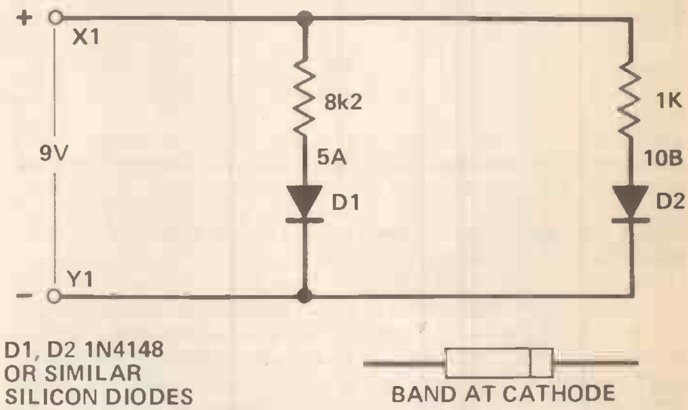

Figure 5. A circuit which shows that diodes do not obey Ohm's law.

What sort of law does it obey, then? The simplest way of looking at it is that the voltage across the diode is around 0.6V for as long as it is conducting in the forward direction. Unless the current changes very greatly this will be about right, but you'll find that the actual voltage will vary from one diode to another and it will also vary as the temperature of the diode varies. If you're prepared to make a (possible) sacrifice, connect up a silicon diode in the circuit

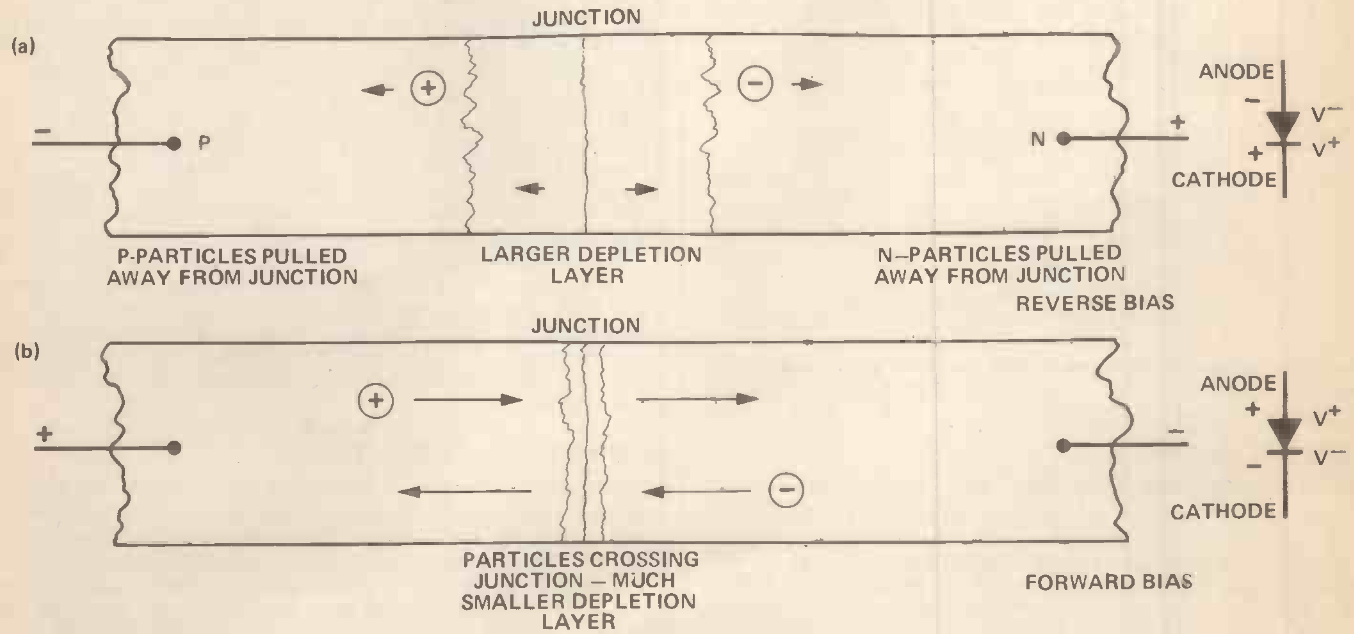

Figure 4. The effect of connecting a diode to a voltage. (a) Negative to the P-type, positive to the N-type, pulls particles away from the depletion layer so that no measureable current can flow. (b) Reversing the voltage pulls particles across the depletion layer; that is, current flows.

of **Figure 6**, with the HE Meter set to the 2.5V range and note the voltage reading on the meter very precisely when the diode is at room temperature. Now hold the end of a hot soldering iron close to the diode, making sure that you aren't going to burn the Eurobreadboard or the insulation of the wire and watch the voltage change. The change isn't large and that's why you have to be pretty precise about the readings. Unless you keep the diode very hot for a long time this experiment should not cause any permanent damage!

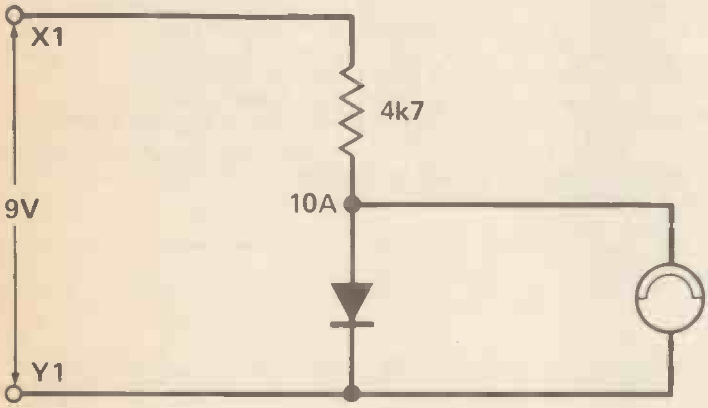

Figure 6. Measuring the forward voltage across a diode as its temperature is changed.

Assuming that the voltage across a diode remains at about 0.6V for any value of current is a simple law which is approximately true for most silicon diode circuits. To describe more precisely how a diode behaves requires a graph of the type which we call a characteristic curve. **Figure 7** shows such a graph for 'typical' germanium and silicon diodes. It shows how each diode starts to conduct at a different voltage and how little the voltage changes even when the current varies quite considerably.

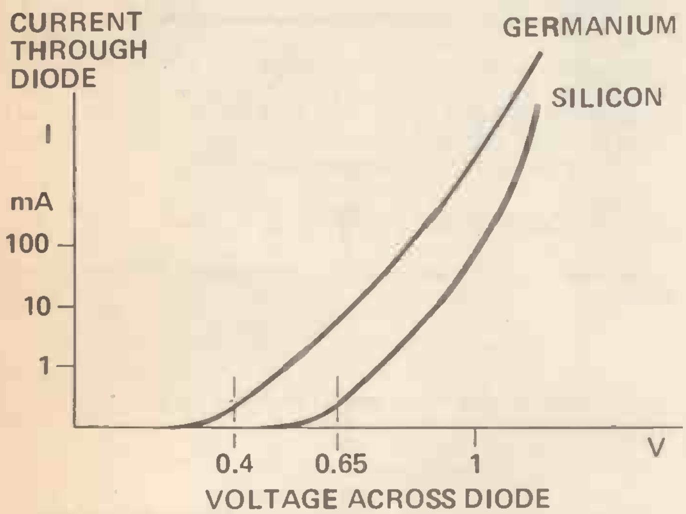

Figure 7. A portion of the characteristic curves of silicon and germanium diodes.

Forward, Reverse

We've assumed that the diode does not conduct at all in the reverse direction — that is, when the voltage is reversed. That's true for a lot of diode circuits, but not quite all of them. For one thing, there's always a small current caused by the minority carriers. It's too small for any but the most sensitive instuments (at least a thousand times more sensitive than the average multimeter) to detect, but it has one very noticeable effect. If we increase the size of the reverse voltage across the diode, we accelerate these minority carriers to higher and higher speeds. At many stages in the journey across the depletion layer, these minority carriers will hit atoms of the semiconductor material. If the minority carriers are moving really fast then each collision will knock carriers away from the atoms and these carriers will be accelerated in turn and will hit other atoms. When this effect (called avalanche effect) occurs, the depletion layer suddenly becomes a conductor because of all the particles that have been released in the collisions. The diode is said to have broken down — it is no longer an insulator for reverse current.

Now we can't illustrate this breakdown effect easily with ordinary silicon diodes like the 1N4148, because the voltage that is needed to make then break down is quite high — certainly higher than we can get from a 9V battery. We can, however, demonstrate this effect on diodes which have been manufactured so that they will break down at lower voltages and which are named Zener diodes, after Clarence Zener who was the first to research this effect.

Connect up the circuit of **Figure 8**, using a 5V6 zener diode and with the HE Meter set on the 10V range. The resistor limits the amount of current that can flow and with the 330R resistor it will be about 10 mA. Notice the reading on the HE Meter; it should be somewhere around 5.6V — if it is 0.6V then you have connected the diode (or the supply) the wrong way round. The voltage will, probably, not be precisely 5.6V because zener diodes have tolerances like all other components, but it should be reasonably near. Note the exact value.

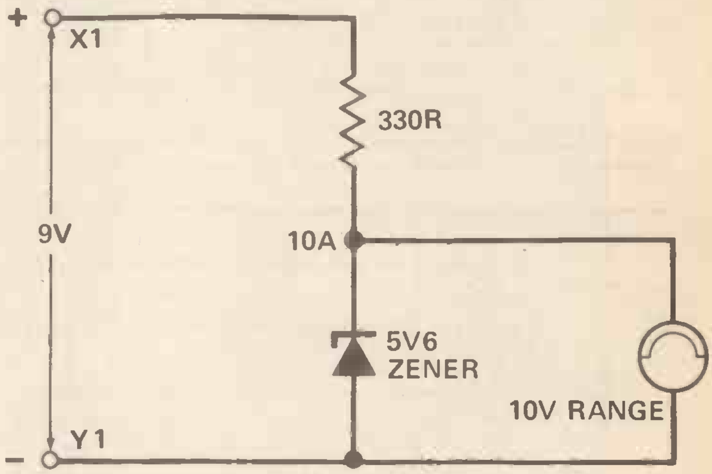

Figure 8. The voltage across a Zener diode. Notice that the diode is reversed.

Now try a 3k3 resistor, which will cut the current through the diode to one tenth of its previous value. Does this cause any change to the voltage? No, and you will find that even values as low as 100R do not make much difference to the voltage. The usefulness of a zener diode lies in the fact that the voltage across it can be more than 0.6V when it is connected in the reverse direction and that the voltage remains steady even if the current is varied considerably. The only point to watch is that there is a minimum current, less than a milliamp, below which the voltage is no longer stable. Zener diodes can be manufactured with breakdown voltages which range from about 2.7V up to 150V or more.

We can now draw the complete characteristic graph for a diode, showing both the forward and the reverse characteristic. Because the range of voltages and currents are so very different in the two directions, the complete characteristic (**Figure 9**) uses two different pairs of scales, with low-voltage, high-current for the forward characteristic and high voltage, low-current for the reverse characteristic.

Don't Confuse it, Use it

Diodes are used for a large number of circuit applications but they are all connected with the one-way movement of current, or the zener effect. Diodes in rectifier circuits play a part in converting AC into DC, using circuits such as that of **Figure 10**. The diodes which are used as rectifiers must be able to pass large amounts of current in the forward direction because the current that flows into the reservoir capacitor, to recharge it on each cycle (or twice per cycle for full-wave rectification), will be much greater than the average amount of current. In addition, because there is very little resistance in series with each rectifier diode, the diodes must not

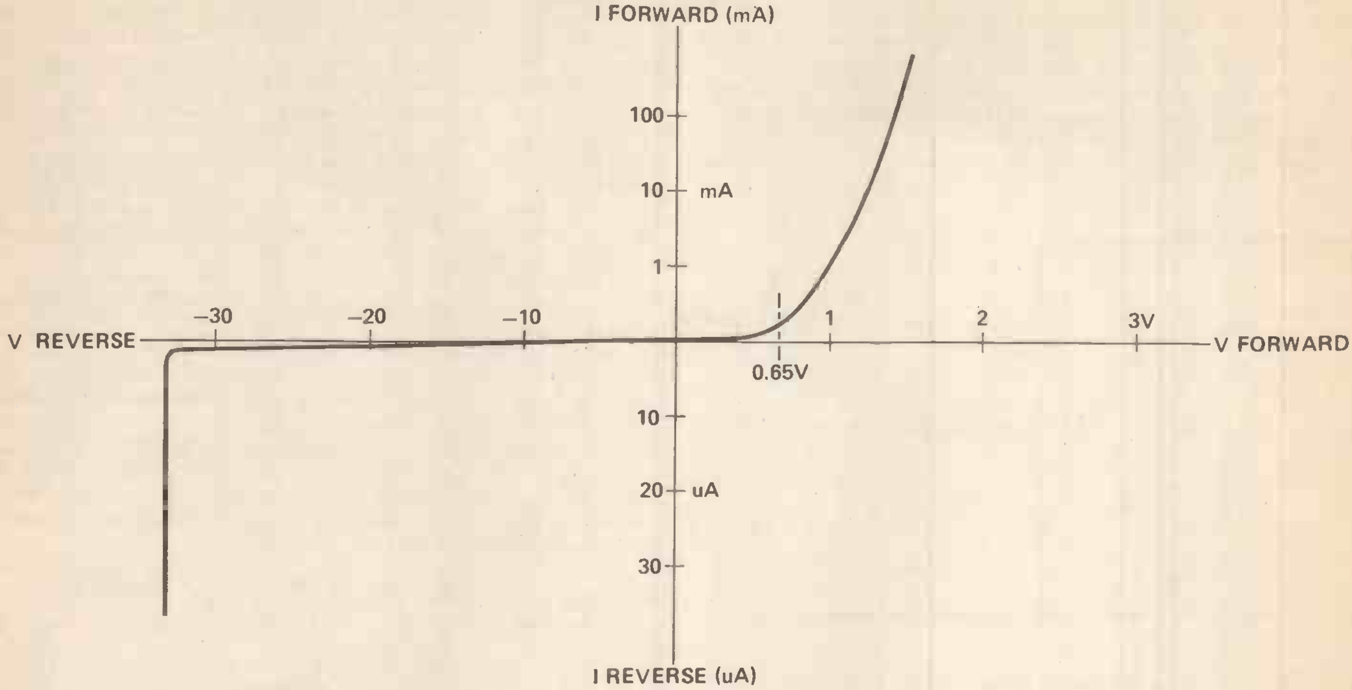

Figure 9. Complete characteristic for a typical silicon diode. Note that the scales for current and for voltage in the reverse direction are different from the scales used for the forward direction.

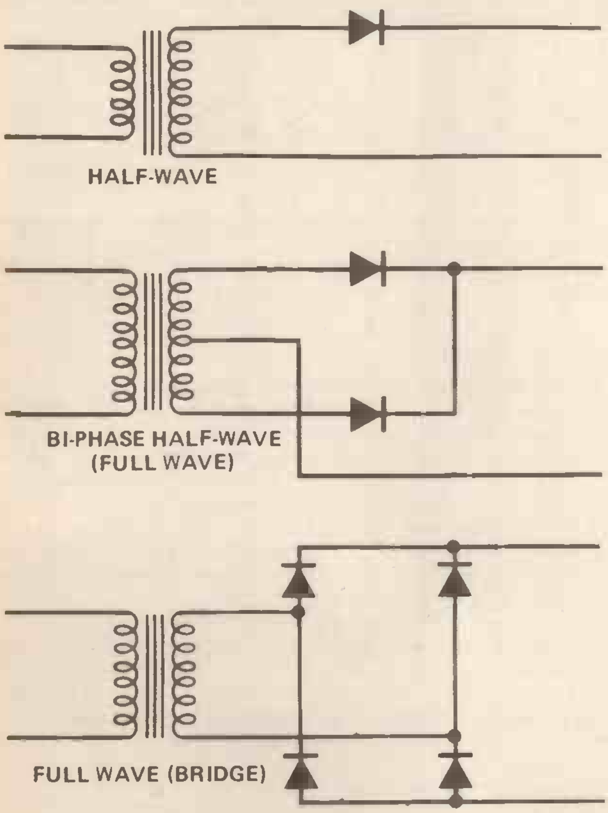

Figure 10. Rectifier circuits using diodes to convert AC into current in one direction.

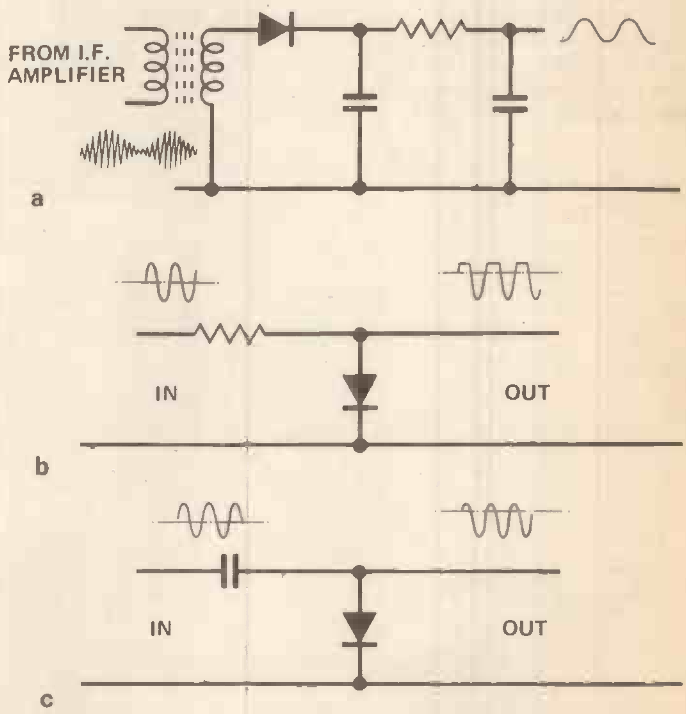

Figure 11. Other uses for diodes. Demodulation (a) produces an audio waveform from a modulated high-frequency wave. Clipping (b) removes signal voltages above or below a selected level, and DC restoration (c) shifts the DC level of a signal.

break down when they are reverse biased because the combination of the large reverse voltage across the diode and the large current would cause overheating, which would quickly melt the junction. Diodes for rectification are usually silicon junction types.

Signal diodes, used for demodulation of radio signals or for clipping and level setting (**Figure 11**) are not required to pass large currents. For some tasks, particularly demodulation, the voltage across the diode should be low and that means using a germanium diode. These are usually point contact diodes, a method of construction which was invented earlier than the junction diode.

Figure That Zener

The calculations that are needed for zener diodes seem to baffle a lot of readers, so here goes with an explanation. The important

TTLs

7400	11p
7401	11p
7402	12p
7403	14p
7404	12p
7405	18p
7406	25p
7407	25p
7408	14p
7409	18p
7410	15p
7411	20p
7412	20p
7413	25p
7414	35p
74C14	60p
7416	25p
7417	25p
7420	17p
7421	30p
7422	20p
7423	22p
7425	28p
7426	30p
7427	25p
7428	30p
7430	15p
7432	25p
7433	27p
7437	27p
7438	30p
7440	17p
7441	70p
7442A	36p
7445	60p
7446A	93p
7447A	45p
7448	45p
7450	17p
7451	17p
7453	17p
7454	17p
7460	17p
7470	36p
7472	30p
7473	30p
7474	20p
7475	38p
7476	30p
7480	50p
7481	100p
7482	70p
7483A	45p
7484	100p
7485	90p
7486	22p
7489	210p
7490A	25p
7491	60p
7492A	30p
7493A	30p
7494	50p
7495A	50p
7496	45p
7497	120p
74100	85p
74107	22p
74109	40p
74116	90p
74118	75p
74119	90p
74120	70p
74121	30p
74122	45p
74123	48p
74125	40p
74126	40p
74128	40p
74132	45p
74136	32p
74141	65p
74142	200p
74145	70p
74147	100p
74148	75p
74150	80p
74151A	45p
74153	45p
74154	70p
74155	50p
74156	50p
74157	50p
74159	100p
74160	60p
74161	60p
74162	60p
74163	60p
74164	65p
74165	60p
74166	70p
74170	160p
74172	300p
74173	75p
74174	70p
74175	70p
74176	50p
74177	70p
74178	100p
74180	60p
74181	160p
74182	90p
74184A	90p
74185	120p
74186	500p
74188	325p
74190	70p
74191	70p
74192	70p
74193	70p
74194	70p
74195	60p
74196	60p
74197	60p
74198	100p
74199	100p
74221	75
74251	70p
74273	75p
74278	150p
74279	80p
74283	75p
74284	200p
74285	200p
74290	100p
74293	100p
74298	100p
74365	55p
74366	55p
74367	55p
74368	55p
74390	100p
74393	100p
74490	120p

74LS SERIES

74LS00	12p
74LS01	14p
74LS02	14p
74LS03	14p
74LS04	15p
74LS05	15p
74LS08	16p
74LS09	15p
74LS10	15p
74LS11	15p
74LS13	25p
74LS14	40p
74LS20	15p
74LS21	15p
74LS22	16p
74LS26	16p
74LS27	16p
74LS30	15p
74LS32	16p
74LS37	16p
74LS38	16p
74LS42	36p
74LS47	40p
74LS51	15p
74LS55	30p
74LS73	25p
74LS74	16p
74LS75	24p
74LS76	20p
74LS83	45p
74LS85	65p
74LS86	20p
74LS90	28p
74LS92	40p
74LS93	30p
74LS95	45p
74LS96	100p
74LS107	45p
74LS109	30p
74LS112	34p
74LS113	30p
74LS114	30p
74LS122	42p
74LS123	50p
74LS124	120p
74LS125	30p
74LS126	30p
74LS132	45p
74LS133	30p
74LS136	30p
74LS138	36p
74LS139	36p
74LS145	75p
74LS147	160p
74LS148	90p
74LS151	70p
74LS153	60p
74LS154	90p
74LS155	40p
74LS156	40p
74LS157	35p
74LS158	36p
74LS160	40p
74LS161	40p
74LS162	40p
74LS163	40p
74LS164	48p
74LS165	100p
74LS166	90p
74LS170	120p
74LS173	70p
74LS174	45p
74LS175	50p
74LS181	140p
74LS190	50p
74LS191	50p
74LS192	50p
74LS193	48p
74LS195	50p
74LS196	60p
74LS197	65p
74LS221	60p
74LS240	90p
74LS241	90p
74LS242	80p
74LS243	80p
74LS244	70p
74LS245	90p
74LS247	70p
74LS251	40p
74LS253	40p
74LS257	45p
74LS258	45p
74LS259	90p
74LS260	100p
74LS266	25p
74LS273	75p
74LS279	40p
74LS283	45p
74LS298	160p
74LS323	250p
74LS324	150p
74LS348	150p
74LS352	100p
74LS353	100p
74LS363	160p
74LS364	160p
74LS365	36p
74LS367	36p
74LS368	50p
74LS373	70p
74LS374	70p
74LS375	50p
74LS377	90p
74LS378	70p
74LS390	55p
74LS393	50p
74LS399	200p
74LS540	135p
74LS541	135p
74LS670	170p

4000 SERIES

4000	12p
4001	14p
4002	16p
4006	65p
4007	16p
4008	60p
4009	35p
4010	40p
4011	14p
4012	16p
4013	35p
4014	60p
4015	60p
4016	30p
4017	45p
4018	60p
4019	32p
4020	60p
4021	65p
4022	70p
4023	20p
4024	40p
4025	20p
4026	130p
4027	32p
4028	60p
4029	75p
4030	40p
4031	170p
4034	160p
4035	80p
4036	295p
4039	295p
4040	55p
4041	70p
4042	55p
4043	60p
4044	70p
4046	70p
4047	55p
4048	55p
4049	27p
4050	27p
4051	60p
4052	80p
4053	60p
4054	130p
4055	125p
4056	120p
4059	500p
4060	90p
4063	100p
4066	35p
4067	400p
4068	18p
4069	18p
4070	18p
4071	18p
4072	18p
4073	20p
4075	20p
4076	60p
4081	16p
4082	20p
4086	72p
4089	150p
4093	40p
4094	150p
4095	95p
4096	95p
4097	340p
4098	90p
4099	120p
40085	90p
40097	£120p
40098	120p
40102	180p
40103	180p
40106	50p
40109	100p
40163	100p
40173	120p
40174	90p
40175	100p
40193	120p
40257	160p
4502	75p
4503	50p
4507	40p
4508	200p
4510	65p
4511	50p
4512	65p
4514	150p
4515	150p
4516	75p
4518	45p
4520	70p
4521	150p
4526	75p
4527	90p
4528	75p
4532	90p
4534	500p
4536	300p
4538	120p
4539	110p
4543	100p
4553	290p
4555	50p
4556	60p
4560	180p
4568	400p
4569	180p
4572	30p
4583	100p
4584	45p
4585	100p
4724	150p
14411	700p
14412	900p
14495	300p
14599	290p

74S SERIES

74S00	60p
74S04	60p
74S08	75p
74S32	90p
74S74	90p
74S85	300p
74S86	180p
74S124	300p
74S132	160p
74S133	75p
74S138	225p
74S139	225p
74S157	250p
74S163	300p
74S174	250p
74S175	320p
74S194	350p
74S241	450p

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CA3028A	120p
CA3019	80p
CA3046	70p
CA3048	225p
CA3059	300p
CA3080E	72p
CA3086	48p
CA3089	225p
CA3090AQ	375p
CA3130E	90p
CA3140	50p
CA3160E	100p
CA3161E	140p
CA3162	450p
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LM318	200p
LM319	225p
LM324	45p
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LM377	175p
LM380	75p
LM381AN	180p
LM382	120p
LM386	95p
LM387	120p
LM389	95p
LM393	100p
LM394	300p
LM709	36p
LM710	50p
LM725	350p
LM733	100p
LM741	18p
LM747	70p
LM748	35p
LM2917	200p
LM3302	140p
LM3900	55p
LM3909	95p
LM3911	130p
LM3914	210p
LM3915	225p
LM3916	225p
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RC4136	70p
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SFF96364	800p
SL490	350p
SN76477	175p
SP8515	750p
TA7205	200p
TB7120	200p
TA7204	250p
TA7222	200p
TA7310	200p
TAA621	275p
TBA651	200p
TBA800	90p
TBA810	100p
TBA820	90p
TBA950	300p
TCA220	350p
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TL094	200p
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UAA170	170p
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ULN2003	100p
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XR2206	300p
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XR2216	675p
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ZN419C	225p
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		TIL311	600p
DISPLAYS		TIL312/3	110p
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DL707 Red	140p	7750/60	200p
FND357	120p	**DRIVERS**	
FND500	90p	9368	250p
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75112	160p
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75115	160p
75150P	140p
75154	140p
75182	230p
75324	375p
75361	150p
75363	150p
75365	150p
75451/2	72p
75453/4	72p
75491/2	70p
8T26	120p
8T28	140p
8T95	140p
8T97	140p
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4.00MHz	150p
4.194MHz	200p
4.43MHz	150p
5.00MHz	175p
6.0MHz	250p
6.0MHz	250p
6.144MHz	250p
7.0MHz	250p
7.168MHz	250p
8.00MHz	250p
8.86MHz	250p
10.00MHz	250p
10.7MHz	250p
16.00MHz	250p
18.00MHz	250p
18.432	150p
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BC172	12p
BC177/8	17p
BC179	18p
BC182/3	10p
BC184	11p
BC187	30p
BC212/3	11p
BC214	12p
BC237	15p
BC327	16p
BC337	16p
BC338	16p
BC461	35p
BC477/8	30p
BC516/7	40p
BC547B	16p
BC548C	9p
BC549C	18p
BC557B	18p
BC559C	18p
BCY70	18p
BCY71/2	22p
BD131/2	50p
BD135/6	64p
BD139	58p
BD140	60p
BD189	60p
BD232	95p
BD233	75p
BD235	85p
BD241	70p
BD242	70p
BD677	80p
BF244B	35p
BF256B	70p
BF257/8	32p
BF259	36p
BFR39	25p
BFR40/1	25p
BFR79	25p
BFR80/1	25p
BFX29	40p
BFX30	34p
BFX84/5	40p
BFX86/7	30p
BFX88	30p
BFX89	180p
BFY50	30p
BFY51/2	30p
BFY56	33p
BFY90	80p
BRY39	45p
BSX19/20	24p
BU104	225p
BU105	190p
BU108	250p
BU109	225p
BU126	150p
BU180A	120p
BU205	200p
BU208	200p
BU406	145p
BUY69C	350p
E310	50p
MJ2501	225p
MJ2955	90p
MJ3001	225p
MJE340	60p
MJE2955	100p
MJE3055	70p
MPF102	45p
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MPF105	40p
MPSA06	30p
MPSA12	50p
MPSA13	50p
MPSA20	50p
MPSA42	50p
MPSA43	50p
MPSA56	32p
MPSA70	50p
MPSU06	63p
MPSU07	60p
MPSU45	90p
MPSU65	78p
TIP29A	40p
TIP29C	55p
TIP30A	48p
TIP30C	60p
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TIP31C	62p
TIP32A	68p
TIP32C	62p
TIP33A	90p
TIP33C	114p
TIP34A	115p
TIP34C	160p
TIP35A	225p
TIP35C	290p
TIP36A	270p
TIP36C	340p
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TIP41C	78p
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ZTX504	30p
VN66	80p
VN10KM	60p
2N697	25p
2N698	45p
2N706A	30p
2N708	30p
2N918	45p
2N930	18p
2N1131/2	30p
2N1613	25p
2N1711	25p
2N2102	70p
2N2160	350p
2N2219A	30p
2N2222A	30p
2N2369A	25p
2N2484	30p
2N2646	45p
2N2904/5	30p
2N2906A	30p
2N2907A	30p
2N2926	9p
2N3053	40p
2N3054	65p
2N3055	48p
2N3442	140p
2N3553	240p
2N3584	250p
2N3643/4	48p
2N3702/3	12p
2N3704/5	12p
2N3706/7	14p
2N3708/9	12p
2N3773	300p
2N3819	25p
2N3820	50p
2N3823	70p
2N3866	90p
2N3902	700p
2N3903/4	18p
2N3905/6	20p
2N4037	65p
2N4123/4	27p
2N4125/6	27p
2N4401/3	27p
2N4427	90p
2N4871	60p
2N5087	27p
2N5089	27p
2N5172	27p
2N5191	90p
2N5194	90p
2N5245	40p
2N5298	60p
2N5401	65p
2N5457/8	40p
2N5459	40p
2N5460	60p
2N5485	44p
2N5875	250p
2N6027	48p
2N6052	300p
2N6059	325p
2N6107	65p
2N6247	190p
2N6254	130p
2N6290	65p
2SC1172	150p
2SC1306	150p
2SC1307	150p
2SC1957	90p
2SC1969	195p
2SC2028	120p
2SC2029	250p
2SC2078	200p
3N128	120p
3N140	120p
3N141	110p
3N201	110p
3N204	120p
40290	260p
40361/2	75p
40408	90p
40409	100p
40410	100p
40411	300p
40594	120p
40595	120p
40673	75p
40871/2	100p

DIODES

BY127	12p
BYX36.300	20p
OA47	8p
OA90/91	9p
OA95	9p
OA200	9p
OA202	10p
1N914	4p
1N916	7p
1N4148	4p
1N4001/2	5p
1N4003/4	6p
1N4005	6p
1N4006/7	7p
1N5401/3	14p
1N5404/7	19p
1S920	9p

BRIDGE RECTIFIERS

1A 50V	19p
1A 100V	20p
1A 400V	25p
1A 600V	30p
2A 50V	30p
2A 100V	35p
2A 400V	45p
3A 200V	60p
3A 600V	72p
4A 100V	95p
4A 400V	100p
6A 50V	80p
6A 100V	100p
6A 400V	120p
10A 400V	200p
25A 400V	400p

ZENERS

2.7V-33V

400mW	9p
1W	15p

TRIACS PLASTIC

3A 400V	60p
6A 400V	70p
6A 500V	88p
8A 400V	75p
8A 500V	95p
12A 400V	85p
12A 500V	105p
16A 400V	110p
16A 500V	130p
T2800D	130p
3A 400V	100p
8A 500V	140p
12A 400V	160p
16A 100V	180p
16A 400V	180p
BT106	110p
C106D	45p
MCR101	36p
TIC44	27p
2N3525	130p
2N4444	140p
2N5060	34p
2N5064	40p

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6V DC coil SPDT 2A 24V DC	160p
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12V DC Coil DPDT 5A 24V DC/240V AC	200p

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Receptacle	90p	200p	240p	270p

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Angled 2 x 32 Way	—	400p
DIN 41617 31 Way	200p	200p

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Solder Pin (angled)	265p	310p
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(As published in Oct/nov 81 PCW)

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facts to bear in mind are the simple ones — the voltage across the diode is constant, but only while the diode passes current in the reverse direction. Let's look at an example.

Taking the circuit of **Figure 12**, think of it first of all with no current being supplied from the zener diode to the load. The supply voltage is 9V, the diode voltage is 5.6V, so the voltage across resistor R1 is the difference, 9-5.6=3.4V. If R1=330R, then the current which flows is, by Ohm's law, about 10 mA. Ohm's law — but didn't we just say that diodes don't obey Ohm's law? We did, but resistors still do, and this calculation is for the resistor. You must always have some resistance in series with a diode in a circuit, because only resistance will be able to control the current, and the control is by good old Ohm's law.

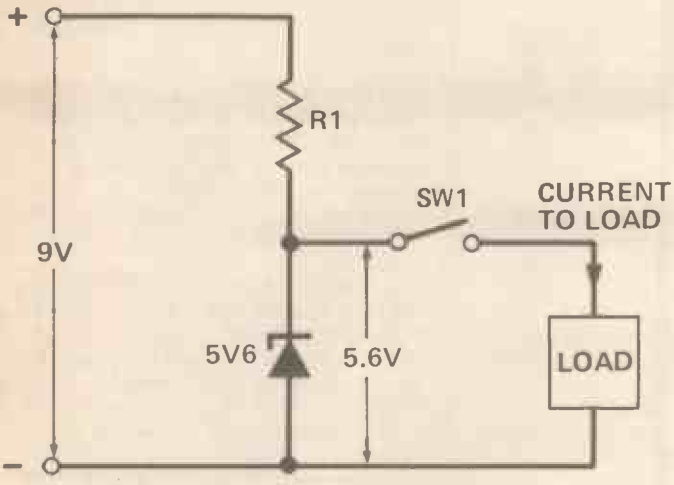

Figure 12. A zener-diode circuit.

Having got this far, we can now calculate the power which is converted to heat in the diode and in the resistance. The voltage across the diode is 5.6V and the current is 10 mA. Multiply these quantities together and we get 56 milliwatts (milliwatts because it was milliamps), which is not enough to overheat the zener diode because most are rated to take at least 250 mW. The voltage across the resistor is less — 3.4V — so that its power dissipation is 3.4 x 10 = 34 mW, and that won't trouble even the smallest eighth watt resistors (1/8 W = 0.125 W or 125 mW).

Now what happens if the battery voltage goes down to 8V? The voltage across the 330R resistor goes down to 2.4V, so that the current drops to about 7 mA, but the voltage across the zener diode remains at 5.6V even with this smaller current flowing. That's why we use zener diodes!

Now look at another reason. Suppose we now close the switch and use the voltage across the zener diode to supply 5 mA to a circuit, the load circuit. With a battery voltage of 9V and 10 mA flowing through the zener diode when the load circuit is not connected, what happens when the load *is* connected? All that happens is that the current flows in different paths. Of the total of 10 mA, 5 mA flows into the load and 5 mA is left flowing through the zener diode, whose voltage is still steady at 5.6V. Even if the battery voltage dropped to 8V and we had only 7 mA flowing through the zener diode before we connected the load circuit, 5 mA will be taken from this, leaving 2 mA flowing through the zener diode, which is enough to keep it working. Notice that the load current does not cause the current through the resistor R1 to change; it simply robs the zener diode! If, however, the load circuit demands more current than was flowing in the zener diode before the load was connected, then the zener will stop operating and the voltage across the load will drop.

It's All Glow

There's one other type of diode which is used a lot and which needs a mention — the light-emitting diode or LED. The LED, to start with, is not made from silicon or germanium but from compound materials (not elements) with exotic names such as gallium arsenide or indium antimonide. Both these materials have two quite unique properties; one is that they are transparent — light can pass through them — and the other is that when an electron meets a hole in a junction made from one of these materials, the two annihilate each other in a flash of light. The light happens to be visible light — a wavelength that we can detect with our eyes.

If we make diodes using these substances, therefore, and use a transparent case around the junction, we can see the junctions glow when current is passed in the forward direction. The usual type of LED has a junction which glows red but other colours can be obtained by using different semiconductor materials.

Electrically, their behaviour follows familiar paths. Unlike silicon or germanium diodes, the forward voltage needs to be quite high (around 2V) so that LED's aren't much use on equipment which is intended to be operated from a 1.5V cell. Like all other diodes, however, the votage does not change much as the current is increased, so that a resistor must be connected in series with an LED, as in **Figure 13** to ensure that the current is limited to an amount that is safe.

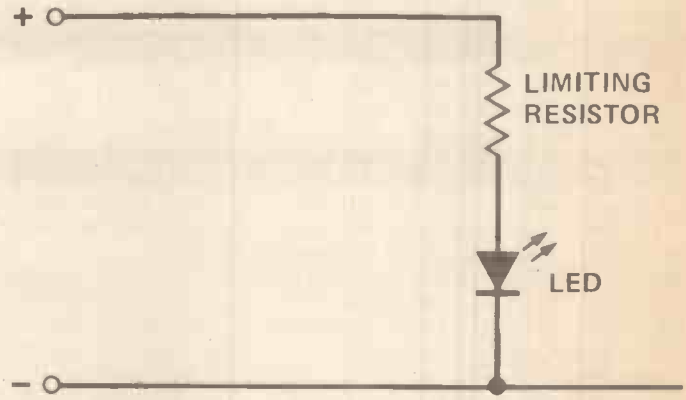

Figure 13. An LED connected with a current-limiting resistor in series.

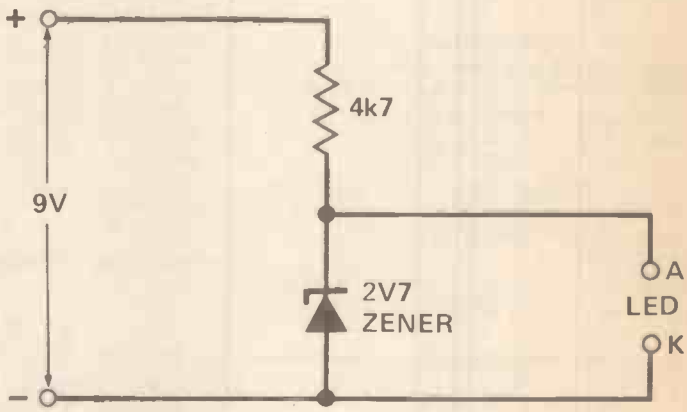

Figure 14. LED test circuit — the voltage is too low to damage the LED if it is connected the wrong way round.

Another important point, which is not always well understood, is that the LED has an unusually low reverse breakdown voltage, only 3-4V, and is easily damaged by quite small reverse voltages. Get an LED the wrong way round in a circuit, switch on, and nothing happens. Turn the LED the right way round and you'll quite often find that you get the same result — nothing! Having burned out the junction when it was connected the wrong way, you can't expect it to work the next time! The only solution is always to be absolutely certain that you have connected LEDs the right way, or to use much higher than normal series resistors (10k or more) until you are sure that the LEDs are correctly connected. The HE Meter is NOT a useful guide because the low ohms scale uses a 1.5V cell, too little voltage to pass current through the LED, while the high-resistance scale uses a 9V battery which can blow it out! So make yourself a circuit like the one in **Figure 14**. This limits the voltage across the LED and lets you test which way round is correct, without risk. Try it on your Eurobreadboard and then transfer it to a more permanent form.

Next month — we take a look inside the transistor, with lots of practical tips.

HE

CLEVER DICK

Editors may come and go, but Clever Dick is here to stay The Show Must Go On!

HEADING-UP the International Section this month is a letter from West Germany.

Dear Richard-With-The-Brains,
As I write, I am in desperate need for information on where I can get the VN67AF VMOS power transistor used in the Super Siren (April 1981) and the two 40 kHz ultrasonic transducers for the Ultrasonic Burglar Alarm (July 1981).
My components shop doesn't stock the transducers, and they say it could be years before they get hold of a VN67AF!
By the way, is my subscription extension and moving notice confirmed?
Yours in dire need,
Victor Chua,
Kronberg/TS,
West Germany.
PS I'm 13, and if you can't give me the information, the least you can do is send me a binder.

Actually, I hadn't noticed you'd moved, myself, but I've passed your letter to our mighty Subscription Department (all-seeing, all-knowing), just in case they haven't noticed either, just this once. I suggest you try one of the many mail-order companies who advertise in Hobby Electronics — they should be able to help you with the components you need. So now you've got the information — too bad about the binder. And that's it for the International Section.

The next one's easy . . .

Dear CD,
Help! I am a beginner in electronics and want to make my own PCBs. Problem: I don't know how.
I would appreciate any information you could give me about using the etch pen and the transfers. Could you also give me some foil patterns for some beginners projects! Any information would be of great help. With your brains (creep, creep) I know you can.
Yours hopefully,
N. J. Harris,
Billericay, Essex.
PS The mag's great — keep up the good work.
PPS What a bind it would be to go to a shop to get the information.

Lastly, disgusting puns like that one deserve to be ignored, so I'll not mention it again . . . I'm sorry I mentioned it in the first place. As to making PCBs, WATCH THESE PAGES (All will be revealed).

We're always open to suggestions (as long as they're nice ones) here at the luxurious offices of ASP, so the next letter has been passed to our Brilliant Design Team.

Dear CD,
I have my own darkroom for processing black-and-white film, but seem to waste tons (slight exaggeration) of expensive photographic paper as exposure test strips.
I would, therefore, like to know — can the Flashmeter (Project Supplement, November 1981) be used under the enlarger to give an exposure-time reading and if so, will any modifications (other than meter calibration) be necessary?
Keith Challenger,
Sheffield.

The Flashmeter is designed to register very, very brief flashes of light, so the circuit would indeed need to be modified heavily. We're looking into this and, all being well, a suitable project will appear. Meanwhile, are there any photo-fans out there who can help Mr. Challenger with suggestions (nice ones, remember) for saving paper?

Now, just for a change, an Errata that wasn't.

Dear Dick,
Could you please tell me if there were any Errata for the System 5080A Power Amplifier (March 1980) and also if Hobbyprints are available?
G. Finney,
Pontypool, Gwent.

The only note I can find concerning the 5080A is that the transformers on special offer were sold out, so you'll have to find and alternative, right? Hobby prints are no longer generally available, but the PCBs for the 5080A are — see the HE PCB Service page in this or any recent issue.

Next, one from the Heavy-Handed Hints Dept.

Dear Clever Dick,
I enjoy reading HE and have all the issues from June '79 and I am looking for a place to keep them — something like a binder (hint, hint).
I have built many of your projects on Verobloc, but only one on Veroboard — the 2 W Amplifier from June '80. I have had good performance from the amp, until now. The problem is that when the input goes high, the output starts buzzing. Could the problem be the LM380N?
What about producing a CB Transceiver? Would it be possible to modify the Super Regenerative VHF Receiver (Project Supplemenmt, November issue) to pick-up 27 MHz signals?
Steven Johnson,
Bishop Auckland, Co. Durham.

Questions, questions. Doesn't anyone write just to say "hello", any more? Well, to answer those questions (but ignoring all requests for unmentionables) . . . In reverse order, yes, it would certainly be possible to modify the VHF Receiver as you suggest, but since it would receive only 27 MHz AM signals — which are illegal — we couldn't possibly recommend it. A CB Transceiver project is also possible; I believe that a series on radio theory is being planned, and may even appear in these pages (anything can happen!) and a CB project may be designed to go with the series.

Can't really help you with the audio problem, though, except to point out that the amplifier is intended to take an audio input, not logic-level (high/low) inputs.

This letter cannot go unanswered. Read on . . .

Dear Macho, Handsome Intelligent Richard, [see what I mean]
Can you help a maiden in distress? I won't bore you with the whys and wherefores, but I desperately need — a circuit! I've searched in vain but nowhere can I find one that links the amount of light falling onto a surface with the movement of a servo-mechanism (such as those used in radio control models), i.e. Darkness = No Movement, Brilliant Sunlight = Full Movement. The Black Baron (my Lecturer) approaches as the final project hand-in date draws nigh . . . will the HE knight in shining armour be in time?!!
Yours Poutingly Desperate,
Lucy Morris,
Portsmouth, Hants.

Who could resist? WHO would resist. Not I, said Clever Dick, so despite the fact that I never (well, hardly ever) answer requests for circuits, I'll make (yet another) exception and despatch a circuit or two. They're in the post.

Here's someone with very strange tastes.

Dear CD,
Maybe everyone licks your boots and grovels for a binder because, like me, they are unable to find an advertisement for them in the magazine — not that I'd say 'NO' to a free one... What about a medium power Guitar Amp project for those of us who normally play acoustic guitar, but sometimes need a boost?
All the best to a great magazine.
Andrew Chapman,
Telford, Shrops.

Now isn't that nice. My boots are available any time — and thanks for the nice words. As a reward, I can tell you that a guitar amp project is being planned (hang on and hope).

And now, by popular request...

Dear CD,
I, for one, do not intend to grovel to get a free binder! I actually want to buy, yes, BUY one. I have written to the suppliers and have been informed that they are no longer in a position to supply them. Can you advise?
Kevin J. McLaren,
Glasgow.
PS perhaps I was a little hasty!

Too late, too late by half. You'll just have to consult the Binder advertisement which, the Editor has assurred me (for all that's worth), appears in this very issue.

Apparently, quite a few people have had problems with the printed circuit boards for the projects in last month's issue. They can't find them.

Dear CD,
How about printing the PCB patterns for the Guitar Graphic Equaliser, the Drum Synth, and the Doorchime? You seem to have forgotten them (tut, tut)!
Peter Smith,
Westbury Park, Bristol.
PS I could do with one of those things to keep my copies of HE in. What do you call them? Bind...something?

Tut, tut indeed. Anymore of this baby talk and I'll send you an all day sucker. The projects you've mentioned were supplied to us by outside contributors who have retained the copyright on the PCB patterns. You'll have to write directly to the companies concerned — that is, if you can remember what to ask for!

Now, a true rarity — a genuine, polite letter.

Dear Clever Dick,
1. What do "K" and "Z" mean on capacitors (mostly ceramics)?
2. Where can I get hold of the first few issues of HE? Can any readers help? How much would they be?
3. Why do readers crawl to you for a binder? Why don't they just ask nicely (like me). Please.
R. Vicent
Stevenage Herts

1. These are part of a manufacturer's code, and do not really concern us, usually. However, a spokesman for Mullard Limited told me that, at Mullard, 'K' could stand for one of three things: 'kilo', ie 1000, to denote the number of picofarads (10K or 10k = 10,000 pf, for example); or, 10% tolerance; or, the data code for 1978. Take your choice — it doesn't really matter. As for 'Z', he thought this could be the first part of 'Z5U', a code used to indicate high-permittivity general-purpose coupling capacitors.
2. The first few issues are definitely not available, here. Even some of mine have been pinched!
3. Sorry, even courtesy won't work.

Andrew Mawson very nearly wins this month's binder. I'm surprised he can even remember December 1978 . . .

Dear CD, Sir,
Why have you decided to build another Light Beam Telephone project? I can see no major differences between the Photon Phone (December 1978) and the Sound Torch (November 1981) except that the Sound Torch has a separate transmitter and receiver whereas the Photon Phone had one item to do the whole job. Why? Did the Photon Phone not work?
Andrew Mawson,
Bingley, West Yorks.
PS I think HE's great, brilliant, marvellous (grovel, grovel).
PPS CanIhaveabinderasI'vegoteveryissue ofHEfromDecember78toNovember81and nowheretoputthem?
PPPS I'm only 13, please, please, please.
PPPPS Where's Breaker One-Four gone?

Weren't me Guv, honest! I expect somebody thought it was a good project and worth reviving — not everyone has every issue from December 78 to November 81, you know. Breaker One Four is temporarily off the air (and that's my bad pun of the month) but hopes to return soon. Finally, just to show I'm not completely heartless, I will relent, give up and submit.
Andrew Mawson, THIS IS YOUR BINDER.

'Bye Now.

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FAMOUS NAMES

Vladimir Zworykin is — or should be — famous for his achievements in the field of Opto-Electronics

WHO? Never heard of him? Well, it's certainly true that Zworykin, a pioneer of electronic television, isn't as well known on this side of the Atlantic as he is on the other, but that's not really an excuse. Zworykin was born in 1889 in Imperial Russia and during the first part of World War One served with distinction in the Radio Corps of the Imperial Russian Army. Then came the Revolution, the army was disbanded in confusion and, like many others, Zworykin escaped while escape was still possible. Emigrating to the USA in 1919, he joined the Westinghouse Electric Corporation in Pittsburg, and launched his brilliant research career. In 1923, he patented the device which provided the first genuine electronic television service. It was the Iconoscope — the first TV camera tube.

The Iconoscope has long been out of date and only survives in a few museums, but it was the mainstay of TV broadcasting from 1936 until well after the second World War. Briefly, the idea was that an image of a scene was projected on to a photosensitive sheet of material inside an evacuated tube. The sheet (or target) wasn't continuous but consisted of tiny dots of conducting material surrounded by insulation, so that each dot became electrically charged by the action of the light falling on it. A beam of electrons was then scanned across the sheet and the differences in charge at various places on the conducting target caused the electron beam to be modulated at the final anode, after the beam had been reflected from the target.

Problems

The principle was fairly simple, though not well understood at the time and depended on being able to construct a target with just the right amount of leakage between conducting sections. This was not possible then, though if a bit more development work had been done, television wouldn't have been sidetracked into mechanical methods left over from the 1880's.

Zworykin, totally committed to all-electronic television, patented a receiver in 1924 and continued development work at Westinghouse. A patent for a colour TV system followed in 1928 and, in 1929, RCA were so impressed by Zworykin's improved working model of a receiver that they offered him the plum job of Director of Research at their Princeton research centre (now at Camden).

The years that followed were extremely exciting for the future of TV. Demonstrations of mechanical systems had caused considerable sums of money to flow into a method which would prove to be a dead end. This had the twin effects of making fewer resources available for research into electronic TV and at the same time convincing many people that television simply wasn't worth having. At RCA, however, Zworykin assembled a team whose objective was to ensure that they came up with the first all-electric TV Meanwhile in Hayes, Middlesex, the EMI Company (then HMV) was working on precisely the same project, with the advantage of having two outstanding research engineers — McGee and Blumlein. McGee (now Professor McGee) was in charge of camera tube development, Blumlein was in charge of circuit development.

Everyone a Winner

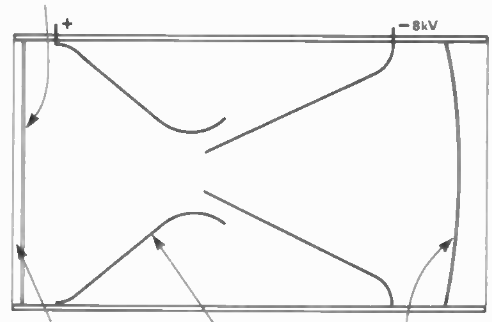
Who won? We all did. One of the remarkable things about that period was the way in which everything went in synchronism (almost) at the two places. If we take the end of the race as being the first public TV broadcast then the EMI team, with the close cooperation of the BBC, just made it. No-one on the other side of the pond is ever going to admit that, though!

As in so many other cases, however, RCA was able to produce and sell TV receivers on a scale which greatly outstripped the UK (there were about 700 receivers in London in 1939) and it was Zworykin's team that undoubtedly made the true mass production of TV receivers a reality.

By the outbreak of war between Japan and the USA, Zworykin had taken out another significant patent. It was for a device which he called an 'electric eye', but which we now recognise as an electron microscope. The development of the electron microscope did not progress much further until after the War, but the basic principles remain those laid out in Zworykin's patent. Our understanding of materials, particularly the nature of semiconductors, owes much to this remarkable instrument.

The onset of war inevitably caused research laboratories to turn away from television. Zworykin's team worked extensively on infra-red imaging tubes, the 'sniperscopes' which can sometimes still be bought as 'war surplus'. The basic principle, illustrated in **Figure 1**, was remarkably simple. A photocathode was made which was sensitive to infra-red (heat) radiation so that electrons were emitted from any part of the photocathode struck by infra-red. These electrons could then be accelerated by a high voltage and used to form a visible image on a phosphor screen. Using a lens to focus the infra-red rays onto the photocathode, the tube produced a visible image from the invisible infra-red.

Early sniperscopes were relatively insensitive but were quite capable of detecting hot engines or guns, allowing artillery to be aimed at night. Towards the end of the war more sensitive versions were developed, capable of detecting human bodies against a colder background. The most recent devices allow us to see with almost the same resolution and contrast range as we would expect from television!



1. Principle of the 'sniperscope'. A photocathode emits electrons when struck by infra-red (heat) rays. The electrons are accelerated to a phosphor screen to produce a visible image, allowing the user to literally "see in the dark".

Images Intensified

It was Zworykin's work which made this and so many other modern light detectors possible. Secondary emission multiplication, a method of noiseless amplification and another first for Zworykin, makes use of an effect which takes place when a fast moving electron hits the surface of an insulator or conductor. When both the speed of the electrons and the voltage between the source of the electrons and the surface are correctly adjusted, each electron which hits a surface can knock off several others. This is where the 'multiplier' comes from; each time this happens, the number of electrons in the beam is being multiplied. Several stages of multiplication can change of current from a fraction of a microamp to one of several milliamps and without any noise signal being introduced. This principle was to be the key to the more sensitive camera tube, the image orthicon, which superceded the iconoscope and its offspring, the super-iconoscope. Scientific investigation was also to benefit from photomultiplier light detectors, which also use the secondary emission effect.

Zworykin's lifetime of research was not overlooked by his colleagues or by RCA He was appointed an Honorary Vice President of the company in 1950 and became Director of the Rockefeller Medical Electronics Institute (now Rockefeller University) in New York City. As the final seal of esteem, in 1967 the National Academy of Sciences awarded him their highest honour, the National Medal of Science.

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VOLUME EXPANDER

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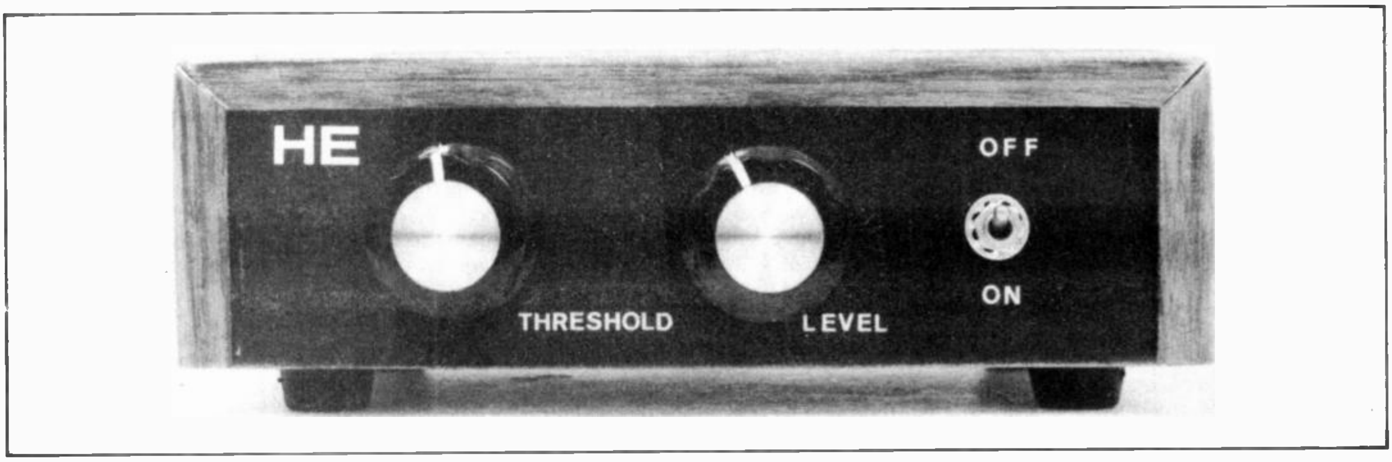


ONE OF THE PROBLEMS of cassette recorders, especially those with no system for noise reduction, is that it is not uncommon for a big crescendo *not* to happen! Instead of an expected rise in volume to a powerful peak, it tends to flatten out and may even become rather muffled and distorted! This is because the dynamic range of the programme material, on tape, is greater than the dynamic range of the system. Dynamic range is simply the difference between the lowest and highest signal levels and the dynamic range of a recording system is the difference between the lowest signal level that can be recorded, without getting lost in noise, and the highest level that can be recorded without serious distortion resulting. If the former is greater than the latter then you obviously have a problem!

On the face of it, the choice is between losing the lowest signal levels in noise or allowing the highest signal levels to overmodulate the tape and cause severe distortion. In practice, it is common for compression to be used (usually in the form of an automatic recording level system or limiter) and this reduces the recording level, during peaks in the dynamic level, so that overmodulation and distortion are avoided while allowing sufficient average gain to keep low-level passages above the 'noise floor'. Unfortunately, this also results in crescendos that are only slightly louder, certainly less loud than they should be and the reproduced music is consequently lacking in impact, to say the least.

Name Of The Gain

It is not really possible to process a compressed signal to precisely restore the dynamic levels to their original condition unless the compression law used during the recording is known. This is not likely to be the case. However, it is possible to use a compromise system which leaves the lower dynamic levels unchanged but boosts the higher levels, so that the lost dynamic range is, after a fashion, restored to something like the original. Of course, the expansion will not exactly match the compression used in the recording stage, and the usefulness (or otherwise) of volume expansion depends largely on the programme material. It might give a dramatic improvement, or it may give an artificial sound to the music. Generally, though, if it's used with programme material that seems to be rather lacking in dynamic range and impact, a very worthwhile improvement can normally be expected.

This simple expander is, therefore, primarily intended for use between an inexpensive cassette recorder and an amplifier. It was designed as a mono expander but, as the two channels are processed separately in a stereo expander, it is merely necessary to use two circuits in order to produce a stereo version.

Construction

There is nothing out of the ordinary in the construction. A small piece of 0.1" Veroboard is used for all components except the controls, etc. Drill the two mounting holes (for 6BA or M3 fixings) and make the breaks in the copper strips before soldering on the components. The layout is quite dense and bridges of solder between copper strips are easily produced, so inspect the finished board for bridges and, if possible, double check using a continuity tester.

Use a metal case for this project as it will screen the board and wiring from mains hum etc. The input and output sockets are 3.5mm jacks, but use another type of connector if this will make it easier to wire the Expander into your system. A PP3-size battery is sufficient to power the unit — the current consumption of 2.5mA does not justify the use of a larger size.

Parts List

RESISTORS (ALL ¼ WATT 5%)

R1	100k
R2	120k
R3	3k3
R4	2k7
R5	1k5
R6	330k
R7	270k
R8	33k
R9	10k
R10	1M8
R11	4k7

POTENTIOMETERS

VR1	2M2 linear carbon
VR2	2M2 linear carbon

CAPICITORS

C1	1uF tantalum
C2	10uF tantalum
C3	0.22uF tantalum
C4	10uF tantalum
C5	0.47uF tantalum
C6	0.1uF polyester (C280)
C7	100uF 10V electrolytic

SEMICONDUCTORS

Q1, 3	BC109C
Q2	BF244B
D1, 2	1N4148

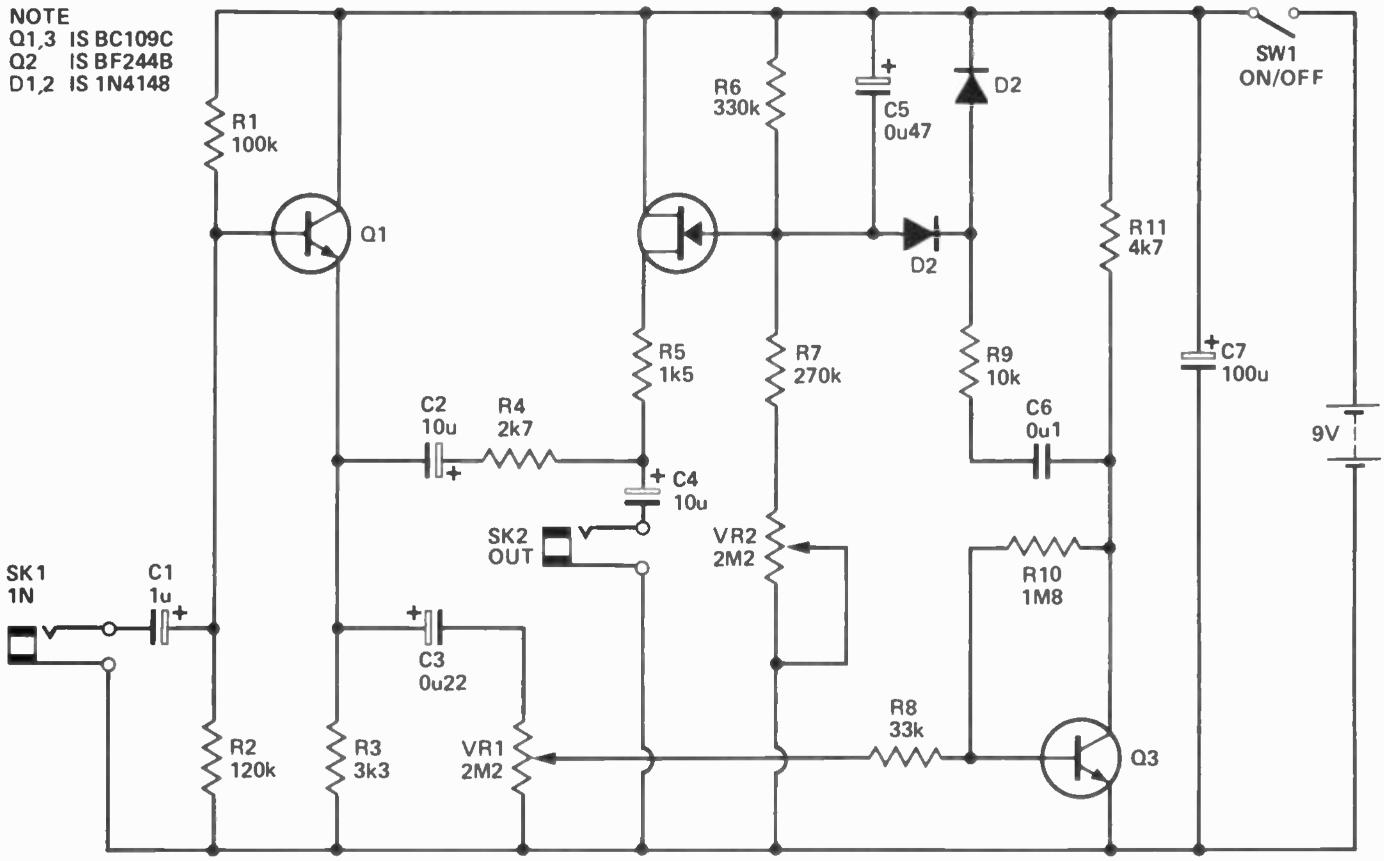
MISCELLANY

SK1,	2 x 3.5mm jacks
SW1	SPST miniature toggle switch

Stripboard panel
PP3 battery and connector
Two control knobs
Wire, solder, etc.

Setting up

The Expander will function with input levels of between about 100mV rms and 3 volts rms and it should be possible to use it successfully with virtually any



▲
Figure 1. Complete circuit diagram of the Expander. The battery is a PP3.

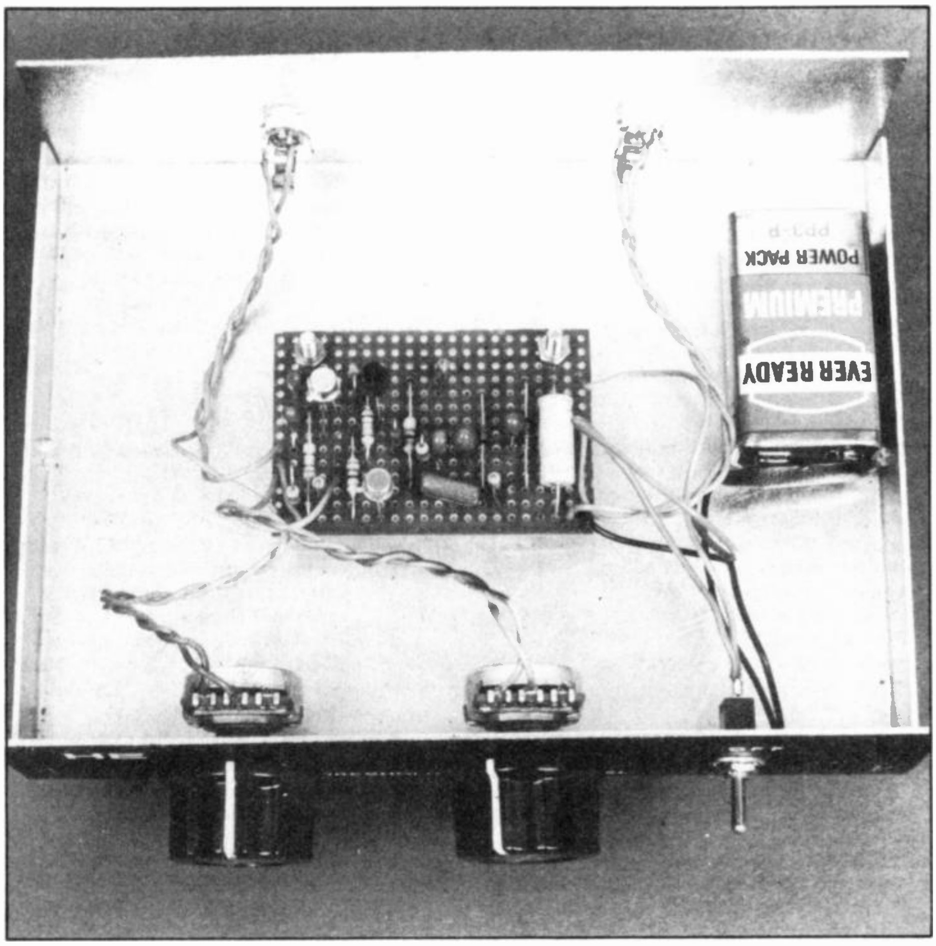


Figure 2. The layout inside the case — a ▶ smaller one could be used.

cassette recorder and amplifier (use screened leads to connect it into the system). With threshold control VR1 backed right off (fully anticlockwise), the volume can be altered to some extent by adjusting the Level control, VR2, but only over a fairly narrow range. Best results will probably be obtained with VR2 backed off just far enough to reduce the volume to its minimum level, however, it is worth experimenting a little here.

Also, if VR1 is not advanced far enough, expansion will not be obtained while (if it is advanced too far) the effect of the unit will be very obvious and probably annoying. Again, it is a matter of experimenting to find the setting that gives best results.

Buylines

The BF244B f.e.t. is available from Technomatic Ltd. The case is a Maplin type TP2, but any similar case should do just as well. The other parts are all easily obtained and the approximate cost of this project should be around £15, excluding the case.

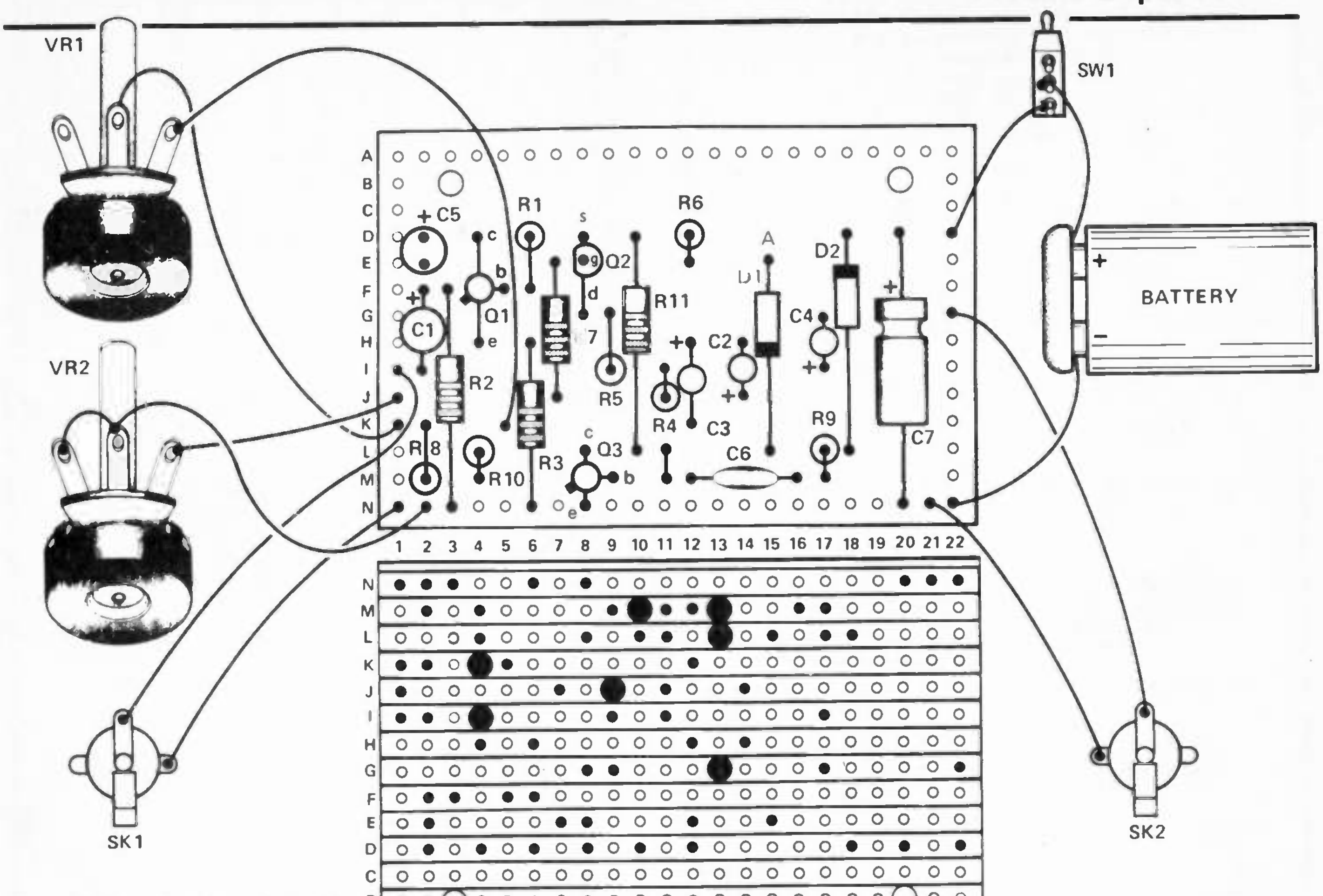
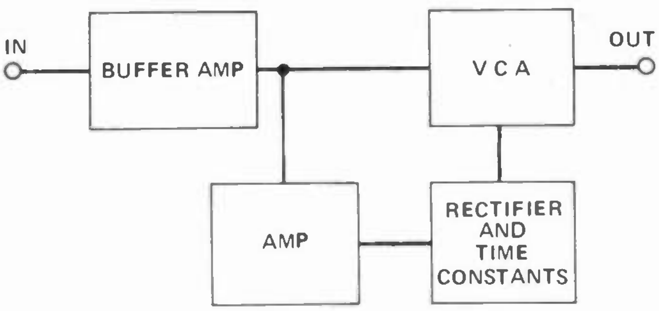


Figure 3. Bottom and top views of the Veroboard showing the external component connections.

How It Works

The input signal is taken to a buffer stage, then to a voltage controlled attenuator (VCA), which reduces the signal level slightly. Some of the output of the buffer is amplified and fed to a rectifier and smoothing circuit which sets the attack and decay times and provides the control voltage for the VCA.

With little input signal, the VCA provides a set amount of attenuation. Higher signal levels are less heavily attenuated so that they are effectively boosted, providing an increase in dynamic range. The attack and decay times are quite short so that the circuit responds almost instantly to changes in level.



The Circuit

The heart of the circuit is a JFET used as a Voltage Control Attenuator. One arm of the attenuator is formed by R4, the other by the resistance of R5 and the drain-top-source resistance of Q2 in series. If Q2 is switched off, it has an extremely high drain-to-source resistance, typically a thousand megohms or more. Assuming the output of the attenuator feeds a medium to high impedance load, it gives very little signal loss. If Q2 is switched on, however, it exhibits a drain-to-source resistance of only a few hundred ohms, at most, and this gives losses of 9 to 10dB.

VR2 is adjusted so that the reverse bias on the gate of Q2 is not sufficient to switch it off. so that the loss through the VCA is 9 to 10dB. Q1 is used in an emitter follower buffer stage to ensure that higher losses do not occur if the unit is fed from a low impedance sourse (which is quite likely to be the case).

Some of the buffered input signal is fed via C3, VR1, and R8 to a common emitter amplifier based on Q3. The output of this is coupled by C6 and R9 to a rectifier circuit, D1, 2, which gives a negative DC output signal, smoothed by C5. This negative bias is applied to the gate of Q2 but will be too small to have any effect at low dynamic levels. VR1 is adjusted so that, at higher dynamic levels, the bias starts to turn off Q2, reaching "pinch off" at or just below peak volume. Thus the attenuation of the unit is reduced as the dynamic level is increased; that is, the volume is expanded. The values of R11, R9, and C6 give the circuit the necessary fast attack time, and the values of C5 and R6 give a somewhat slower but still quite rapid decay time. It is essential that the response is fast enough to follow the rise and fall of the signal level, or the action of the circuit would become clearly audible. On the other hand, there must be a small delay, provided by the slower decay time, or the circuit would seriously distort the processed signal.

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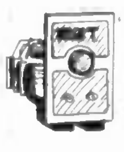

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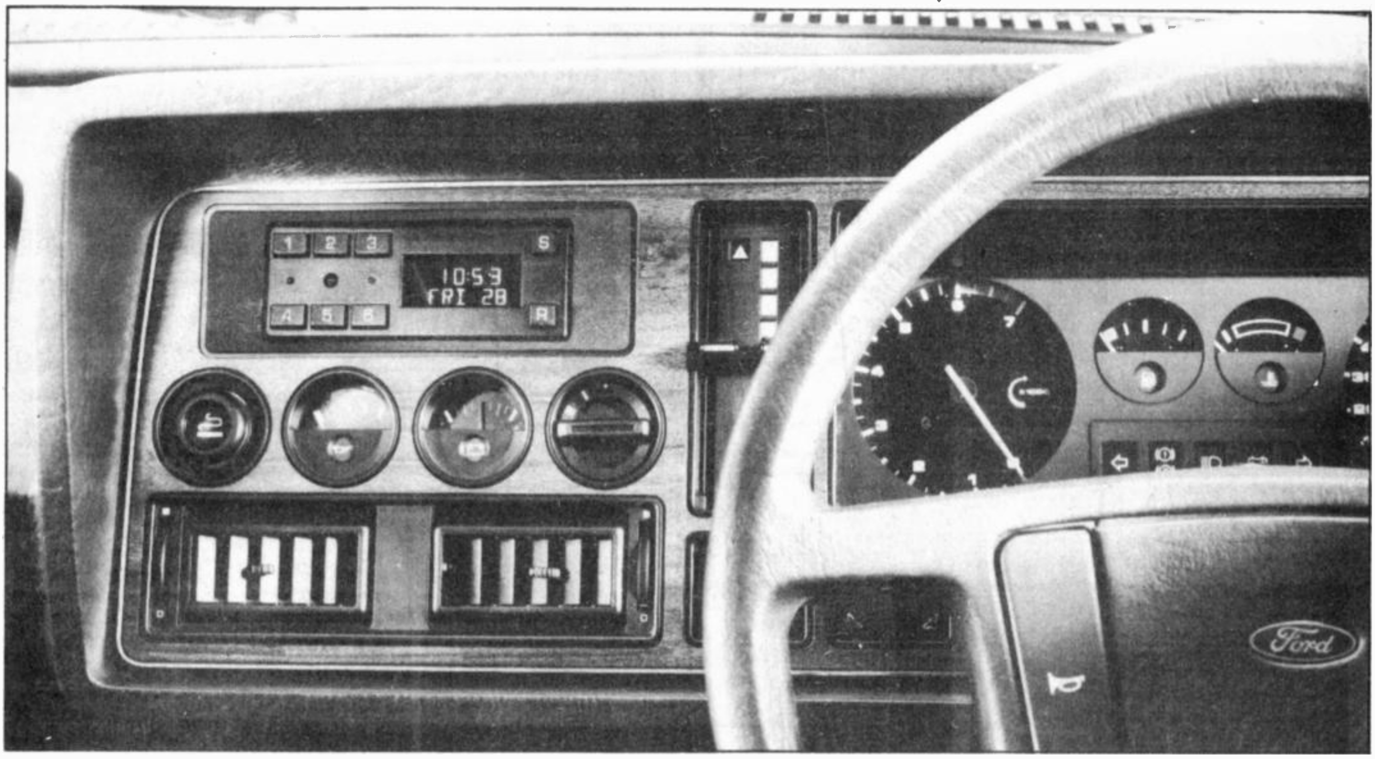
The final part of our in-depth preview of the "Car of the Future"



Despite the apparent acceptance worldwide of DCEL and VF as the most suitable forms of instrument displays, a number of other techniques are currently being investigated which may have advantages in limited applications. In Japan, NEC has an electronic multi-coloured instrument panel using a combination of back-lit liquid cystal displays and vacuum fluorescent techniques, and is developing a dot matrix readout with a highly flexible format for displaying symbols, letters and numbers. Jaeger SA of France has also developed an electrolytic liquid display in which light is dispersed from a silver film deposited on a clear electrode, while in the USA, a number of companies are active in the field of VF. One such company, Zenith Radio Corp, has even proposed a computerised cathode-ray tube display system. (A variety of different types of displays were described in *Digits On Display* in the November '81 issue of HE, pp 14-17.)

Voice synthesis techniques, now well established, are also being investigated for providing 'spoken' indications of low fuel, presence of ice, low oil pressure etc, as a means of attracting the driver's attention.

Driver information and car status has been carried a stage further by Siemens of West Germany. This company, in collaboration with BMW, has developed a microcomputer system that offers the driver fifteen functions. In additon to the milometer and speedometer, it includes such things as average petrol consumption, the residual range with the residual fuel carried, distance to destination, likely time of arrival, and flashing lights with gong alarm that warns of maximum speed and icy road hazards.

Integration Requires A Reliable Power Source

Any electronic system is only as good as its power supply, and this applies equally to vehicle systems. Here again, integrated circuitry comes to the rescue by making it possible to design a single-chip voltage regulator that can absorb all the electrical stresses that occur in a car, and to provide at its output safe and stable supplies. One such regulator is the SGS-ATES L2600 (Fig. 5) which can withstand at its input peak voltages between −150 V and +120 V and steady DC voltages between −28 V and +28 V. Also, because it has been designed to supply devices that must operate during start-up, when it is possible for the battery voltage to drop to as low as 6.5 V, the drop-out voltage is only 1.5 V. Even at this voltage it does not actually drop out but 'drops off' by following the input voltage. Full output stage, overvoltage and thermal protection are built in 'on chip', and a particularly important aspect is the high precision of the output voltage which can be set to ±2% during production of the device.

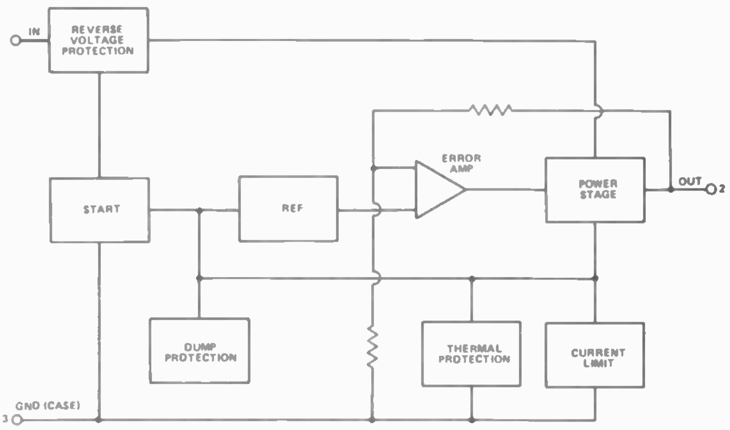


Figure 5. Block diagram of SGS-ATES' L2600 regulator

To maintain the cost of the device within reasonable limits, the maximum current capability has been limited to about 0.5 A. When a higher current is needed, a specially designed power transistor can be added which has a collector current of greater than 20 A, thus allowing it to withstand extreme reverse polarity conditions. By including this transistor in a circuit configuration such as that shown in **Fig. 6**, it is possible to design a power supply that not only provides the high and low voltage and current requirements for all of the in-car electronics, but also offers protection against possible destructive abnormal electrical conditions that could be encountered.

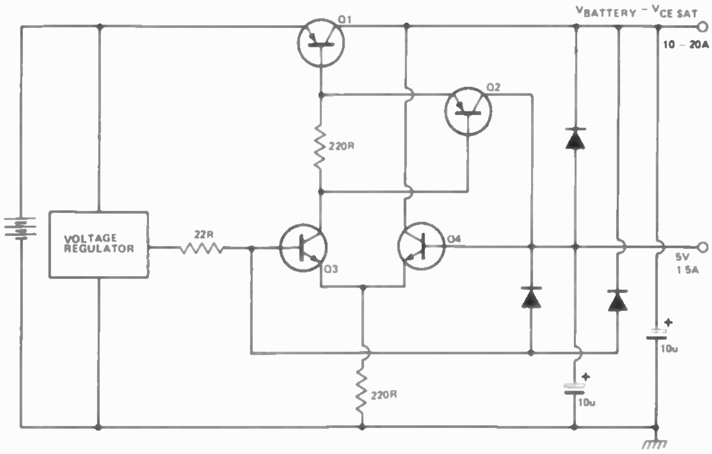


Figure 6. The L2600 regulator with added protection for high/low voltage and power

Another type of regulator, the L485, is a monolithic (single chip) integrated circuit that has been designed for use in conjunction with a Darlington power transistor as voltage regulator in a three-phase alternator charging system (**Fig. 7**). Particular features are complete built-in diagnostics, 3 W lamp direct driving, lamp short-circuit protection, 120 V load disconnection protection, 300 V low energy interference spikes protection and thermal protection.

Other Areas For Electronic Control

One important application for the microprocessor which has not yet been mentioned is in transmission control which, in the future, will not include separate and definite gears but instead will have a microprocessor-controlled servomechanism that will automatically adjust itself according to the load the car is being required to carry. As a result, the proper gear ratios will always be chosen to maintain optimum torque efficiency and maximum engine efficiency.

Another important area, depending upon how comfortable you like to be, is the air conditioning and temperature control of the car interior. This is particularly relevant to European cars which do not always provide the same degree of comfort as that enjoyed by American drivers.

Most of the ancillaries such as signal flashers, hazard warning lamps, interior dimming, headlight dipping, screen wipers, rear window de-misting or de-frosting can all benefit from integrated circuit or microprocessor control.

Putting It All Together

The application of integrated circuits and microprocessors to individual areas of vehicle systems presents no real problems to current technology. Bringing them together into one integrated system under the control of a microcomputer, or using a distributed technique whereby a number of microprocessors or microcomputers control specific areas in an inter-linked system, requires a more elaborate approach. It is this approach which is now being investigated by the major semiconductor houses in co-operation with the car manufacturers.

Obviously, only the larger functions such as engine management and fuel injection, ignition control, anti-skid braking, instrumentation, transmission and power supply, would be integrated into a total system, leaving the ancillary areas to individual control, but how can all this be put together efficiently, economically and in an orderly manner? It has been said that a camel is a horse designed by a committee — it has all the bits, it does the job, but what a combination! (Apologies to camel lovers.) As more and more electronics are added to the car we could, if we are not very careful, be in danger of producing a 20th century camel unless some orderly approach is adopted.

The actual method of approach adopted will depend very much on the preferences of the individual car manufacturers and whichever electronics companies supply their systems, and either of the two methods referred to above — centralised or distributed control — could be adopted.

One international electronics company, SGS-ATES of Milan, has formulated an approach it calls 'partitioning' which is fully integrated, and which caters for the severe electrical en-

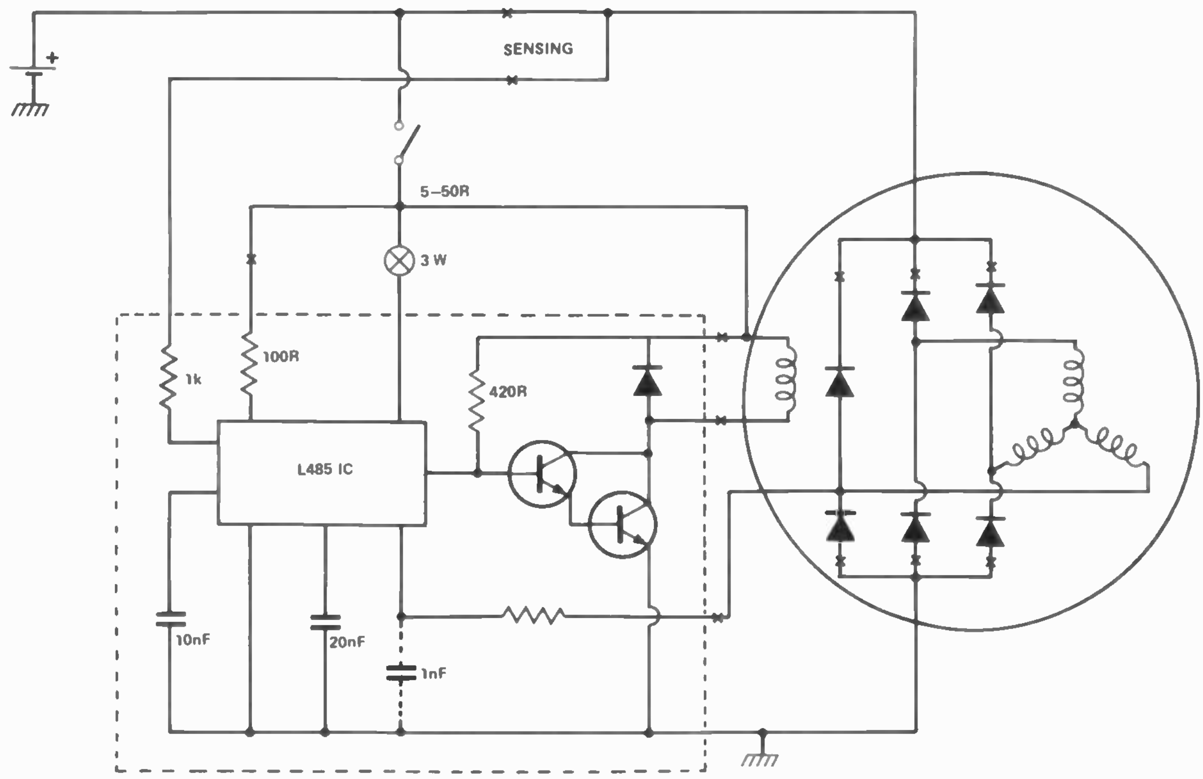


Figure 7. Electronic voltage regulator for use with a three-phase car alternator

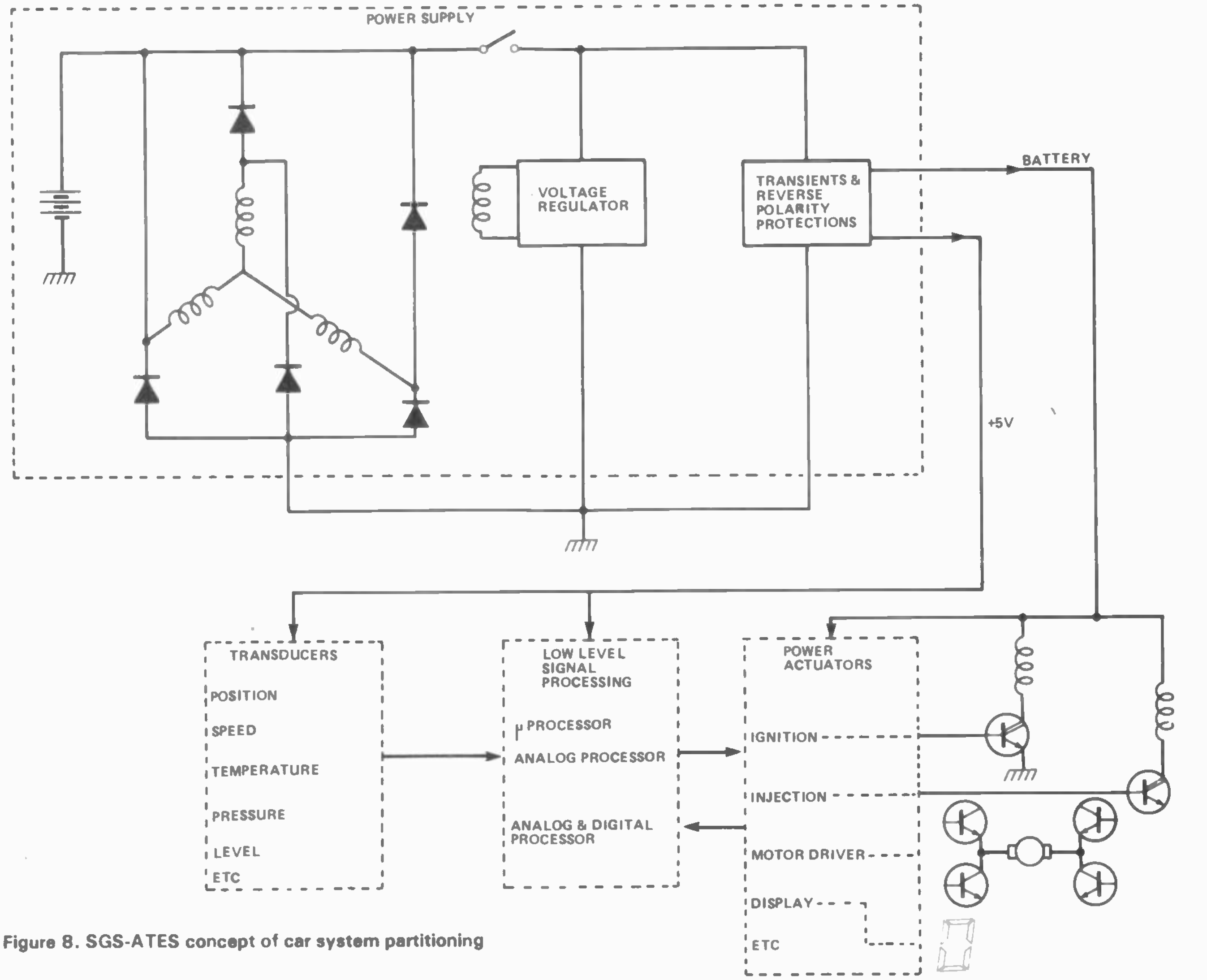


Figure 8. SGS-ATES concept of car system partitioning

vironments encountered in cars by providing a fully protected central power supply.

The system operates by splitting the car electronics into separate groups characterised by technology, performance and function,as shown in Fig. 8. In general, this results in four different groups. At the heart of the system is the power supply group, the function of which is to convert the normal car supply into a safe and appropriate supply for each of the other groups in the system. Devices working in this power supply section must not only be of high power rating and of high efficiency but they must also be protected against all the adverse conditions such as overvoltage, transients, wrong polarity etc.

Having obtained a safe supply, it is then possible to optimise the remaining units according to their functions, using the most appropriate technology available and without worrying about device protection. For instance, input sensors can be designed with the optimum signal-to-noise ratio, linearity and drift, the three major requirements of such devices. It is possible to process signals at low voltages and, because the supply is constant and secure, it is also possible to use more standard semiconductor devices than specially-designed devices.

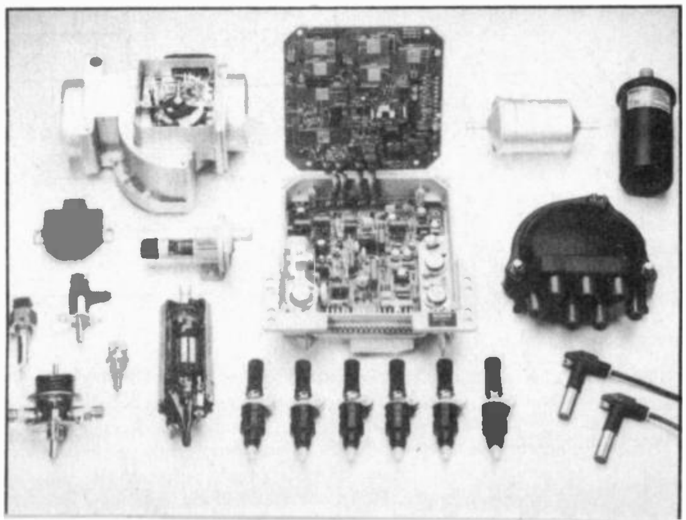
Power actuators for driving motors, solenoids etc use the same technology as the power supply, but unlike devices in the power group these need no special electrical protection against supply variations, and therefore the whole semiconductor design can be concentrated on achieving the desired function.

What About The Wiring?

By now, even from the brief examples quoted, it must be obvious that fully integrated car electronics with microprocessor control could present problems in interconnection techniques (that is, circuits sited around the car 'talking' to a central computer) unless something other than the conventional cable harness was used. Fortunately, the answer to this problem already exists in well-established computer systems — digital multiplexing. This is a combinational method of transmitting binary information selected from one of many input lines to a single output line. It can be likened to a single-pole multiposition switch that passes digital data in one direction only.

The trend in car electronics will be towards this method for the replacement of conventional cable harnesses to carry all signal data, and it is possible that fibre optics will be used instead of copper wire to achieve savings in cost and weight.

For those unfamiliar with the term fibre optics, it is used to describe light 'pipes' made up of many strands of glass drawn and fused together as a solid length. When light is applied to one end-face of the pipe, it is transmitted to the other face with little lost on the way; that is, none escapes from the wall of the pipe.



Thus many digital signals, converted to modulated light, can be transmitted along the pipe, with total freedom from electrical interference. ('Interference' here applies to that generated by the data lines as well as that picked up from other electrical circuits in the vehicle.)

Even in cars fitted out with a fibre optic network copper cables will, of course, still be used for the power wiring.

The actual system of data transmission that will be used is uncertain, but it could well be that described in MIL STD 1553B (or variant) which is an American standard relating to a serial mutliplexed data bus ('bus' is the term given to one or more conductors used as a signal path for transmitting information from one of several sources to any of several destinations. A group of such signal paths is often referred to as a 'highway' or 'data highway'). This MIL STD is presently being adopted as a NATO standard and as a UK Defence standard. Marconi Electronic Devices Ltd of Lincoln has completed a detailed circuit design for a MIL STD 1553B terminal suitable for implementation in metal gate CMOS integrated circuits, and it is understood that this company has expressed interest in the application of this approach to car electronics.

Computer Control On An Automatic Highway

What must be considered as the ultimate in vehicle electronics is the fully automatic highway system (AHS) which is still a decade or so away, and which will involve a wide range of communication and computer technologies, many of which exist today. Examples are: automatic vehicle identification, automatic vehicle monitoring and route guidance. (Before we go any further, I should point out that 'highway' here relates to real roads for vehicles — not the electronic data highways described above!)

On the subject of vehicle identification, a number of technologies are being investigated but experience has shown that, within the concept of the automatic highway, the established technique of vehicle-mounted transponders and buried loops is bulky and expensive, and that microwave or infra-red techniques offer the most promise.

For automatic vehicle monitoring, where the location of road vehicles within some well-defined area would be determined automatically and communicated to a central facility, the three approaches being considered are proximity methods, trilateration and dead reckoning.

In the first, vehicle position is determined when it receives a signal from a fixed post along its path: the vehicle then transmits its post location to the control centre.

With trilateration a vehicle is located by direct measurements on radio signals travelling between the vehicle and a number of fixed stations: this offers the potential of providing wide-area location data at a low cost.

In dead reckoning the vehicle position is determined by a reference position, directional information and incremental position updates.

The primary objective for route guidance is to provide a driver automatically with routing instructions at decision points in the road network using two way links from the vehicle to the roadside. The technology is well known but application in route guidance systems is still to be proven.

The concept of the automatic highway system (AHS) makes use of a roadway complex which would consist of both automated and non-automated roads — various main arteries would probably be equipped for automation while secondary roads would not. In theory, a vehicle would enter the system at a special entrance, where it would first undergo a rapid automatic safety check-out and the driver would indicate the destination. If the vehicle passed the check-out it would be merged automatically into the traffic stream, but if it failed the check it would be guided into a nearby service facility for repair. Once in the traffic stream, the vehicle would remain under automatic control until the driver's preselected exit was reached when it would be guided off the roadway onto an exit ramp. At this point control would be returned to the driver. In the event of a vehicle breakdown, it would be released from the main stream and, if still driveable, routed to the nearest emergency exit. If it were not still driveable, the use of one lane would be lost and the main stream would have to be directed around the disabled vehicle. Hence, some provision would have to be made for clearing the roadway as quickly as possible.

The technology required for AHS depends upon the selected system structure, and this can be represented by two extremes — a highly centralised structure and a decentralised structure. The first would be characterised by an extensive computing and decision-making network, intercomputer and computer-to-vehicle communications, guideway-based devices to determine the state of each vehicle, and individually controlled vehicles with a minimum amount of on-board sensing and decision-making capability. At present this would be beyond the current state-of-the-art for computer hardware, and two-way computer-to-vehicle communications would pose severe problems although it would be feasible. For a decentralised structure, the technology would be characterised by a relatively modest computing and decision-making network, vehicle-to-roadside communications, complex vehicle-based sensors, and controlled vehicles with maximum on-board decision-making capabilities. Computing hardware for such a structure would be available, communications requirements would be less stringent, but reliable vehicle-to-vehicle and vehicle-to-roadside communications would require considerable research effort.

It is conceivable, therefore, that any choice would fall between these two extremes, and a study is being made in the USA in an attempt to resolve the issue.

Forecast

Undoubtedly, the application of micro-electronics to specific areas of vehicle systems will continue to grow, but the extent to which total integration will be applied, when, and by whom, are matters for conjecture. In an industrially sane world we should expect to see all car manufacturers embodying an increasing range of micro-electronics systems in their vehicles within the next 12-18 months, and by 1983 the first cars with fully integrated mico-electronics should be rolling off the production lines in the USA and Japan, followed by West Germany, Italy, France, and possibly the UK, a year or two later. Obviously, the USA must be the favourite in this race because of that country's vast home-based micro-electronics capability. Japan is also a favourite because of its industry's exceptional entrepreneurial prowess.

However, at present we do not live in an industrially sane world, and the recession that now affects the car industries in most countries is likely to modify these forecasts. In the USA, for example, the recession in the car industry has forced micro-electronics companies to shelve ideas for the development of new integrated circuits and microprocessors for vehicle systems. Instead, they are placing emphasis on improved manufacturing techniques to give greater reliability and productivity, and on the modification of existing designs to withstand the harsh environments of vehicle applications.

Finally, but nevertheless extremely important, the problems of car maintenance must be considered. While car owners will, in general, welcome the improved performances, greater economies, and increased safety that electronic systems will bring, there is no doubt that higher levels of garage maintenance skills will be required because of the increased difficulties of servicing. Of course, the well-proven techniques of easily-replaceable subsystems and modules will be applied to vehicle electronics, but this would result in a customer having to pay for a fairly costly module replacement, even if only one component fails, because module repair would be beyond the capabilities of the average service station.

Identification of faults in car electronic systems will be made that much easier by the incorporation of system test points that the manufacturers would have to build in, and this in turn will generate the demand for a whole new range of specialised, easy-to-use test instruments for diagnosing and finding system failures.

General References

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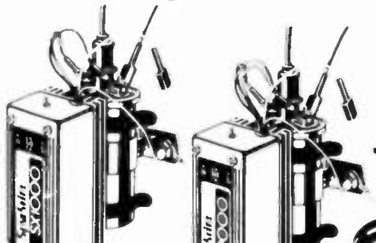

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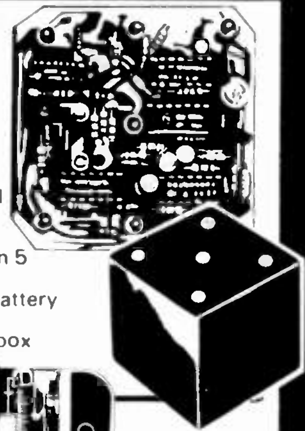

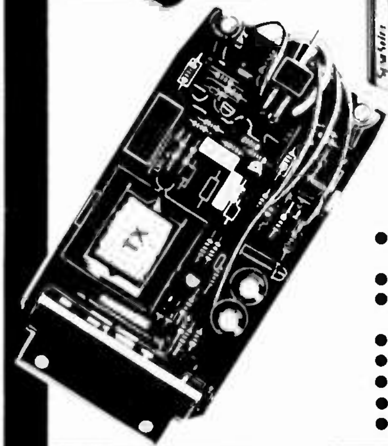

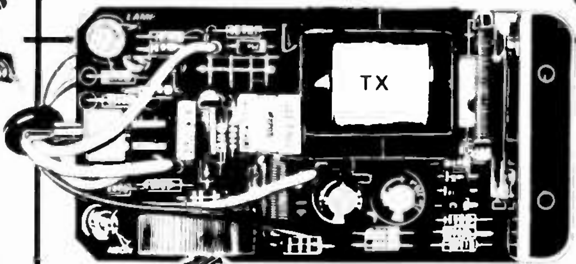

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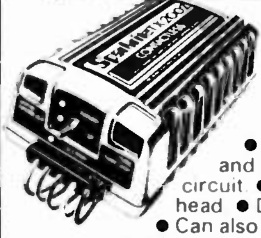
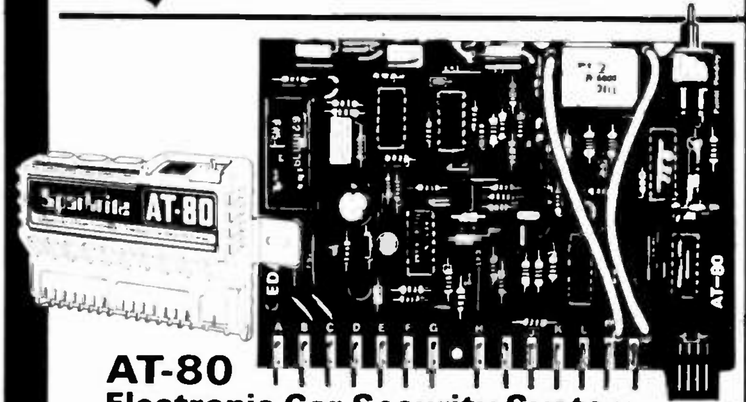
- Three position changeover switch
- Over 130 components to assemble
- Patented clip-to-coil fitting
- Fits all 12v neg. earth vehicles



TX2002
Electronic Ignition

● The ultimate system ● Switchable contactless ● Three position switch with Auxiliary back-up inductive circuit ● Reactive Discharge. Combined capacitive and inductive ● Extended coil energy storage circuit ● Magnetic contactless distributor trigger head ● Distributor triggerhead adaptors included ● Can also be triggered by existing contact breakers ● Die cast waterproof case with clip-to-coil fitting ● Fits majority of 4 and 6 cylinder 12v neg. earth vehicles ● Over 150 components to assemble

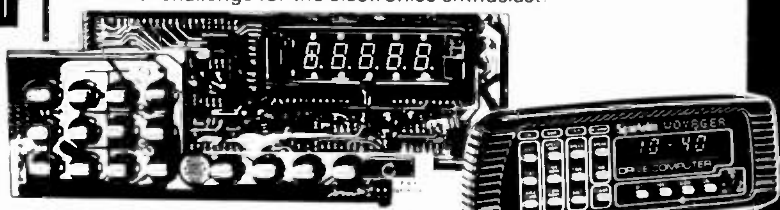


AT-80
Electronic Car Security System

- Arms doors, boot, bonnet and has security loop to protect fog/spot lamps, radio/tape, CB equipment
- Programmable personal code entry system
- Armed and disarmed from outside vehicle using a special magnetic key fob against a windscreen sensor pad adhered to the inside of the screen ● Fits all 12V neg earth vehicles
- Over 250 components to assemble

VOYAGER Car Drive Computer

● A most sophisticated accessory. ● Utilises a single chip mask programmed microprocessor incorporating a unique programme designed by EDA Sparkrite Ltd. ● Affords 12 functions centred on Fuel, Speed, Distance and Time. ● Visual and Audible alarms warning of Excess Speed, Frost/Ice, Lights-left-on. ● Facility to operate LOG and TRIP functions independently or synchronously. ● Large 10mm high 400ft-L fluorescent display with auto intensity. ● Unique speed and fuel transducers giving a programmed accuracy of + or — 1%. ● Large LOG & TRIP memories. 2,000 miles. 180 gallons. 100 hours. ● Full Imperial and Metric calibrations. ● Over 300 components to assemble. A real challenge for the electronics enthusiast!



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