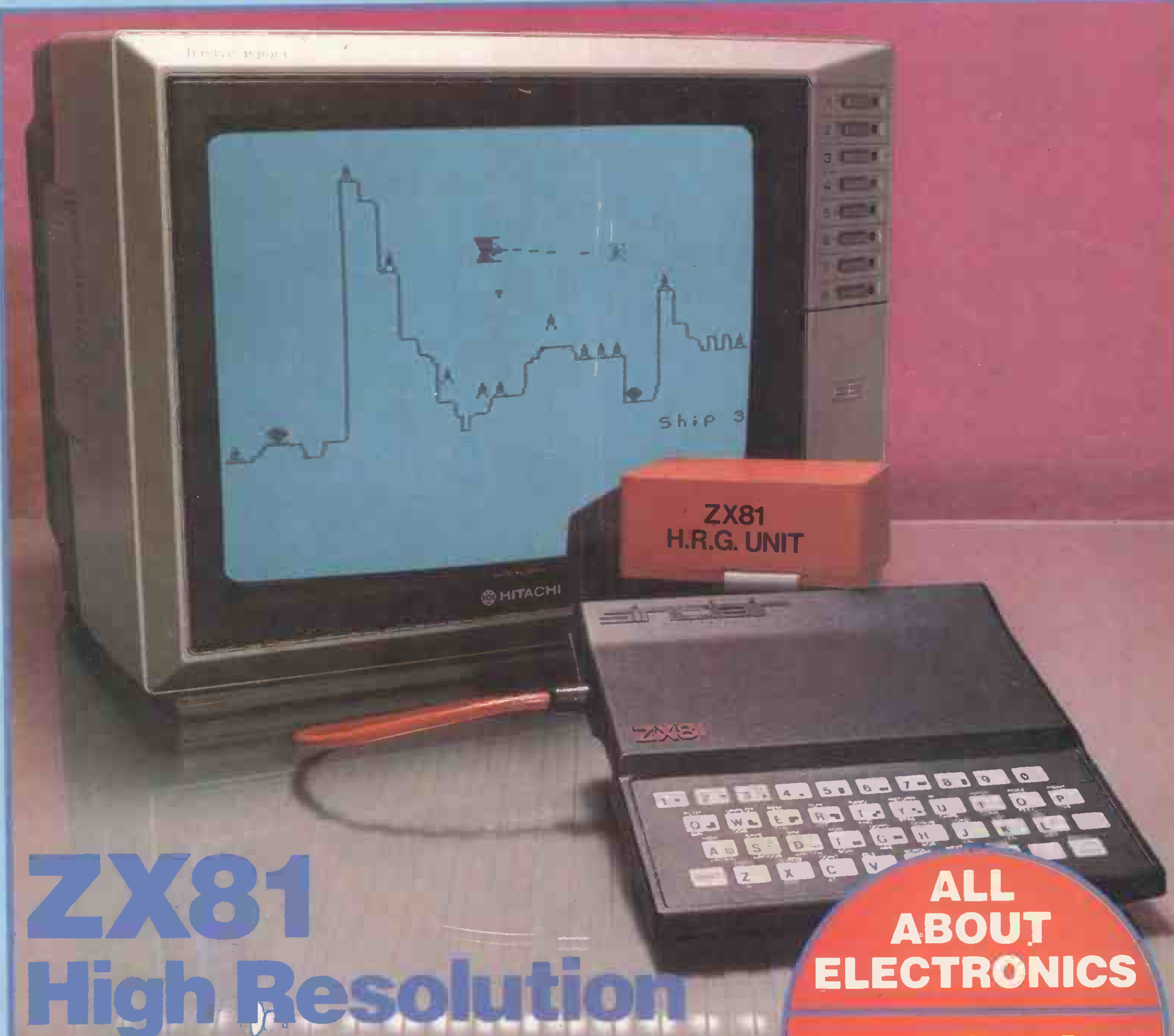
JULY '83

Hobby Electronics

AN ARGUS SPECIALIST PUBLICATION

Project Electronics For Everyone

85p



ZX81 High Resolution Graphics Project

ALL ABOUT ELECTRONICS

New Series From Basics to Broadcasting

Ins and Outs of the ORIC-1

Simple Audio Projects to Build

Play the AMBIT numbers game ......

The long awaited implementation of on-line order processing is with us at last, and whilst this means that orders for in-stock items can now be processed more efficiently, it also means that orders should be submitted using stock codes for best results. Our current catalogue (75p) includes all order codes (watch out for the new expanded Spring edition), but here's an abstract from some of the more popular lines to use as a quick reference.

Remember that you can also access our catalogue via REWSHOP on REWTEL, which now includes on-line current price and delivery information. You need a 300 baud MODEM and RS232 terminal, (various suitable configurations based on popular micros have been published in recent past issues of Radio and Electronics World).

Prices shown here exclude VAT, and the P&P charge is currently 60p per order (unless otherwise indicated). Remember that our telesales service operates with human beings (not 'dumb' machines) from 8am to 7pm (and frequently later) Monday to Friday, and 9am to 6pm on Saturdays. REWSHOP operates 24 hours a day, 365 days a year with full price and delivery information.

ALWAYS USE STOCK NUMBERS WHEN ORDERING PLEASE.

4000 CMOS

Type	Stock No.	Price
4000UB	22-04000	0.11
4001	23-04001	0.11
4002	23-04002	0.12
4007	23-04007	0.13
4008	23-04008	0.50
4009UB	22-04009	0.25
4011	23-04011	0.11
4011UB	23-04011	0.11
4012	23-04012	0.14
4013	23-04013	0.25
4015	23-04015	0.50
4016	23-04016	0.22
4017	23-04017	0.40
4020	23-04020	0.55
4021	23-04021	0.55
4022	23-04022	0.55
4023	23-04023	0.15
4024	23-04024	0.33
4025	23-04025	0.15
4027	23-04027	0.26
4028	23-04028	0.50
4029	23-04029	0.55
4035	23-04035	0.67
4040	23-04040	0.68
4042	23-04042	0.50
4043	23-04043	0.60
4044	23-04044	0.68
4046	23-04046	0.60
4049UB	22-04049	0.24
4050	23-04050	0.24
4051	23-04051	0.55
4052	23-04052	0.56
4053	23-04053	0.55
4060	23-04060	0.75
4066	23-04066	0.30
4068	23-04068	0.16
4069UB	22-04069	0.14
4070	23-04070	0.16
4071	23-04071	0.16
4072	23-04072	0.16
4073	23-04073	0.16
4075	23-04075	0.16
4076	23-04076	0.55
4077	23-04077	0.18
4078	23-04078	0.18
4081	23-04081	0.18
4082	23-04082	0.18
4093	23-04093	0.30
4099	23-04099	0.80
4175	23-04175	0.80
4502	23-04502	0.60
4503	23-04503	0.50
4506	23-04506	0.70
4507	23-04507	0.37
4508	23-04508	1.50
4510	23-04510	0.55
4511	23-04511	0.45
4512	23-04512	0.55
4514	23-04514	1.25
4515	23-04515	1.25
4516	23-04516	0.80
4518	23-04518	0.35
4520	23-04520	0.60
4521	23-04521	1.30
4522	23-04522	0.89
4526	23-04526	0.60
4527	23-04527	0.80
4528	23-04528	0.65
4529	23-04529	0.70
4531	23-04531	0.85
4532	23-04532	0.80
4534	23-04534	4.00
4536	23-04536	2.50
4538	23-04538	0.85
4539	23-04539	0.80
4543	23-04543	0.80
4549	23-04549	3.50
4553	23-04553	2.70
4554	23-04554	1.20
4555	23-04555	0.35
4556	23-04556	0.40
4557	23-04557	2.30
4558	23-04558	0.80
4559	23-04559	3.60
4560	23-04560	2.50
4561	23-04561	1.00
4562	23-04562	2.50
4566	23-04566	1.20
4568	23-04568	1.45
4569	23-04569	1.70
45672UB	23-04572	0.32
4580	23-04580	3.25
4581	23-04581	1.40
4582	23-04582	0.70
4583	23-04583	0.80
4584	23-04584	0.27
4585	23-04585	0.45
4702	23-04702	4.50

Type	Stock No.	Price
4703	23-04703	4.48
4704	23-04704	4.24
4705	23-04705	4.24
4706	23-04706	4.50
4720	23-04720	4.00
4723	23-04723	0.95
4724	23-04724	0.95
4725	23-04725	2.24
40014	23-40014	0.54
40085	23-40085	0.89
40098	23-40098	0.54
40106	23-40106	0.69
40160	23-40160	1.05
40161	23-40161	1.05
40162	23-40162	1.05
40163	23-40163	1.05
40174	23-40174	1.05
40175	23-40175	1.05
40192	23-40192	1.08
40193	23-40193	1.08
40195	23-40195	1.08

74LSXX

Type	Stock No.	Price
74LS00	31-07400	0.11
74LS01	31-07401	0.11
74LS02	31-07402	0.11
74LS03	31-07403	0.11
74LS04	31-07404	0.14
74LS05	31-07405	0.14
74LS08	31-07408	0.14
74LS09	31-07409	0.14
74LS10	31-07410	0.14
74LS11	31-07411	0.14
74LS12	31-07412	0.14
74LS13	31-07413	0.32
74LS14	31-07414	0.32
74LS15	31-07415	0.14
74LS20	31-07420	0.14
74LS21	31-07421	0.14
74LS22	31-07422	0.14
74LS26	31-07426	0.14
74LS27	31-07427	0.30
74LS28	31-07428	0.18
74LS30	31-07430	0.14
74LS32	31-07432	0.14
74LS33	31-07433	0.14
74LS37	31-07437	0.14
74LS38	31-07438	0.14
74LS40	31-07440	0.18
74LS42	31-07427	0.30
74LS47	31-07447	0.75
74LS48	31-07448	0.40
74LS49	31-07449	0.80
74LS51	31-07451	0.14
74LS54	31-07454	0.14
74LS55	31-07455	0.14
74LS74	31-07474	0.21
74LS75	31-07475	0.21
74LS76	31-07476	0.25
74LS78	31-07478	0.19
74LS83	31-07483	0.33
74LS85	31-07485	0.44
74LS86	31-07486	0.15
74LS90	31-07490	0.24
74LS91	31-07491	0.36
74LS92	31-07492	0.32
74LS93	31-07493	0.24
74LS95	31-07495	0.36
74LS107	31-74107	0.31
74LS109	31-74109	0.25
74LS112	31-74112	0.21
74LS113	31-74113	0.21
74LS114	31-74114	0.21
74LS122	31-74122	0.27
74LS123	31-74123	0.36
74LS125	31-74125	0.27
74LS126	31-74126	0.27
74LS132	31-74132	0.27
74LS133	31-74133	0.27
74LS136	31-74136	0.20
74LS138	31-74138	0.30
74LS139	31-74139	0.30
74LS151	31-74151	0.30
74LS153	31-74153	0.30
74LS155	31-74155	0.30
74LS156	31-74156	0.33
74LS157	31-74157	0.27
74LS158	31-74158	0.27
74LS160	31-74160	0.34
74LS161	31-74161	0.36
74LS162	31-74162	0.36
74LS163	31-74163	0.36
74LS164	31-74164	0.40
74LS165	31-74165	0.60
74LS166	31-74166	0.58
74LS168	31-74168	0.69
74LS170	31-74170	0.63
74LS173	31-74173	0.47
74LS174	31-74174	0.37
74LS175	31-74175	0.40

Type	Stock No.	Price
74LS181	31-74181	0.87
74LS183	31-74183	1.05
74LS190	31-74190	0.39
74LS191	31-74191	0.39
74LS192	31-74192	0.39
74LS193	31-74193	0.39
74LS194	31-74194	0.39
74LS195	31-74196	0.39
74LS196	31-74196	0.39
74LS197	31-74197	0.47
74LS221	31-74221	0.50
74LS240	31-74240	0.60
74LS241	31-74241	0.60
74LS242	31-74242	0.55
74LS243	31-74243	0.55
74LS244	31-74244	0.60
74LS245	31-74245	1.00
74LS251	31-74251	0.36
74LS253	31-74253	0.36
74LS257	31-74257	0.36
74LS258	31-74258	0.36
74LS259	31-74259	0.51
74LS260	31-74260	0.28
74LS266	31-74266	0.20
74LS273	31-74273	0.70
74LS279	31-74279	0.35
74LS283	31-74283	0.40
74LS290	31-74290	0.40
74LS293	31-74293	0.40
74LS298	31-74298	0.54
74LS365	31-74365	0.34
74LS366	31-74366	0.40
74LS367	31-74367	0.30
74LS368	31-74368	0.30
74LS373	31-74373	0.72
74LS374	31-74374	0.72
74LS375	31-74375	0.31
74LS377	31-74377	0.60
74LS378	31-74378	0.44
74LS379	31-74379	0.44
74LS385	31-74385	1.30
74LS386	31-74386	0.27
74LS390	31-74390	0.51
74LS393	31-74393	0.48
74LS398	31-74398	0.80
74LS399	31-74399	0.65
74LS490	31-74490	0.60
74LS670	31-74670	1.15

74CXX

Type	Stock No.	Price
74C00	29-07400	0.35
74C02	29-07402	0.35
74C04	4069C	
74C08	29-07408	0.35
74C10	29-07410	0.35
74C14	4584C	
74C20	29-07420	0.35
74C30	29-07430	0.35
74C32	29-07432	0.35
74C42	29-07442	1.05
74C48	29-07448	1.50
74C73	29-07473	0.75
74C74	29-07474	0.75
74C76	29-07476	0.60
74C83	29-07483	1.30
74C85	29-07485	1.30
74C86	29-07485	1.30
74C89	29-07489	3.60
74C90	29-07490	1.05
74C93	29-07493	1.05
74C95	29-07495	1.25
74C107	29-74107	0.60
74C151	29-74151	2.10
74C154	29-74154	3.05
74C157	29-74157	2.10
74C160	40160	
74C1610	40161CM	
74C1620	40182CM	
74C1630	40183CM	
74C164	29-74164	1.05
74C165	29-74165	1.10
74C173	40174	
74C1740	40174CM	
74C1750	40175CM	
74C1820	40192CM	
74C1930	40193CM	
74C1950	40195CM	
74C200	29-74200	6.50
74C221	29-74221	1.55
74C901	29-74901	0.55
74C902	29-74902	0.55
74C903	29-74903	0.55
74C904	29-74904	0.55
74C905	29-74905	8.50
74C906	29-74906	0.55
74C907	29-74907	0.55
74C908	29-74908	1.10
74C909	29-74909	2.10
74C910	29-74910	5.00

Type	Stock No.	Price
74C914	29-74914	1.10
74C918	29-74918	1.30
74C925	29-74925	6.00
74C926	29-74926	6.00
74C927	29-74927	6.00

74HCXX

Type	Stock No.	Price
74HC00	30-07400	0.56
74HC02	30-07402	0.56
74HC04	30-07404	0.68
74HC10	30-07410	0.56
74HC20	30-07420	0.56
74HC86	30-07486	0.74
74HC132	30-74132	1.26
74HC266	30-74266	0.81
74HC4002	30-04002	0.56
74HC4075	30-04075	0.56
74HC242	30-74242	2.00
74HC243	30-74243	2.00
74HC74	30-07474	0.74
74HC109	30-74109	0.68
74HC175	30-74175	1.08
74HC373	30-74373	2.40
74HC374	30-74374	2.40
74HC533	30-74533	2.40
74HC534	30-74534	2.40
74HC165	30-74165	1.96
74HC173	30-74173	1.20
74HC160	30-74160	1.33
74HC161	30-74161	1.33
74HC162	30-74162	1.33
74HC163	30-74163	1.33
74HC4538	30-74538	2.10
74HC85	30-74280	2.95
74HC280	30-74280	2.95
74HC42	30-07442	1.00
74HC138	30-74138	1.08
74HC139	30-74139	1.08
74HC4514	30-04514	3.40
74HC4543	30-04543	2.75
74HC157	30-74157	0.92
74HC158	30-74158	0.90
74HC257	30-74257	0.90

LINEAR ICs

Type	Stock No.	Price
LM10CN	61-00010	3.88
MF10	61-00011	5.05
L149	61-00149	1.86
ZNA234	61-02340	8.50
U2378	61-00237	1.28
U2478	61-00247	1.28
U2578	61-00257	1.28
U2678	61-00267	1.28
LM301AH	61-03010	0.67
LM301AN	61-03011	0.27
LM308H	61-03080	0.70
LM308CN	61-03081	0.65
LM324	61-03240	0.45
LM339N	61-03390	0.66
LF347	61-00347	1.60
LM348	61-03480	0.90
LF351	61-03510	0.49
LF353	61-03530	0.76
LM380N	61-00380	1.00
LM381	61-00381	1.81
LM382	61-00382	1.81
ZN419CE	61-00419	1.98
ZNA423	61-04230	1.00
ZN425E/8	61-04250	3.50
ZN426E/8	61-04260	3.00
ZN427E/8	61-04270	6.28
ZN428E/8	61-04280	4.78
ZN429E/8	61-04290	2.10
ZN432CJ10	61-04320	28.09
ZN433CJ10	61-04330	22.59
ZN450E	61-04500	7.61
NE542	61-05420	1.20
NE544	61-00544	1.80
NE555N	61-05550	0.20
NE556N	61-05560	0.50
SL560C	61-05600	1.98
NE562	61-00562	4.05
NE564	61-00564	4.29
NE565	61-00565	1.00
NE566	61-00566	1.30
NE567	61-00567	1.30
NE570N	61-00570	3.85
SL624	61-00624	3.28
uA709HC	61-07090	0.64
uA709PC	61-07091	0.36
uA710HC	61-07100	0.64
uA710PC	61-07101	0.59
uA711CN	61-07110	0.85
uA733CN	61-07330	0.89
uA741CH	61-07410	0.66
uA741CN	61-07411	0.20
uA747CN	61-07470	0.70
uA748CN	61-04780	0.30

Type	Stock No.	Price
uA758	61-00758	2.35
TBA820M	61-00820	0.78
TDA1028	61-01028	2.11
TDA1029	61-01029	2.11
ZNA1034	61-01034	2.10
LM1035	61-01034	2.10
TDA1054M	61-01054	1.45
TDA1062	61-01062	1.95
TDA1072	61-01072	2.69
TDA1074A	61-01074	5.04
TDA1083	61-01083	1.95
TDA1090	61-01090	3.05
HA1137	61-12411	1.20
HA1196	61-01196	2.00
HA1197	61-01197	1.00
TDA1220	61-01220	1.40
LM1303	61-01303	0.99
LM1307	61-01307	1.55
MC1310P	61-01310	1.90
MC1330	61-01330	1.20
MC1350	61-01350	1.20
HA1370	61-11370	1.90
HA1388	61-01388	2.75
LM1458N	61-14580	0.45
MC1496P	61-01496	1.25
SL1610	61-01610	1.92
SL1611	61-01611	1.92
SL1612	61-01612	1.92
SL1613	61-01613	2.06
SL1620	61-01620	2.50
SL1621	61-01621	2.50
SL1623	61-01623	2.50
SL1625	61-01625	2.50
SL1626	(SL6270)	
SL1630	61-01630	1.62
SL1640	61-01640	2.25
SL1641	61-01641	2.25
MC1648	61-01648	3.25
TDA2002	61-02002	1.25
ULN2240	61-02240	3.25
ULN2242	61-01090	3.05
ULN2283	61-02283	1.00
CA3080	61-03080	0.70
CA3089	61-03089	1.84
CA3123	61-03123	1.40
CA3130E	61-31300	0.80
CA3130T	61-31301	0.90
CA3140E	61-31400	0.46
CA3189E	61-03189	2.20
CA3240E	61-32400	1.27
MC3357	61-03357	2.85
MC3359 (see ULN3859)		
ULN3859	61-03859	2.95
KM3701	61-03701	85.53
KM3702	61-03702	74.84
LM3900	61-39000	0.60
LM3909N	61-39090	0.68
LM3914N	61-03914	2.80
LM3915N	61-03915	2.80
KB4400	61-04400	0.80
KB4412	61-04412	1.95
KB4413	61-04413	1.95
KB4417	61-04417	1.80
KB44208	61-04420	1.09
TDA4420	61-14420	2.65
TDA4421	61-14421	2.65
KB4423	61-04423	2.30
KB4424	61-04424	1.65
KB4430	61-04430	2.30
KB4431	61-04431	1.95
KB4432	61-04432	1.95
KB4433	61-04433	1.52
KB4436	61-04436	2.53
KB4437	61-04437	1.75
KB4438	61-04438	2.22
KB4441	61-04441	1.35
KB4445	61-04445	1.29
KB4446	61-04446	2.75
KB4448	61-04448	1.65
NE5044	61-05044	2.26
MC5229	61-05229	9.60
NE5532	61-55320	1.85
KM5624	61-05624	4.35
SD6000	61-06000	3.75
SL6270	61-06270	2.03
SL6310	61-06310	2.45
SL6440	61-06440	3.38
SL6600	61-06600	3.75
SAS6610	61-06610	1.48
SL6640	61-06640	2.75
SL6690	61-06690	3.75
SL6700	61-06700	2.75
SAS6710	61-06710	1.48
LS7225	61-07225	3.65
ICM7555	61-75550	0.80
CL8038CC	61-08038	4.50
MSL9362	61-09362	1.75
MSL9363	61-09[illegible]	1.75
K10170	61-10170	1.87
TK10321	61-10321	2.75

Type	Stock No.	Price
HA11223	61-11223	2.15
HA11225	61-11225	1.45
HA12002	61-12002	1.22
HA12017	61-12017	0.80
HA12402	61-12402	1.95
HA12411	61-12411	1.20
HA12412	61-12412	1.55
LF13741	61-13741	0.33
MK50366	61-50366	3.35
MK50375	61-50375	3.85
MM53200	61-53200	3.90

PRESCALER

Type	Stock No.	Price
U264	61-02640	2.27
U265	61-02650	3.16
U266	61-02660	2.43
11C900C	61-01190	12.95
MSL2312R	61-02312	3.94
MSL2318	61-02318	3.84
MSM5523	61-05523	11.30
MSM5524	61-05524	11.30
MSM5525	61-05525	7.85
MSM5526	61-05526	7.85
MSM55271	61-55271	9.75
ICM7106CP	61-07106	9.55
ICM7107CP	61-07107	9.55
LC7137	61-07137	7.50
ICM7216B	61-72161	19.50
ICM7216C	61-72162	19.95
ICM7217A	61-07217	9.50
SP8629	61-08629	3.85
SP8647	61-08647	6.00
SP8793	61-08793	7.70
95H90	61-09590	7.80
HD10551	61-10551	2.45
HA12009	61-12009	6.00
HD44015	61-44015	4.45
HD44752	61-44752	8.00
MC145151P	61-14151	6.00
MC145152P	61-14151	6.60
MC145156P	61-14156	4.60

SMALL SIGNAL AUDIO

Type	Stock No.	Price
BC182	58-00182	0.10
BC212	58-00212	0.10
BC237	58-00237	0.08
BC238	58-00238	0.08
BC239	58-00239	0.08
BC307	58-00307	0.08
BC308	58-00308	0.08
BC309	58-00309	0.08
BC327	58-00327	0.13
BC337	58-00337	0.13
BC413	58-00413	0.10
BC414	58-00414	0.11
BC415	58-00415	0.10
BC416	58-00416	0.11
BC546	58-00546	0.12
BC550	58-00550	0.12
BC556	58-00556	0.12
BC560	58-00560	0.12
BC639	58-00639	0.22
BC640	58-00640	0.22
MPSA13	58-04013	0.30
MPSA63	58-04063	0.30
ZTX108	58-01108	0.10
ZTX212	58-01212	0.10
ZTX653	58-01653	0.20
ZTX753	58-01753	0.20
2N2904	58-02904	0.25
2N2905	58-02905	0.26
ZN3905	58-03905	0.10
2SB646A	58-03646	0.30
2SB648A	58-03648	0.40
ZSD666A	58-03666	0.30
2SD668A	58-03668	0.40
2SA872A	58-02872	0.19
2SA1084E	58-01084	0.25
2SA1085E	58-01085	0.25
2SC1775A	58-01775	0.19
2SC2546E	58-02546	0.24
2SC2547E	58-02547	0.24

AUDIO POWER

Type	Stock No.	Price
BD139	58-15139	0.29
BD140	58-15140	0.31
BD165	58-15165	0.46
BD166	58-15166	0.48
BD179	58-15179	0.38
BD180	58-15180	0.41
TIP31A	58-15031	0.35
TIP32A	58-15032	0.36
MJ2955	58-12955	0.68
2N3055	58-13099	0.58
2SB720	58-15720	0.60
2SD760	58-17600	0.60
2SJ49	60-01049	3.10
2SJ50	60-01050	4.25
2SJ83	60-01083	3.55

Type	Stock No.	Price
2SK134	60-00134	3.10
2SK135	60-00135	4.25
2SK227	60-00227	3.55
2SD753	58-03753	2.34

SMALL SIGNAL RF

Type	Stock No.	Price
BFY50	58-06500	0.22
BF241	58-06241	0.18
BF273	58-06273	0.18
BF274	58-06274	0.20
BF362	58-06362	0.49
BF440	58-06440	0.21
BF441	58-06441	0.21
BF479	58-06479	0.66
BF6795	58-06679	0.55
BFR91	58-07091	1.33
BFT95	58-10095	0.99
BFW92	58-08092	0.60
BFY90	58-09090	0.90
NE21936	58-21936	5.00
ZTX323	58-06232	0.60
2N2369A	58-02369	0.38

RF POWER

Type	Stock No.	Price
BFW16A	58-08016	0.65
MRF237	58-14237	3.20
MRF238	58-14238	16.50
MRF245	58-14245	40.00
MRF449A	58-14449	16.50
MRF472	58-14472	1.25
MRF475	58-14475	4.60
MRF629	58-14629	4.99
PT8811	58-18811	9.50
TP2320	58-12320	10.24
VN66AF	60-02066	0.95
ZTX3866	58-03866	0.45
2N3866	58-13866	1.20

SMALL SIGNAL FET

Type	Stock No.	Price
BF256	59-00256	0.38
BF960	60-06960	0.99
BF961	60-06961	0.70
BF963	60-06963	0.99
J310	59-02310	0.69
J176	59-02176	0.65
2SK55	59-01055	0.32
2SK168	59-01168	0.37
3SK45	60-04045	0.49
3SK51	60-04051	0.54
3SK60	60-04060	0.58
3SK88	60-04088	0.99
40673 see 3SK51		
40822 see 3SK51		
40823	60-03823	0.65
3SK112	60-04112	4.60

DIODES

Type	Stock No.	Price
AA112	12-01126	0.25
BA244	12-02447	0.17
BA379	12-03797	0.35
ND4981-7E	12-49817	0.51
OA91	12-00916	0.07
OA47	12-00476	0.10
PW02	12-62006	0.75
S04	12-24006	0.45
W005	12-10506	0.28
1N4001	12-40016	0.06
1N4002	12-40026	0.07
1N4004	12-40046	0.07
1N4148	12-41486	0.05
1N5404	12-54046	0.16
1N6263	12-62637	0.62

VARICAPS

Type	Stock No.	Price
BA102	12-01025	0.30
BA121	12-01215	0.30
BB105B	12-01055	0.30
BB109B	12-01095	0.27
BB204B	12-02045	0.36
BB212	12-02125	1.95
ITT210	12-02105	0.30
MVAM115 see KV1236		
MVAM125 see KV1225		
KV1210	12-12105	2.45
KV1211 see KV1236		
KV1225	12-12255	2.75
KV1235	12-12355	2.75
KV1236	12-12365	2.55
KV1310	12-13105	0.40
KV1310	12-13205	0.40

ZENER DIODES

BZY88C 400mW. 5%.

Type	Stock No.	Price
2V7	12-00278	0.10
3V3	12-00338	0.10
3V9	12-00398	0.10
4V7	12-00478	0.10
5V1	12-00518	0.10
5V6	12-00568	0.10
6V8	12-00688	0.10
8V2	12-00828	0.10
9V1	12-00918	0.10
10	12-01008	0.10
11	12-01108	0.10
12	12-01208	0.10
15	12-01508	0.10
18	12-01808	0.10
22	12-02208	0.10
27	12-02708	0.10
33	12-03308	0.10

SCRS TRIACS

Type	Stock No.	Price
BRY55-100	52-55100	0.50
C106D1	52-00106	0.70
C122D1	52-00122	1.45
2N6403	52-06403	2.22
2N6073A	58-06073	0.98

BALANCED MIXERS

Type	Stock No.	Price
SBL1	12-00003	4.68
SBL1-8	12-00013	5.00
SBL1-X	12-00023	6.33
SRA1	12-00033	10.80
SRA1-1	12-00043	12.77
SRA1H	12-00053	16.34
SRA3	12-00063	15.35

LEDs

3mm round types

Type	Stock No.	Price
CQX25-Red/Clr	15-20250	0.15
V178P Red	15-01780	0.15
CQX26-Gr Clr	15-20260	0.16
V179P-Green	15-01790	0.16
CQX27-Yel/Clr	15-20270	0.18
V180P-Yellow	15-01800	0.18
CQX41A-Or/Rd	15-20410	0.19

Standard 5mm DIA LEDs

Type	Stock No.	Price
CQY40L Red	15-10400	0.12
CQY72L Green	15-10720	0.15
CQY74L Yellow	15-10740	0.15
CQX38A Or/rd	15-20380	0.20
CQX39B Or/rd	15-20390	0.29

Rectangular 2.5 x 5mm LEDs

Type	Stock No.	Price
CQX10 Red	15-20100	0.17
CQX11 Green	15-20110	0.20
CQX12 Yellow	15-20150	0.20
CQX40 Or/Red	15-20400	0.24

Infra Red LEDs

Type	Stock No.	Price
CQY99 Emit	15-10990	0.56
BPW41 Det	15-30410	1.51

I-R Optocoupler

Type	Stock No.	Price
BNY37	15-40370	1.44

FLAT DIFFUSED

Type	Stock No.	Price
V320	15-03200	0.17
V321	15-03210	0.26
V322	15-03220	0.20
V323	15-03230	0.20
V330	15-03300	0.17
V331	15-03310	0.26
V332	15-03320	0.20
V333	15-03330	0.20
V340	15-03400	0.17
V341	15-03410	0.26
V342	15-03420	0.20
V343	15-03430	0.20
V510	15-05100	0.17
V511	15-05110	0.26
V512	15-05120	0.20
V513	15-05130	0.20
V520	15-05200	0.17
V521	15-05210	0.26
V522	15-05220	0.20
V523	15-05230	0.20
V530	15-05300	0.17
V531	15-05310	0.26
V532	15-05320	0.20
V533	15-05330	0.20
V540	15-05200	0.17
V541	15-05410	0.26
V542	15-05420	0.20
V543	15-05430	0.20
V550	15-05500	0.17
V551	15-05510	0.26
V552	15-05520	0.20
V553	15-05530	0.20

TRI COLOUR

Type	Stock No.	Price
V518	15-05180	0.80

Ambit international

200 North Service Road
Brentwood, Essex
CM14 4SG

Telecom directory:
Consumer 0277-230909
Industrial 0277-231616
Telex 995194 AMBIT G
DATEL 0277-232628

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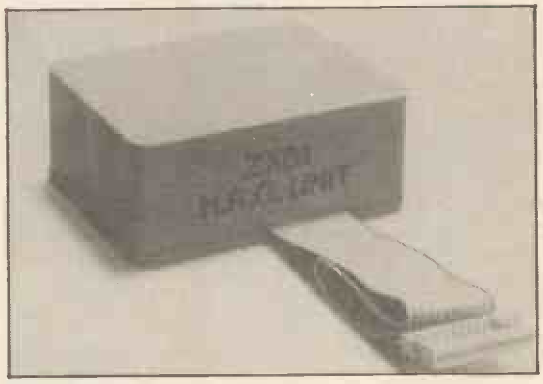
Hobby Electronics

JULY 1983
Vol 5 No 7

PROJECTS

FEATURES

REGULARS



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Stereo Expander Project — page 52

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THE HOBBY 'SCOPE: Due to circumstances beyond our control, we regret that the second instalment of this project has had to be withdrawn from this issue of Hobby Electronics. The second part of the ***Components for Computing*** *article dealing with computer display techniques has also been cancelled. We apologise for these changes, but would like to assure our readers that both articles will be completed in future issues.*

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LINEAR

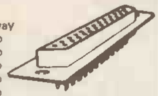
				LM339	45	LM3911	120	NE566	140	TL064	96
				LM348	60	LM3914	175	▶NE567	100	TL071	30
				LM358	50	LM3915	195	▶NE570	370	TL072	50
555CMDS	80	ICL7106	790	LM377	170	LM13600	105	NE571	370	TL074	95
556CMOS	150	ICL7611	95	▶LM380	65	MC1496	68	▶RC4136	55	▶TL081	25
709	25	ICL7621	180	▶LM381	120	MC3340	135	▶RC4558	60	TL082	45
▶741	14	ICL7622	180	LM382	120	▶MF10CN	350	SL480	170	TL084	95
748	35	ICL8038	295	LM384	130	ML922	400	SL490	250	TL170	50
9400CJ	350	ICL8211A	200	LM386	65	ML924	195	SL76018	150	UA2240	120
AY-3-1270	720	ICM7224	785	LM387	120	ML925	210	▶SN76477	380	ULN2003	85
AY-3-8910	370	ICM7555	80	LM393	100	ML926	140	SP8629	250	ULN2004	90
AY-3-8912	540	▶LF351	45	LM709	25	ML927	140	TBA120S	70	XR2206	290
CA3046	60	LF353	85	LM711	60	ML928	140	TBA800	75	ZN414	100
▶CA3080	65	LF356	90	LM725	350	ML929	140	TBA810	96	ZN423	135
CA3089	190	LM10	360	LM733	75	MM5387A	465	TBA820	70	ZN424	135
CA3090AO	375	LM301A	25	LM741	14	NE529	225	TBA950	220	ZN425E	350
CA3130E	85	LM311	70	LM747	60	NE531	150	TDA1008	320	ZN426E	330
▶CA3140E	36	LM318	120	LM1458	40	NE544	205	▶TDA1022	490	ZN427E	650
CA3161E	100	LM324	40	LM2917	200	▶NE555	16	TDA1024	125	ZN428E	480
CA3189	290	LM334Z	100	LM3900	45	▶NE556	45	TL061	40	ZN459	285
▶CA3240E	110	LM335Z	125	▶LM3909	70	NE565	110	TL062	60	ZN1034E	200

TRANSISTORS

				BC517	40	BF337	40	MPSU56	60	ZTX108	8	2N3055	50
				BC547	7	BFR40	23	TIP29A	30	ZTX109	12	2N3442	120
				BC548	10	BFR80	23	TIP29B	55	ZTX300	14	▶2N3702	6
AC125	35	BC149	9	BC549	10	▶BFR81	20	TIP29C	37	ZTX301	16	2N3703	9
AC126	25	BC157	8	BC558	10	BFX29	26	TIP30A	35	ZTX302	16	▶2N3704	6
AC127	25	BC158	10	BCY70	18	BFX84	25	TIP30B	50	ZTX304	17	2N3705	9
▶AC128	20	BC159	8	BCY71	18	BFX85	25	TIP30C	37	ZTX341	30	2N3706	9
AC176	25	BC160	45	BCY72	18	BFX86	28	TIP31A	35	ZTX500	15	2N3707	10
AC187	22	BC168C	10	BD115	55	BFX87	25	TIP31C	37	ZTX501	15	2N3708	10
AC188	22	BC169C	10	BD131	35	BFX88	25	TIP32A	35	ZTX502	15	2N3709	10
AD142	120	BC170	8	BD132	35	BFY50	23	TIP32C	37	ZTX503	18	2N3772	170
AD149	80	BC171	10	BD133	50	BFY51	20	TIP33A	50	ZTX504	25	▶2N3773	195
AD161	40	BC172	8	BD135	40	BFY52	23	TIP33C	75	2N697	20	▶2N3819	18
AD162	40	BC177	18	BD136	30	BFY53	32	TIP34A	60	2N698	40	2N3820	40
AF124	60	BC178	18	BD137	30	BFY55	32	TIP34C	85	2N706A	20	2N3823	65
AF126	50	BC179	18	BD138	30	BFY56	32	TIP35A	105	2N708	20	2N3866	90
AF139	40	BC182	10	▶BD139	35	BRY39	40	TIP35C	125	2N918	35	2N3903	10
AF186	70	▶BC182L	8	▶BD140	35	BSX20	20	TIP36A	125	2N1132	22	2N3904	10
AF239	75	BC183	10	BD204	110	BSX29	35	TIP36C	135	2N1613	30	2N3905	6
BC107	10	BC183L	10	BD206	110	BSY95A	25	TIP41A	45	2N2218A	45	2N3906	10
BC107B	12	BC184	10	BD222	85	BU205	160	TIP42A	45	2N2219A	25	2N4037	45
▶BC108	10	BC184L	7	BF180	35	BU206	180	TIP120	90	2N2221A	25	2N4058	10
BC108B	12	BC212	10	BF182	35	BU208	170	TIP121	90	2N2222A	20	2N4060	10
BC108C	12	BC212L	10	BF184	25	MJ2955	99	TIP122	90	2N2368	25	2N4061	10
▶BC109	10	BC213	10	BF185	25	MJE340	50	TIP141	98	2N2369	16	2N4062	10
BC109C	12	BC213L	10	BF194	12	MJE520	65	TIP142	98	2N2484	25	2N5457	36
BC114	18	BC214	10	BF195	12	MJE521	95	TIP147	110	2N2646	45	2N5458	36
BC115	22	▶BC214L	8	BF196	12	MJE3055	70	TIP2955	60	2N2904	20	2N5459	30
BC117	18	BC237	8	BF197	12	MPF102	40	TIP3055	55	2N2904A	20	2N5485	36
BC119	35	BC238	14	BF198	10	MPF104	40	TIS43	40	2N2905	22	2N5777	45
BC137	40	BC308	12	BF199	18	MPSA05	22	TIS44	45	2N2905A	22	2N6027	30
BC139	40	BC327	14	BF200	30	MPSA06	25	TIS90	30	2N2906	25	40360	40
BC140	28	BC328	14	▶BF244B	22	MPSA12	30	TIS91	30	2N2906A	25	40361	50
BC141	30	BC337	14	BF245	30	MPSA55	30	VN10KM	45	2N2907	25	40362	50
BC142	25	BC338	14	BF256B	45	MPSA56	30	VN46AF	75	2N2907A	25	40408	70
BC143	25	BC477	30	BF257	32	MPSU05	55	VN66AF	85	2N2926	9		
BC147	8	BC478	30	BF258	25	MPSU06	55	VN88AF	95	▶2N3053	23		
BC148	8	BC479	30	BF259	35	MPSU55	60	ZTX107	8	2N3054	55		

MIN. D CONNECTORS

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



SOLDERING IRONS

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

CONNECTORS

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

UHF (CB) Connectors:
PL259 Plug 40p. Reducer 14p.
SO239 square chassis skt 38p.
SO239S round chassis skt 40p.
IEC 3 pin 250V/6A.
Plug chassis mounting . . 38p
Socket free hanging . . . 60p
Socket with 2m lead . . 120p

SCRs

▶C106D	30
400V 8A	70
400V 12A	95

VERO

VEROBLOC◀	350
Size 0.1 matrix:	
2.5 x 1	22
2.5 x 3.75	75
2.5 x 5	85
3.75 x 5	95
VQ board	160
Veropins per 100:	
Single sided	50
Double sided	60
Spot face cutter	105
Pin insertion tool . . .	162
Wiring pen and spool . .	310
Spere spool 75p Combs .	6

VOICE SYNTHESISER!

Now your computer can talk. The GI SP0256 speech processor is able through stored program to synthesize speech. Allophone (extended phoneme) system gives unlimited vocabulary.
Easily interfaced with any digitel system; ten TTL compatible signals are used to select the allophones.
SP0256 . 770p. Data: 50p.

SWITCHES

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

MICRO

		6116P3	320	6852	240	8228	220
		6502CPU	325	6875	495	8251	250
		6522VIA	295	6880	100	8253	390
		6532	570	81LS95	85	8255	225
		6551 ACIA	650	81LS96	85	8259	390
2114L2	75	6800CPU	220	81LS97	85	MC1488	55
2716	205	6802CPU	250	8080A	260	MC1489	55
2532	290	6809CPU	620	8085AC	340	Z80ACPU	290
2732	290	6810RAM	115	8156	350	Z80APIO	260
2764	540	6821 PIA	110	8212	110	Z80ACTC	260
4116P20	70	6840	360	8216	100	Z80ASIO	900
5101L-1	220	6850	110	8224	120	Z80ADMA	1150

SOCKETS

	Low profile	Wire wrap
8 pin	6p	25p
14 pin	8p	35p
16 pin	9p	42p
18 pin	12p	52p
20 pin	13p	60p
22 pin	[illegible]	72p
24 pin	15p	70p
28 pin	[illegible]	80p
40 pin	[illegible]	[illegible]

[illegible] per 100

COMPONENT KITS

An ideal opportunity for the beginner or the experienced constructor to obtain a wide range of components at greatly reduced prices. ¼W 5% Resistor kit. Contains 10 of each value from 4.7 ohms to 1M (total of 650 resistors) 530
Ceramic Cap. kit. 5 of each value - 22p to 0.01u (135 caps) . . 370
Polyester Cap. kit. 5 of each value from 0.01 to 1uF (65 caps) . 575
Preset kit. Contains 5 of each value from 100 ohms to 1M (total 65 presets 425
Nut and Bolt kit (total 300 items): 180p

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

CABLES

20 metre pack single core connecting cable ten different colours.	65p
Speaker cable . . .	10p/m
Standard screened . .	16p/m
Twin screened . . .	24p/m
2.5A 3 core mains . .	23p/m
10 way rainbow ribbon	65p/m
20 way rainbow ribbon	120p/m
10 way gery ribbon . .	38p/m
20 way grey ribbon . .	80p/m

HARDWARE

PP3 battery clips . . .	6
Red or black crocodile clips .	6
Black pointer control knob .	15
Pr Ultrasonic transducers	350
▶6V Electronic buzzer .	60
▶12V Electronic buzzer .	65
▶PB2720 Piezo transducer .	75
▶64mm 64 ohm speaker .	70
▶64mm 8 ohm speaker .	70
20mm panel fuseholder .	25

CAPACITORS

Polyester, radial leads. 250v. C280 type: 0.01, 0.015, 0.022, 0.033 - 6p; 0.047, 0.068, 0.1 - 7p; 0.15, 0.22 - 9p; 0.33, 0.47 - 13p; 0.68 - 20p; 1u - 23p.
Electrolytic, radial or axial leads: 0.47/63V, 1/63V, 2.2/63V, 4.7/63V, 10/25V - 7p; 22/25V, 47/25V - 8p; 100/25V - 9p; 220/25V - 14p; 470/25V - 22p; 1000/25V - 30p; 2200/25V - 50p.
Tag end power supply electrolytics: 2200/40V - 110p; 4700/40V - 160p 2200/63V - 140p; 4700/63V - 230p
Polyester, miniature Siemens PCB: 1n, 2n2, 3n3, 4n7, 6n8, 10n, 15n, 7p; 22n, 33n, 47n, 68n, 8p; 100n, 9p; 150n, 11p; 220n, 13p; 330n, 20p; 470n 26p; 680n, 29p; 1u 33p; 2u2, 50p.
Tantalum bead: 0.1, 0.22, 0.33, 0.47, 1.0 @ 35V - 12p. 2.2, 4.7, 10 @ 25V - 20p; 15/16V - 30p; 22/16V - 27p; 33/16V - 45p; 47/6V - 27p; 47/16V - 70p; 68/6V - 40p; 100/10V - 90p.
Cer. disc. 22p-0.01u 50V, 3p each.
Mullard miniature ceramic plate: 1.8pF to 100pF 6p each.
Polystyrene, 5% tol: 10p-1000p, 6p; 1500-4700, 8p; 6800 0.012u, 10p.
Trimmers. Mullard 808 series: 2-10 pF, 22p; 2-22pF, 30p; 5.5-65pF, 35p

REGULATORS

78L05	30	79L05	65
78L12	30	79L12	65
78L15	30	79L15	65
7805	35	7905	40
7812	35	7912	40
7815	35	7915	40
LM309K	130	LM723	35
LM317K	270	SPECIAL OFFER!	
LM317T	120	78P05 10A +5V	
LM323K	350	only 390p each.	

POTENTIOMETERS

Rotary. Carbon track Log or Lin 1K - 2M2. Single 32p. Stereo 85p. Single switched 80p. Slide 60mm travel single Log or Lin 5K - 500K 63p each.
Preset submin. hor. 100 ohms -1M 7p each.
Cermet precision multiturn, 0.75W ¾" 100 ohms to 100K - 88p each.

TRIACS

		400V 8A	65
		400V 16A	95
400V 4A	50	BR100	25

DIODES

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

JUMPER LEADS

Length	14pin	16pin	24pin	40pin
Sgle ended DIP(header plug) jumper				
24 ins.	145	165	240	380
Dble ended DIP(header plug) jumper				
6 ins.	185	205	300	465
12 ins.	195	215	315	490
24 ins.	210	235	345	540
36ins.	230	250	375	595

25 way D Connector jumpers
18ins. long single ended male 495p.
18ins. long single ended f/male 525p.

BRIDGE RECTIFIERS

		2A 200V	40
		2A 400V	45
		6A 100V	80
		6A 400V	95
1A 50V	20	VM18 DIL 0.9A	
1A 400V	35	200V . .	50

OPTO

▶3mm red	7	▶5mm red	7
▶3mm green	10	▶5mm green	10
▶3mm yellow	10	▶5mm yellow	10

Clips to suit - 3p each.

Rectangular		TIL32	40
▶red	12	TIL78	40
green	17	▶TIL111	60
yellow	17	ORP12	85
▶TIL38	40	TIL100	90
2N5777	45	Dual colour	60

Seven segment displays:

Com cathode		Com anode	
DL704 0.3"	95	DL707 0.3"	95
▶FNO500 0.5"	100	FND507 0.5"	100
TIL313 0.3"	115	TIL312 0.3"	115
TIL322 0.5"	115	TIL321 0.5"	115

LCD: 3½ digit 580p. 4 digit 620p.

EPSON PRINTERS

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

RX80 100 CPS 80 column
Tractor feed £288.00

FX80 160 CPS 80 column
Tractor Feed . . . . . £398.00 Carriage £7 per printer.

RESISTORS

¼W 5% Carbon film E12 series 4.7 ohm - 1M. . . . 1p each.
½W 5% Carbon film E12 series 4.7 ohm to 4M7 . . . 2p each.
¼W 1% metal film E24 series 10 ohm - 1M . . . 6p each.

PCB MATERIALS

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

BOXES

		Aluminium	
		3 x 2 x 1"	65
Plastic with lid & screws		4 x 2¾ x 1½"	95
		4 x 2½ x 2"	95
3 x 2 x 1"	55	6 x 4 x 2"	120
4½ x 3 x 1½"	88	7 x 5 x 2½"	165
7 x 4 x 2"	160	8 x 6 x 3"	205

CMOS

		4016	20	4034	140	4054	78	4081	12	40193	65	4528	45
		4017	30	4036	249	4055	80	4082	12	4502	60	4529	150
		4018	45	4039	280	4059	430	4085	48	4503	32	4532	60
4000	10	4019	25	4040	40	4060	42	4086	50	4507	35	4534	400
4001	10	4020	42	4041	40	4063	80	4089	125	4508	110	4538	60
4002	12	4021	40	4042	38	4066	22	4093	18	4510	45	4543	50
4006	50	4022	45	4043	40	4067	225	4094	68	4511	40	4549	360
4007	14	4023	16	4044	40	4068	14	4095	65	4512	40	4553	215
4008	36	4024	33	4046	40	4069	13	4097	290	4514	115	4555	35
4009	24	4025	12	4047	35	4070	13	4098	70	4515	115	4556	35
4010	24	4026	75	4048	38	4071	13	4099	70	4516	55	4559	390
4011	10	4027	20	4049	21	4072	13	40106	40	4518	40	4560	140
4012	15	4028	40	4050	21	4073	13	40109	110	4520	50	4584	35
4013	20	4029	45	4051	42	4075	13	40163	60	4521	130	4585	60
4014	45	4030	14	4052	48	4076	45	40173	100	4526	60	4724	140
4015	40	4031	125	4053	48	4077	14	40175	75	4527	50		

LS TTL

		LS20	12	LS75	20	LS123	34	LS160	35	LS197	45	LS353	60
		LS21	12	LS76	17	LS125	24	LS161	35	LS221	50	LS365	28
		LS22	12	LS78	17	LS126	25	LS162	35	LS240	60	LS366	28
LS00	11	LS26	14	LS83	35	LS132	35	LS163	35	LS241	55	LS367	28
LS01	11	LS27	12	LS85	48	LS136	26	LS164	40	LS242	55	LS368	29
LS02	11	LS30	12	LS86	16	LS138	30	LS165	55	LS243	55	LS373	58
LS03	12	LS32	13	LS90	24	LS139	30	LS166	60	LS244	55	LS374	60
LS04	12	LS37	14	LS92	25	LS145	70	LS170	75	LS245	70	LS375	43
LS05	12	LS38	15	LS93	24	LS147	150	LS173	60	LS247	48	LS377	60
LS08	12	LS40	13	LS95	38	LS148	75	LS174	45	LS251	28	LS378	67
LS09	12	LS42	28	LS96	95	LS151	38	LS175	45	LS257	32	LS390	45
LS10	12	LS47	35	LS107	40	LS153	38	LS190	35	LS258	32	LS393	40
LS11	12	LS48	45	LS109	21	LS154	75	LS191	35	LS259	55	LS399	156
LS12	12	LS51	14	LS112	21	LS155	33	LS192	35	LS266	20	LS541	78
LS13	19	LS55	14	LS113	21	LS156	36	LS193	36	LS273	58	LS670	135
LS14	30	LS73	18	LS114	22	LS157	26	LS195	32	LS279	30		
LS15	12	LS74	17	LS122	35	LS158	29	LS196	45	LS283	38		

TTL

		7413	17	7444	85	7483	30	74122	38	74161	46	74190	40
		7414	23	7446	58	7485	60	74123	38	74162	46	74191	40
		7416	19	7447	36	7486	19	74125	33	74163	46	74192	40
7400	11	7417	19	7448	43	7489	180	74126	33	74164	46	74193	40
7401	11	7420	14	7450	14	7490	19	74132	30	74165	46	74194	40
7402	11	7421	19	7451	14	7491	34	74141	54	74167	150	74195	40
7403	12	7422	19	7453	14	7492	24	74145	48	74170	115	74196	40
7404	12	7427	18	7454	14	7493	24	74147	75	74173	58	74197	40
7405	14	7428	25	7460	14	7494	33	74148	60	74174	53	74198	80
7406	19	7430	13	7472	22	7495	33	74150	48	74175	45	74199	80
7407	19	7432	20	7473	24	7496	38	74153	38	74176	35		
7408	13	7433	20	7474	19	7497	86	74154	47	74177	42		
7409	13	7437	23	7475	26	74100	78	74155	36	74179	75		
7410	13	7438	24	7476	26	74107	22	74156	36	74180	38		
7411	15	7440	14	7480	45	74109	24	74157	28	74181	100		
7412	17	7442	30	7482	65	74121	24	74160	55	74182	55		

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

ORDERING INFO. All components brand new and full specification. All prices exclude VAT. Please add to total order. Please add 50p carriage to all orders under £15 in value. Send cheque/P.O. or Access/Visa number with order. Our detailed catalogue costs 45p (free with orders over £10). Callers most welcome. Telephone orders welcome with Access or Visa. Official orders accepted from colleges, Schools, etc. . . Callers most welcome, we are open Monday to Friday.

MONITOR

Have You Heard The One About The Irish Computer Club . . . ?

Dublin computer enthusiasts have formed the **Irish Amateur Computer Club**, and they are looking for micro buffs from all over Ireland to join them.

"The initial response has been excellent, with our membership now exceeding seventy." writes Secretary Nigel Carey. "Although our members are all very enthusiastic and some are experienced programmers, we are lacking in hardware specialists."

(You are not the only one, Mr. Carey. If too many hobbyists follow the trend and concentrate on micros to the exclusion of hardware, they won't even be able to wire up their own plugs in a few year' time! It won't be "no user-servicable parts" any longer, it'll be "no useable parts servicers" . . . but enough of this . . .)

"We are hoping that a mention in your magazine might prompt some of your Irish readers to join the club. The IACC is open to all micro enthusiasts both experts and beginners. We meet at least once each month in **Power's Hotel, 47 Dawson St., Dublin** (on the second Sunday of each month from 10.00am to 2.00pm). Club members receive regular bulletins and newsletter. Demonstrations, market facilities, lectures and social evenings are just a few of our many activities."

The man to contact is **Mr. Nigel Carey, 166 McKee Avenue, Finglas, Dublin 11**. I expect they would appreciate an SAE, too.

Texas Rides Again

Texas Instruments have introduced a compact, low cost computer for professionals. The CC-40 is programmable in enhanced BASIC and can run applications software loaded either from solid state cartridges or small tape cartridges. The system is battery operated and can be carried in a briefcase as well as being fully operational as a desk-top computer.

The CC-40 has 34K bytes of built-in ROM allowing immediate use of BASIC, and the TI BASIC used is compatible with that used in TI's Home Computer family (see Texas For Starters).

6K bytes of user-addressable RAM can be expanded to 16K and a module port, provided for up to 128K of application software, can be used to expand the computer's RAM. The CC-40 has a suggested retail price of £169.95 and should be available by the time you read this.

A 'Hex-bus' intelligent peripheral interface connector on the module allows connection of current and future peripherals in the Compact family. An RS232 interface, printer/plotter and 'Wafertape' digital tape drive are planned immediately, and other peripherals such as a bar code reader, modems, printers, and a black and white TV interface for the near future. Each unit will include a 'Hex-bus' port and

interface cable, and will be designed to operate with the TI-99 Basic Computer and with an adapter with the TI-99/4A Family Computer.

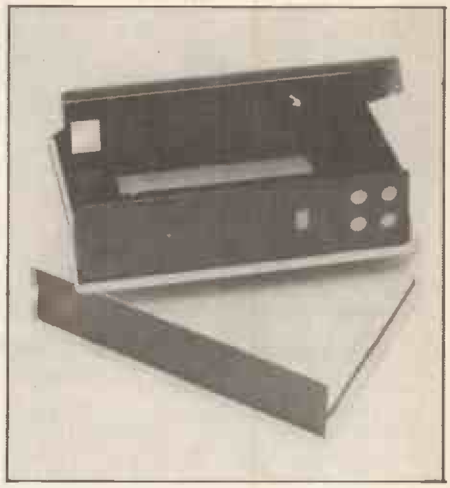
Suggested retail prices are £99.95 for the RS232 interface, £149.95 for the printer/plotter and £119.95 for the 'Wafertape' tape drive.

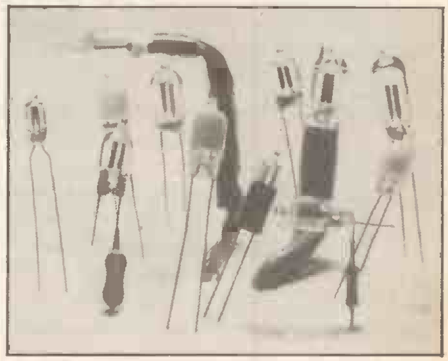
There will be twenty-two software applications packages available to start with, including Maths, Finance, Perspective Drawing, Advanced Electrical Engineering, Editor/Assembler and games packages on cartridge, and Elementary Dynamics, Photography, Inventory Control and several others on 'Wafertape' cartridges. TI expect to have seventy-five cartridges available by the autumn.

For futher information contact **Texas Instruments Ltd., Manton Lane, Bedford, MK41 7PA. Tel: (0234) 67466.**

Light Box

Boss Industrial Mouldings, sole UK distributors for **Phillips** miniature neons, have now introduced blue and green fluorescent neons with AC striking voltages of less than 100V and 94V respectively and a life expectancy of more than 20,000 hours. They are





available as individual components or with a butt welded special film resistor suitable for 110-130V or 220-250V operation at temperature up to 130°C.

They also do customer-specified neon assemblies for bulk/industrial buyers.

Boss have also added another model to their BIM3000 series: this is a metal case available in two similar sizes, 250 x 167.5 x 68.5mm or 250 x 187.5 x 78.5mm with a matt black stoved chassis and red, grey or orange stove enamelled top and bottom covers. The design includes integral brackets, etc., for components, PBCs and other assemblies. Custom cut-outs and punchings are available to bulk buyers.

Contact **Boss Industrial Mouldings, James Carter Rd., Mildenhall, Suffolk IL28 7DE. Tel: (0638) 716101.**

Attention All Suppliers

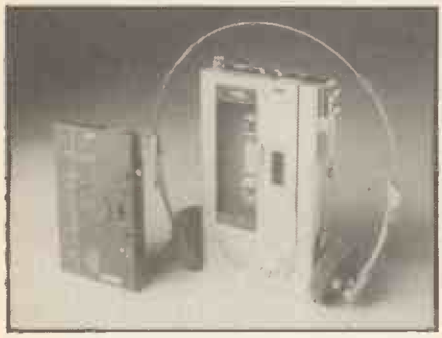
Manufacturers, Importers, Mail-Order Firms, Clubs, Exhibition Organisers. Hobby Readers need YOU . . .

Hobby Electronics' Monitor pages are our new products, new ideas, and forthcoming events column. The electronics fan has to know you're there before he can take advantage of your services. So please let us know, just as early as you can, when something new is coming up that you want our readers to know about.

Remember that the Hobby readership is diverse. People of all ages and walks of life, from Primary students to Professors, take advantage of our emphasis on self-education in every field of electronics. They want to find out what it's all about. Help MONITOR keep them in the picture.

Note: Hobby Electronics is produced up to eight weeks before it hits the newstands, so news never comes too soon.

Send press releases and news items to **MONITOR, Hobby Electronics, Argus Specialist Publications, 145 Charing Cross Road, London WC2H 0EE.**



Back On The Streets

It's enough to bring the Editor out in permanent apoplexy, but the new crop of Personal Stereos have arrived. I notice, however, that no-one has yet taken up our challenge to make one that runs on wind power . . .

From **Heron Electronics** comes the **Crown** CH-10 at around £24.95. This little object boasts headphones of an advanced design to give exceptional clarity, four-track, two-channel stereo, auto stop and cue functions, LED battery indicator, balance control and an output power of 30mW per channel. It measures 94 x 157 x 30mm, weighs 240gm and comes with a shoulder strap. Enquiries to your local hifi store or to **Heron Electronics Ltd., Heron House, 19 Marylebone Rd., London NW1 5JL. Tel: 01 486 4477.** There is also a Ch-20, at around £38.95, which includes an FM radio with stereo tuner, with a very similar specification.

From **Panasonic** comes another budget model, the RQ-J75. This will retail for around £33.50, and Panasonic don't mention any special features with this one except good value for money with their usual high standards. Dimensions are 88 x 134 x 35mm. Enquire at your local Panasonic dealer or to **National Panasonic (UK) Ltd., 300-318 Bath Rd., Slough, Berks SL1 6JB. Tel: Slough 34522.**

A more upmarket portable from **JVC** has a separate FM radio tuner module, shaped like a cassette tape, which loads into the cassette compartment for use. Not so convenient, perhaps, as a

machine with the tuner permanently built in, but the CQ-F2E boasts advanced features such as an improved tape transport system with and anti-rolling device, Dolby B, and metal tape compatibility, as well as the more usual features.

The CQ-F2E costs around £69.90. See your JVC dealer or contact **JCV (UK) Ltd., Eldonwall Trading Estate, Staples Corner, 6-8 Priestly Way, London NW2 7AF. Tel: 01 450 2621.** for more information.

Micro Add-Ons

Kempston (Micro) Electronics' Competition-Pro joystick (featured in Monitor HE May '83) is now available for the VIC-20, and Atari 400 and 800 micros, as well as the Sinclair Spectrum. The Spectrum version costs £25 including interface, and the new editions cost £16.50.

Kempston have also produced an interface to link the Spectrum with **Centronics**-type printers.

The interface is able to recognise LLIST and LPRINT commands, so that programs can be listed directly from the Spectrum and listings (in BASIC only) can be printed out without special user calls. It is also possible to produce condensed, expanded, etc. characters. The interface comes ready to plug in directly to any Centronics type printer, ie all Epsons, Seikosha 100A, OK1, Microline 80, etc. and includes driving software for up to 128 characters per line depending on printer type.

There is also a range of business software from **Hilderbray Ltd.**, including accounts, and stock control, etc., for use with these printers.

The interface costs £45.00 complete (plus £1.00 p&p). Orders and enquiries to **Kempston (Micro) Electronics, 180a Bedford Rd., Kempston, Bedford MK42 8BL. Tel: (0234) 852997.**

Testing, Testing, Testing

Dawne Instruments and Electronics have announced a string of new test instruments in their range.

Two new digital multimeters, the HC6010 and HC7030, have been produced to supplement the successful HC610 and HC703 models. These are 3½-digit LCD hand-held DMMs with retractable bench stands, and features include automatic zero, polarity and low battery indication, full ranges of DC and AC Volts and Amps, Ohms with switchable hi-voltage for diode testing and lo-voltage for in-circuit resistance tests, overload protection on all ranges, recessed input sockets, and a basic DC accuracy of 0.6% for the 6010 and 0.2% for the 7030. All models carry a year's guarantee and include free test leads, battery and manual. A carrying case is an optional extra at £3.00.

The HC6010 is £37.00 and the HC7030 is £47.00, with the older models slightly cheaper, but prices are quoted here ex-VAT or p&p, so if you want to buy mail-order you will have to send off for a pro-forma or check the price first.

A new 3½-digit multimeter, the 3300A has transistor hFE measurement facilities for both NPN and PNP devices, with an hFE range of 0 to 1,000. It directly indicates the hFE values, with about 10uA of Base current and 2V8 of Vce. Overload protection is 1000VDC and 750V rms AC. Diode test facilities give a maximum of 3V2 o/c and OmA2 test current. Other functions include VAC and VDC, DC current to 10A and resistance to 20MR, and 800 hours of battery life from one 9V cell. The cost, ex VAT etc., is £42.00.

The Model 5000 is a counter-timer produced by **GSC**. This is a miniature hand-held battery-operated instrument, which measures pulse width in addition to frequency and period, and uses the

latest developments in high speed CMOS logic circuitry to provide characteristics normally only found in expensive benchtop instruments.

The 5000 has an 8-digit LCD display. It incorporates a wide range of signal-conditioning facilities including attenuation, slope selection, AC or DC coupling and variable trigger control. Signal input for all functions is via a BNC connector with an input impedance of 1MR, and attenuation settings of x1, x10 and x100 are available.

In the frequency mode the 5000 can handle inputs from OHz1 to 50MHz; the equivalent for the period and pulse-width modes are 25ns to 10s, and either the high or low part of the signal can be selected, as can gate times of 0.01, 0.1, 1.0 or 10s. Averaging can be carried out over 10, 100 or 100 cycles.

The unit is powered by six AA NiCad or alkaline batteries, or by an AC adaptor/charger. We don't have a price for this one, nor for the following:

GSC's Model 3002 autoranging capacitance meter also boasts the virtues of a benchtop machine in a handheld model. The direct capacitance readings are from 1pF to 10uF990. There are eight automatically selected ranges, and Dawne claim an accuracy of within 0.2% (± one count) up to 199uF, and 1.0% ditto thereafter. As DC charging characteristics are used for measurement, the meter can be used for measurements on switches, cables and other components as well as capacitors. Input connectors are provided for round or flat-leaded devices

The Model 3002 operates from six AA NiCad or alkaline batteries or from an optional/charger.

The Model 6000 low-cost frequency counter provides two front-panel BNC inputs, one from 5Hz to 100MHz with a 1MR impedance and the other from 40MHz and 650MHz with a 50R impedance. A switchable low-pass filter gives 3dB/octave rolloff at 60kHz for audio and ultrasonic measurements, and gate times of 0.1, 1.0 and 10s.

Another feature of this new model is a 3MHz579545 temperature-compensated crystal oscillator with an accuracy of ±0.1 part in 10^6.

All enquiries to **Dawne Instruments and Electronics, Shields Rd., Bill Quay, Gateshead NE10 0RS. Tel: (0632) 695117.**

Tooling Up

Two from Toolmail: a computer service wallet containing twenty-five tools specially chosen for the simple maintenance of microcomputers and similar equipment. Tools include a miniature soldering iron, solder, pliers, tweezers, knife, IC puller, screwdrivers and adjusting tools among other basics. The kit costs £39.50 all inclusive.

Toolmail are also now supplying a range of Sanwa multimeters. Sanwa offer the widest range of multimeters anywhere in the world and supply

industrial and government users. A brochure with their selection is available from Toolmail.

Toolmail's latest catalogue is now available, with 128 pages, cost £1.00. Orders and enquiries to **Toolmail, (1982) Ltd., PO Box 46, Maidstone, Kent ME15 8EQ. Tel: (0622) 683861.**

Speed Of Light

For the ardent PCB-maker or anyone going into production even on a small scale, **Electronic Assistance Ltd.** have two UV exposure units at a reasonable price.

The UV-800 uses four 15W actinic UV lamps and is capable of etching more than 800sq cm of pre-sensitised PCBs or lables in less than three minutes, which is appreciably faster than traditional fluorescent tubes can achieve.

The UV-800 uses a very sensitive timer unit based on the ZN 1034E chip which allows repeated exposure to within 0.1% of the set time limit, over a wide temperature range. This is an integral part of the exposure unit.

Safety and efficient operation features include a flame retardant foam pressure pad designed to avoid displacement of artwork when closing, and a positively interlocked microswitch which prevents UV emission reaching the operator's eyes when the pressure pad is raised.

There is also a more basic unit, of interest to hobbyists, without the timer function but with all the safety features. This is the UV-300, and costs £35.00 plus VAT. The UV-800 costs £85.00 plus VAT.

Enquiries to **Electronic Assistance Ltd., Unit 1, Brynberth Industrial Estate, Rhayader, Powys LD6 5EN. Tel: (0597) 810711.**

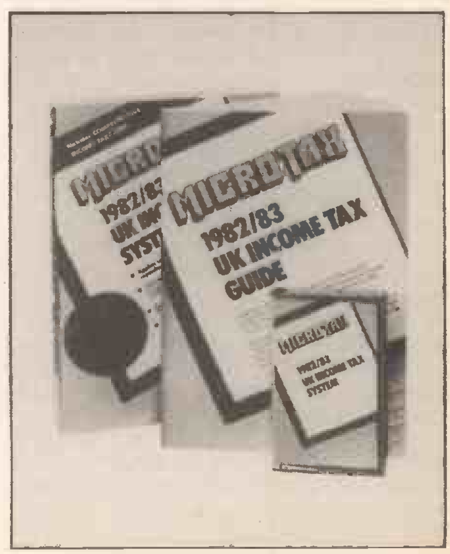
Less Taxing

A revolution in coping with that dreaded income tax return is forecast by the producers of **Microtax**, a new software system developed for Britain's growing number of home computer users.

Microtax, which consists of a set of programs on tape or disk and supporting manual, is claimed to be the first comprehensive, easy-to-use micro-computer system for completing tax returns.

The first Microtax system is an income tax system for the tax year 1982/1983 (ie for the current tax return) — this announcement is a trifle late for anyone who is not him or herself a trifle late, but the 1983/84 will be out in the autumn of 1983. Also available in 1983 will be complementary systems for dealing in more detail with the taxation of business and professional income, and a third system to cover Capital Gains Tax.

In addition to the calculation of tax liabilities, Microtax provides all the details to be filled in on the tax return, and for those with their own printers, a printout of all the relevant details is provided, which can be attached to the tax return.



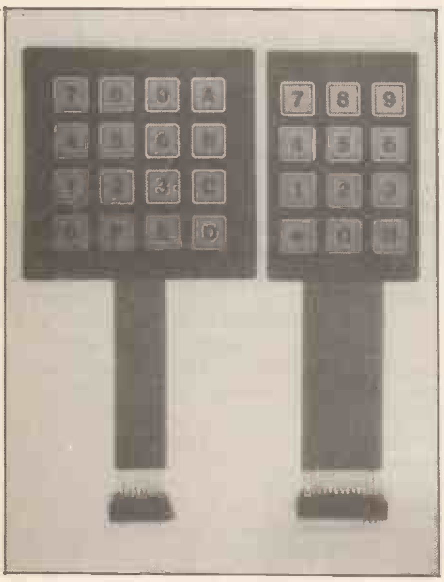
Microtax can currently be used on the 48K Spectrum, Commodore VIC 20 with 16K RAM pack, Commodore 64, Pet 400 Series (disk or tape), Dragon 32 and BBC Model B. Systems are being developed for use on the Sharp M80Z and Newbrain micros — in fact, these will probably be ready by the time you read this.

Microtax was developed by two taxation experts from **Tax and Financial Planning Ltd.**, and took nine months of professional accountancy time and the equivalent of two years of program time to develop for the 1983/4 tax returns. The Microtax package costs £24.94 all inclusive from **Microtax Ltd., Barratt House, 7 Chertsy Rd., Woking, Surrey GU21 5AB. Tel: (04862) 20369.** Please state which micro you are using when ordering.

Membrane Keypads

Velleman have announced the introduction of a new range of membrane keypads available with 12 keys (type KB12) or 16 keys (type KB16). Both versions are offered with standard legend or with blank keys to enable customers to print their own legend.

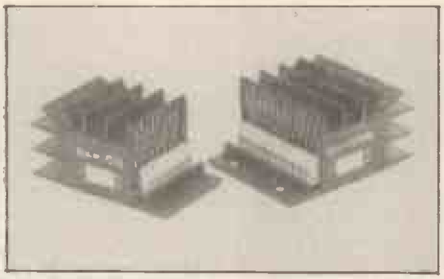
These multi-layer keyboards are manufactured by Velleman using high

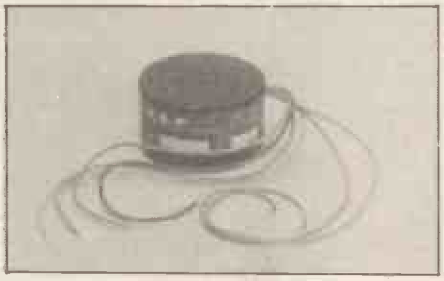


quality materials, with the top layer being polycarbonate film which resists scratching, dust and water. Termination is by insulated flat cable and a suitable PBC connector with 2.54mm (0.1in) spacing is supplied. Ratings are 24V and 25mA maximum.

A data sheet with full technical specifications is available upon request. Price including VAT and postage is £8.44 for both versions (1 off quantity), with discounts available for larger quantities. Velleman will also manufacture special keyboards to customers own design.

Contact **Velleman (UK) Ltd., PO Box 30, St. Leonards-on-Sea, East Sussex, TN37 7NL. Tel: (0424) 753246.**





Help From ILP

ILP Electronics have introduced a 15W (rms) per channel stereo power booster for car radio and cassette players to accompany their 15W mono power booster already on the market.

Both modules, the mono C15 and the stereo C1515, somewhat resemble electronic hedgehogs and are designed to increase the output power of car radio /cassette players without distortion. They come as encapsulated modules with two-hole fixings, screw terminal blocks for easy wiring-up, automatic supply on switch-on, selectable input level facility and output protection circuitry.

Also from ILP comes 15VA transformers fully encased in ABS plastic shells with easy fixing by an M4 bush at the base. ILP are planning more transformers in the encased toroid style up to 120VA.

For information and prices on both components, contact **ILP Electronics Ltd., Graham Bell House, Roper Close, Canterbury, Kent CT2 7EP. Tel: (0227) 54778.**

Sussex Mobile Rally

The Sussex Mobile Rally is being held at Brighton Racecourse on Sunday July 17th.

Features will include 20,000 square feet of exhibition areas, under cover, free minibus rides between the racecourse and the seafront (about four miles away), trade stands and a huge, popular Bring and Buy stall, and talk-in facilities on S22 and 80m. The rally is designed as a family attraction, not just for diehard fans.

The rally opens at 10.30am and closes at 5pm. Admission is £1.00, free to children and disabled people. There will be free car parking for up to 4,000 cars.

Advance tickets for clubs, and general information, can be obtained from **W. Firmager, Flat 2, 23 Chatham Place, Brighton, Sussex.**

Turn On The Lites

From **Light Soldering Developments** comes more soldering equipment and also a piece of gear which isn't anything to do with soldering but certainly utilises their experience with soldering irons.

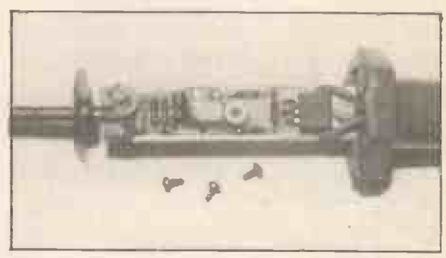
This is the Adamin Electric Stylus, which employs the blocking foil to mark and label a wide range of materials.

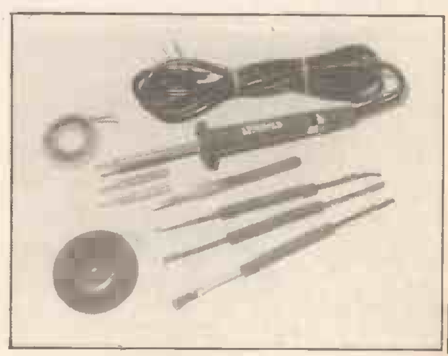
The Adamin is about the size of a ballpoint pen and operates from its own 4V5 mains plug and transformer, which fits a 13A socket. The silver-alloy writing tip heats in about 30 seconds to a temperature sufficient to activate the foil to allow writing. The foil comes in a variety of metallic and coloured finishes, and the Adamin is supplied initially with the plug/transformer and nine strips of foil in gold, silver, copper and six colours. The cost is £15.04 all inclusive.

Litesold have modified their LE40 24V electronically controlled iron to incorporate proportional band temperature control. Within this band, power is supplied in regular pulses of equal intervals and of a length which varies according to the actual and 'set' temperature of the iron. At the set temperature, the power-on and power-off periods are equal. Above and below this, they are modified until, at the limits of the proportional bands, the power is either fully on or fully off.

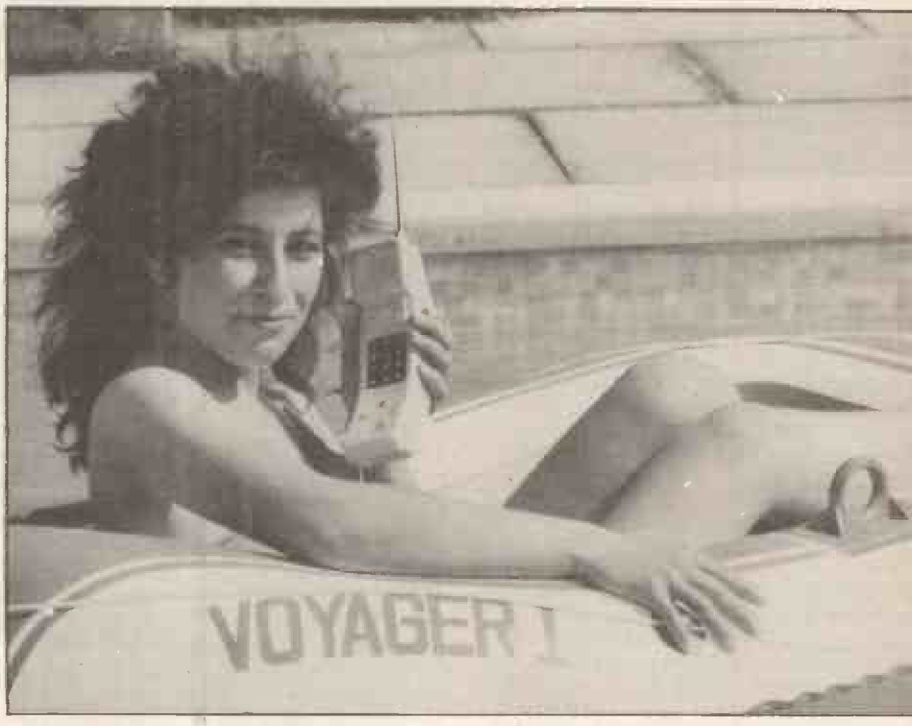
This system provides an improved temperature control, claim Litesold. To endorse their confidence in the iron, the 'set' temperature at manufacture is 370°C, lower than many controlled irons, but possible because of the exceptionally good control response of the iron. The lower working temperatures reduces the risk of damage to components and PBCs and allows longer life to the iron and bits.

The temperature can be user-adjusted anywhere between 280 and 420°C and stability around the point set is typically ±2°C.





MONITOR



The PU2450 Power Unit, designed for use with the LE40, now features a LED load indicator which glows when the iron is drawing load current. This provides a constant confirmation of the iron's correct operation and is useful for showing the exact setting point when adjusting the temperature.

Mail order prices for the LE40 are £25.67 all inclusive, for the PU2450 £32.69 and for both together £57.99.

Litesold have recently introduced a complete soldering/desoldering kit for hobbyists. This includes an 18W mains iron fitted with a 3.2mm copper bit, with two alternative bits of 1.6mm and 2.4mm; three metres of 18 swg flux-cored solder, stainless steel tweezers, three double-ended desoldering tools and a reel of desoldering braid. The kit comes in a clear PVC wallet and is available at the mail order price of £14.55 all inclusive.

Orders and enquiries to **Light Soldering Developments Ltd., Spencer Place, 97/99 Gloucester Road, Croydon CR0 2DN. Tel: 01 689 0574.**

Shorts

For owners of the 16K **Sinclair** Spectrum, Sinclair are now offering a 32K upgrade, priced at £60 inclusive of all labour and postage costs. Owners who opt for the upgrade are also being offered a free Sinclair 48K cassette of their choice and the chance to buy Sinclair's ZX Printer at the special inclusive price of £39.95 (instead of the normal price some £20 higher).

Sinclair Research Ltd., 25 Willis Rd., Cambridge CB1 2AQ. Tel: (0233) 353204.

A new edition of the **RSGB's** *A Guide to Amateur Radio* — the 19th edition, to be exactl — by Pat Hawker G3VA has come out. The book is an all-round handbook, covering topics from basic electronics, detailed looks at the different units of amateur radio equipment, the RAE, operating a station, international radio amateur organisations and appendices. The book is an 160-page paperback costing £2.75, or £3.44 by post, from the **RSGB, Alma House, Cranbourne Rd., Potters Bar, Herts EN6 3JW. Tel: Potters Bar 59015.**

Ambit International, the component suppliers who specialise in many unusual and imported lines, have released their 1983/84 catalogue, which is available through newsagents priced 75p. In the event of problems, contact **Ambit International, 200 North Service Rd., Brentwood, Essex CM14 4SG.**

The **Leeds Electronics Show** takes place from 5th to 7th July at the University of Leeds. This is a professional show, but anyone wanting information should contact Pat Hyatt on **(0799) 26699.**

A multimeter also from **Electronic and Computer Workshop**. This is the **Steinel** Digi-Check, a 3½-digit hand-held meter of an unusual design. It consists of two probe tips, each weighing 250gm, which contain the instrumentation (A/D converter on a single CMOS LSI chip), digital display, PSU and battery charger, plus the test lead. The points under investigation can be tested and the display viewed simultaneously, while the scale selected can be changed while the instrument is in use.

Specifications include DCV from OmV1 to 500V, ACV from 10mV to 500 and resistance from OR1 to 20MR; pushbutton reading storage ensures that measurements can be made even in hard-to-reach places, and then the display can be brought out to where it can be read.

For more information contact **Electronic & Computer Workshop Ltd., 171 Broomfield Rd., Chelmsford, Essex CM1 1RY. Tel: (0245) 62149.**

Get Off The Line . . .

A new creature may be appearing in homes and gardens this summer — Britian's first legal cordless telephone.

This licence-free gadget is made by **Fidelity Radio** and has a nominal range of one furlong (700 ft), and perhaps double that from a high place with a clean line of sight. The base unit plugs into an ordinary British Telecom phone socket, and will recharge the batteries in the handset overnight.

The mobile handset is said to sound and work just like a conventional fixed phone, but includes automatic recall of the number dialled (useful for repeat attempts to reach an engaged number) and an intercom call-button for conversation between the base unit and the handset.

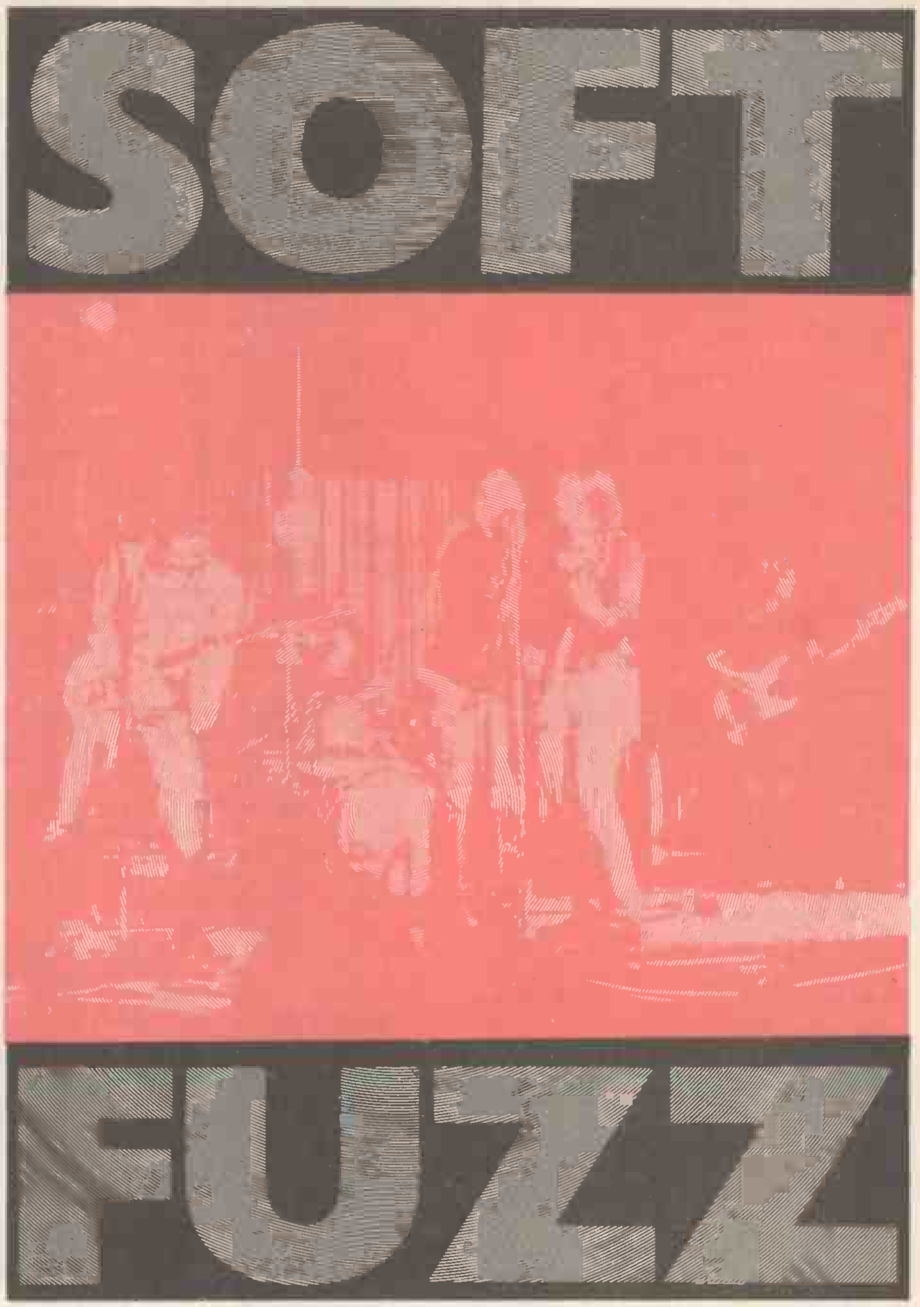
This is obviously aimed at businesspersons and the Leisure Class at present, but how long will it be before we can all have one on our bikes? Probably not long. This unit costs £169.00, with a twelve month warranty, and the standard socket is installed by British Telecom for £11.50. The makers point out that purchase and installation of a cordless phone roughly equates to installation and six years' rental of a standard pushbutton Trimphone. Cordless phones have been in use in the USA for nearly 15 years and 'listening in' has not proved a problem, we are told, because any one of the 20,000 different electronic signatures used to link the base and handset units is highly unlikely to be repeated within a quarter-mile radius.

Enquiries to **Micro Equipment Centre Ltd., 18 Brock St., Bath BA1 2LW. Tel: (0225) 20312.**

HE

Andy Armstrong

More vibrations than the Beach Boys, more Shakin' than Stevens, more rattle than a snake, more mystery than Toyah, hairier than those gentlemen on the right, breakin' more glass than Hazel O'Connor, more fuzz than . . . the Beasties??



THIS PROJECT is a subtle variation on an old idea. Fuzz-tone is used either purely for effect — heavy metal power chords would not be the same without it — or to mimic the soft clipping tones of an over-driven valve amplifier.

Depending on the values chosen for R10, 11, 12, 13, 14 and 15 the unit can be constructed to produce anything from a traditional, harsh fuzz sound to a reasonable imitation of a valve amplifier pushed a little too hard. The 'fuzz control' potentiometer allows variations around the basic sound and, according to one user, at moderate settings "it sounds like Jimmy Page reversing uncontrollably into a large greenhouse". That's a recommendation?!

Fuzz On The Circuit

The first stage of the circuit (**Figure 1**) is a simple preamplifier, designed to accept an input directly from an

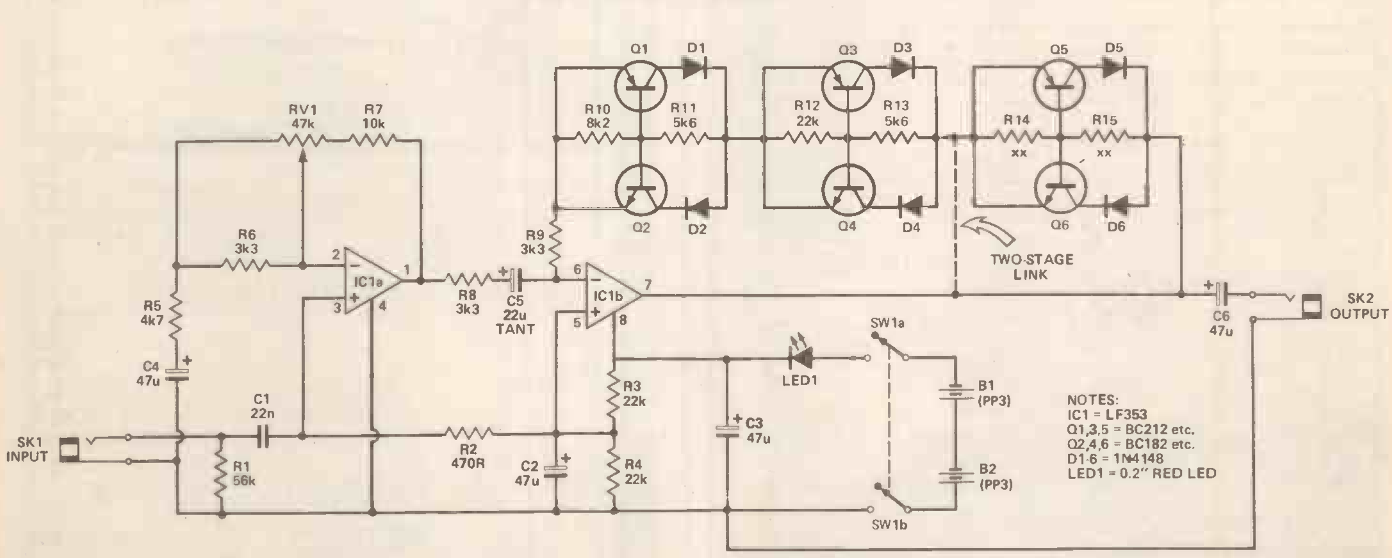


Figure 1. The circuit, with an optional third stafe for experimenters. For other constructors, the third-stage is by-passed by a wire link.

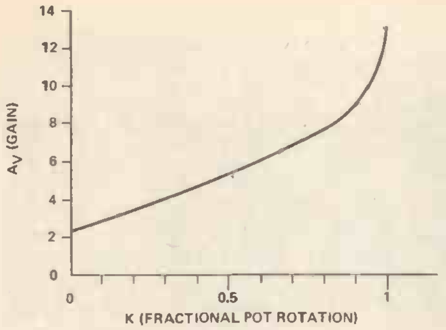


Figure 2. Potentiometer law.

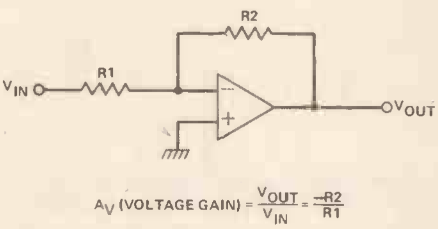


Figure 3. The operation of an op-amp in the inverting mode under normal conditions. In the Soft Fuzz, however, this is modified by a Zener-like network.

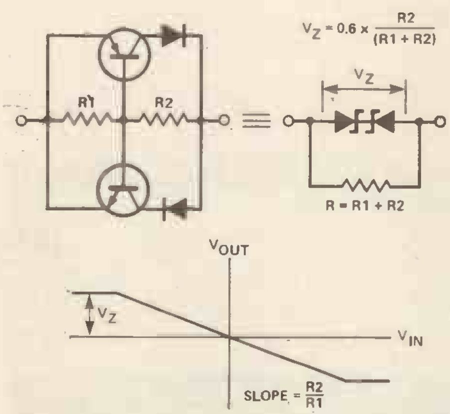


Figure 4. The 'Zener' network and its characteristics.

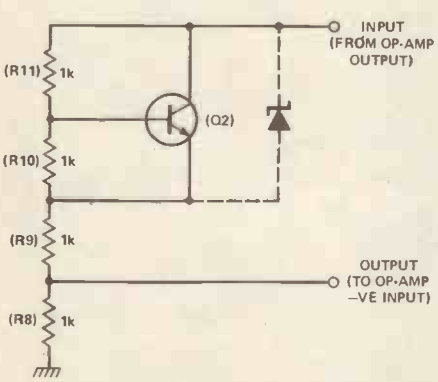


Figure 5. The operation of the 'Zener' network when the input voltage is positive.

electric guitar. The gain is adjustable between about 2.3 and 13 using RV1. Although a linear potentiometer is specified (generally it's possible to get better quality linear pots than logarithmic types, and a Cermet variety would be a good idea here to reduce the noise to a minimum), the variation of amplifier gain with resistance is not, as shown by **Figure 2**.

The output of the preamp will range up to about 4V RMS and is AC coupled to the next stage to avoid amplifying the DC offset produced by IC1, which is an LF353 dual JFET op-amp. The coupling capacitor C1 should be tantalum bead type, since the polarity of the DC offset voltage may be different from unit to unit, and tantalums can stand up to about OV3 reverse polarisation.

The second stage is the bit that makes the interesting crunchy sounds. It consists of an op-amp connected as an inverting amplifier, with several complicated looking two-transistor networks in the feedback loop. But to describe all this, we're better off first looking at a simplified circuit.

First though, it ought to be remembered that the gain of an op-amp in the inverting mode is as shown in **Figure 3**. In the main circuit, however, the feedback resistor has been replaced by a network consisting of two transistors, two diodes and two resistors. These form, in effect, a pair of back-to-back Zener diodes in parallel with a resistor. Up to the operating voltage of the "Zeners", the circuit looks like a pure resistance but above the voltage Vz the "Zeners" conduct so the resistor is taken out of circuit. The input/output characteristic of this network (**Figure 4**) shows that it is linear up to the "Zener" voltage, but clips for input voltages higher than that.

Half of the "Zener" network has been re-drawn in **Figure 5**; this is the half that is operating when the input voltage is positive (the resistors have been re-numbered to agree with one section of the main circuit but the values have been changed to simplify the explanation).

Zener Diode Lately?

Generally an NPN transistor will begin to conduct when the base is about OV6 more positive than the emitter. In this case, the base voltage is derived from the input (which is actually from the op-amp output, remember); if the input is say, 1V, then with the resistor values shown the base will be at OV75 and the emitter at OV5, so the transistor will be cut off and the output is another OV25 less than the emitter voltage. But if the input rises to around 2V4, something different happens; the base voltage becomes 1V8 while the emitter voltage is 1V2 and the transistor will begin to conduct.

Now if the input voltage rises to around 4V, say, the transistor is well and truly switched on — however it will only conduct just enough to maintain the base voltage OV6 higher than the emitter, as described. The circuit is thus acting as a Zener diode, maintaining a fixed voltage of 1V2 across it, and the input voltage less the collector to emitter voltage appears on the emitter.

Another way of describing this is to say that for input voltages above 2V4 only R8 and R9 are left in circuit to oppose the increase in current due to increased input voltage. Hence the current increases twice as much for a given voltage change above the 2V4 level than it does for the same change at voltages below 2V4.

The graph of the transfer (input/output) characteristic of the circuit is shown in **Figure 6**. The

Parts List

RESISTORS
(All ¼ watt 5% carbon)
R1 .... 56k
R2 .... 470R
R3, 4, 12 .... 22k
R5 .... 4k7
R6, 8, 9, 14, 15 .... 3k3
R7 .... 10k
R10 .... 8k2
R11, 13 .... 5k6

POTENTIOMETERS
RV1 .... 47k
linear law

CAPACITORS
(All 25V axial electro except as noted)
C1 .... 22n
disc ceramic
C2, 3, 6 .... 47u
C4 .... 47u
25V radial electro
C5 .... 22u 16V
tantalum bead

SEMICONDUCTORS
IC1 .... LF353
dual JFET op-amp
Q1, 3, 5 .... BC212 etc.
PNP general purpose
Q2, 4, 6 .... BC182
NPN general purpose
D1-D6 .... 1N4148
LED1 .... 0.2" Red

MISCELLANEOUS
SW1 .... DPST
min. slide or toggle
SK1, 2 .... PP3
Case, approx 102 x 102 x 51mm; PP3 battery clips; Veropins; PCB; 4 x M2.5 or 6BA nuts and bolts, wire, solder etc.

BUYLINES .... **page 34**

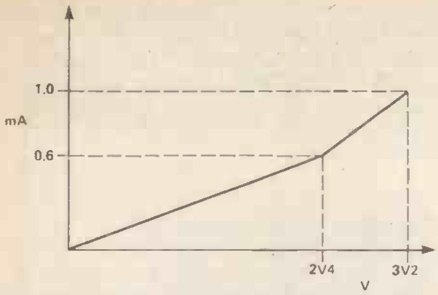


Figure 6. The transfer characteristics of the Soft Fuzz circuit.

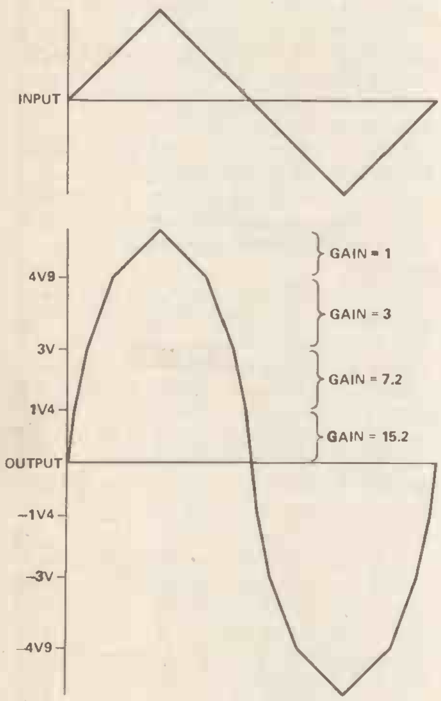


Figure 7. The curve in the lower diagram shows the effect of the Soft Fuzz circuits on a triangular waveform.

resistance of the curve is equal to the slope of the graph, and for the first part it is 2V4/0mA6 = 4kR, while for the second part it is 0V8/0mA4 = 2kR, as expected. This apparent resistance, calculated from the change in current resulting from a change in voltage, is called the 'incremental resistance', and if the circuit is used in the feedback loop of an op-amp, it is plain that the gain at any time will be proportional to the incremental resistance.

Of course this simplified circuit illustrates only half of the network, but the PNP transistor performs an identical function when the input (op-amp output) waveform goes negative.

The net effect of placing a network such as this in the feedback path is to reduce the gain as the input signal increases.

By carefully calculating the values of the resistors R10-15, the 'breakpoints' at which the incremental resistance slope changes can be selected to give smooth compression of the signal (clipping is just sudden and hard compression . . .). Three non-linear elements are used to give three breakpoints, and the overall

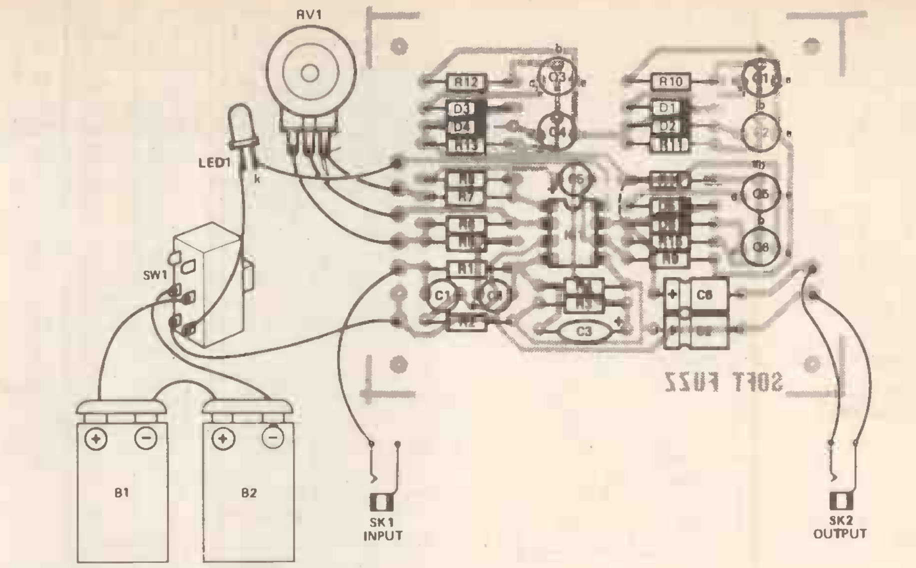


Figure 8. The PCB overlay.

effect of the unit on a triangular waveform is shown in Figure 7. The breakpoints selected for this project produce a gain of 15.5 for inputs (from IC1b) up to 1V4, a gain of 7.2 for inputs from 1V4 to 3V and a gain of 3 for signals from 3V to 4V9; thereafter the gain is one, no matter how large the input signal! Hence the triangle wave is amplified with four separate slopes; one generated by each breakpoint, plus the base gain of one.

Construction

The project is easily assembled with the aid of the component overlay, Figure 8. The third stage of non-linear feedback has been made optional so if you wish to proceed with only two stages, insert a link to join IC1 pin 7 to the junction of R13, D3 and D4. The components used for the third network should then be omitted but they can always be added at a later stage if desired and the link removed.

Connections to and from the board are best made via PCB-pins; both the input and output leads should be screened cable, and keep the leads to the potentiometer as short as possible. The LED power-on indicator is a bit of 'flash', but as it may prevent the unit from being left on it will probably earn its keep! It should be mounted on the side of the box near the on/off switch. The usual alternative, of course, to to use a double-pole jack socket which disconnects the battery when the guitar plug is removed.

An aluminium box is preferred for mounting the PCB, because of its screening property, and the board is easily fixed with four M2.5 or 6BA nuts and bolts.

HE

74 SERIES

7400	11p
7401	11p
7402	11p
7403	12p
7404	12p
7405	15p
7406	18p
7407	18p
7408	14p
7409	14p
7410	14p
7411	16p
7412	14p
7413	16p
7414	18p
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7427	18p
7428	18p
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7454	15p
7460	15p
7470	30p
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7480	48p
7481	120p
7482	65p
7483A	38p
7484	65p
7485	60p
7486	18p
7489	170p
7490A	20p
7491	35p
7492A	25p
7493A	24p
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7495A	35p
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7497	90p
74100	80p
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74119	60p
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74290	75p
74293	80p
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74351	150p
74365	30p
74366	35p
74367	35p
74368	30p
74376	100p
74390	75p
74393	90p
74490	95p

74LS SERIES

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74LS01	11p
74LS02	11p
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74LS86	16p
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74LS113	20p
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74LS126	25p
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74LS133	25p
74LS136	25p
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74LS145	70p
74LS147	100p
74LS148	75p
74LS151	40p
74LS153	40p
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74LS155	30p
74LS156	36p
74LS157	25p
74LS158	30p
74LS160	38p
74LS161	38p
74LS162	38p
74LS163	38p
74LS164	38p
74LS165	50p
74LS166	55p
74LS170	50p
74LS173	55p
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74LS221	50p
74LS240	55p
74LS241	55p
74LS242	55p
74LS243	55p
74LS244	50p
74LS245	70p
74LS251	30p
74LS253	30p
74LS256	150p
74LS257	30p
74LS258	35p
74LS259	55p
74LS260	22p
74LS261	50p
74LS266	20p
74LS273	55p
74LS279	30p
74LS283	40p
74LS298	90p
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74LS324	150p
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74LS368	30p
74LS373	55p
74LS374	55p
74LS375	45p
74LS377	70p
74LS378	70p
74LS390	45p
74LS393	45p
74LS399	160p
74LS612	£19
74LS540	90p
74LS541	80p
74LS610	£19
74LS626	150p
74LS628	150p
74LS670	120p
74LS687	400p

4000 SERIES

4000	10p
4001	10p
4002	12p
4006	50p
4007	14p
4008	36p
4009	24p
4010	24p
4011	11p
4012	16p
4013	20p
4014	48p
4015	40p
4016	20p
4017	32p
4018	45p
4019	25p
4020	48p
4021	40p
4022	45p
4023	13p
4024	32p
4025	13p
4026	80p
4027	20p
4028	40p
4029	45p
4030	15p
4031	125p
4033	125p
4034	140p
4035	45p
4036	275p
4037	110p
4039	290p
4040	40p
4041	40p
4042	40p
4043	40p
4044	40p
4076	48p
4077	18p
4078	16p
4081	14p
4082	15p
4086	40p
4089	125p
4093	24p
4094	90p
4095	75p
4096	70p
4097	290p
4098	90p
4099	100p
4500	575p
4502	60p
4503	45p
4505	400p
4507	35p
4508	130p
4510	45p
4511	45p
4512	48p
4514	110p
4515	110p
4516	55p
4518	40p
4520	50p
4521	90p
4526	60p
4527	60p
4528	50p
4532	70p
4534	400p
4536	270p
4538	90p
4539	70p
4543	75p
4553	245p
4555	35p
4556	35p
4560	120p
4568	250p
4569	170p
4572	30p
4583	90p
4584	38p
4585	75p
40085	90p
40097	50p
40102	140p
40103	170p
40106	36p
40109	100p
40163	60p
40174	50p
40175	50p
40193	60p
14495	300p
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LC7130	325p
LC7137	270p
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LF347	150p
LF351	48p
LF353	95p
LF356P	95p
LF357	110p
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LM301A	25p
LM307	45p
LM308	45p
LM308N	75p
LM310	120p
LM318	150p
LM319	215p
LM324	30p
LM334Z	90p
LM335Z	140p
LM339	50p
LM348	66p
LM358P	60p
LM377	175p
LM380	75p
LM381AN	180p
LM382	120p
LM384	140p
LM386	90p
LM387	120p
LM389	95p
LM391	150p
LM393	100p
LM394	300p
LM709	36p
LM710	50p
LM711	70p
LM723	35p
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BC516/7	36p
BC547B	12p
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BC549C	12p
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BC559C	16p
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BD232	95p
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BD235	75p
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BD242A	70p
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BFX89	150p
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BFY51/2	24p
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BFY90	50p
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MJE3055	70p
MPF102	30p
MPF103/4	30p
MPF105	30p
MPSA12	30p
MPSA13	50p
MPSA20	50p
MPSA42	50p
MPSA43	50p
MPSA56	25p
MPSA70	50p
MPSA93	50p
MPSU06	55p
MPSU07	60p
MPSU45	90p
MPSU65	78p
TIP29A	35p
TIP29C	40p
TIP30A	35p
TIP30C	40p
TIP31A	40p
TIP31C	50p
TIP32A	40p
TIP32C	45p
TIP33A	90p
TIP33C	80p
TIP34A	90p
TIP34C	80p
TIP35A	120p
TIP35C	150p
TIP36A	140p
TIP36C	160p
TIP41A	45p
TIP41C	55p
TIP42A	50p
TIP42C	60p
TIP54	160p
TIP120	50p
TIP121	70p
TIP122	60p
TIP142	110p
TIP147	120p
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2N2160	295p
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2N2222A	25p
2N2369A	17p
2N2484	25p
2N2646	40p
2N2905A	25p
2N2907A	25p
2N3053	25p
2N3054	55p
2N3055	35p
2N3442	140p
2N3553	240p
2N3702/3	10p
2N3704/5	12p
2N3706/7	10p
2N3773	200p
2N3819	20p
2N3823	30p
2N3866	90p
2N3904	15p
2N3906	16p
2N4037	65p
2N4056	65p
2N4124	27p
2N4126	27p
2N4401/3	25p
2N4427	90p
2N4871	50p
2N5062	36p
2N5087	27p
2N5089	27p
2N5172	27p
2N5192	75p
2N5245	40p
2N5401	50p
2N6457/8	30p
2N5459	30p
2N5460	60p
2N5485	36p
2N5875	250p
2N6027	30p
2N6052	300p
2N6059	325p
2N6107	65p
2N6247	190p
2N6254	130p
2N6290	65p
2SC1306	100p
2SC1307	150p
2SC1957	90p
2SC1969	150p
2SC2028	80p
2SC2029	200p
2SC2078	160p
2SC2335	200p
2SC2612	200p
3N128	120p
3N140	120p
3N141	110p
3N201	110p
3N204	120p
40290	260p
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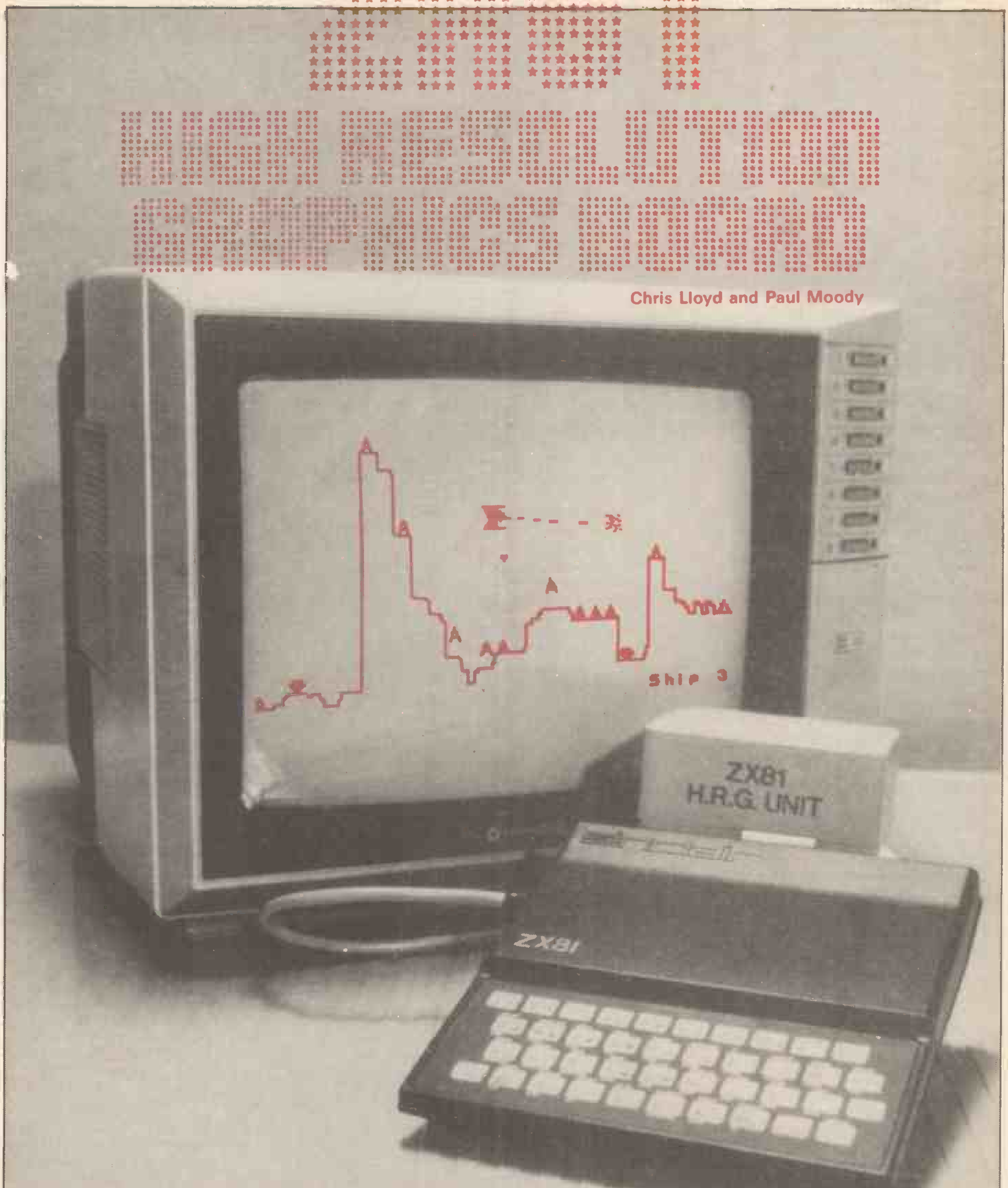
ZX81 HIGH RESOLUTION GRAPHICS BOARD

Chris Lloyd and Paul Moody



Fed up with chunky, block graphics on your ZX81? Then try our High Resolution Graphics board. It allows you to plot at least 512 points (more, with clever programming) and works with either the standard 1K computer or with a 16K RAM pack plugged in.

THE POPULARITY of the Sinclair ZX81 has amply demonstrated the high demand for low priced home computers but, after buying their ZX81 and discovering for the first time the joys of computing, many owners soon wish to improve on the basic Sinclair system. Then they find that extra money or a commercial High Resolution Graphics (HRG) board costs almost as much as the original machine.

But wait! The high resolution graphics system decribed here is available as a kit for only £17.50 and offers facilities superior to many HRG add-ons. It enables the user to define his own graphics symbols — making it possible to plot accurate graphs and shapes, to play games such as chess or Invaders with realistic figures, or to devise any new character — all with a screen resolution of 256 x 176 pixels. In addition no hardware modificiations are required; the unit plugs directly into the ZX81 ROM socket and is completely software controlled.

Sinclair Displays Itself

One of the main reasons for the ZX81's low price is that it uses very little hardware to produce the display. Instead of a dedicated display chip, Sinclair cleverly manages to trick the Z80 CPU into handling the display, making it behave in a way it is not normally intended to work.

The problem of displaying data this way is simply one of speed. To output the characters fast enough, the CPU has to do two things; first it must read the character code in RAM, and second it must find the pattern of dots in ROM that correspond to the required character.

With most processors this is impossible to do at any reasonable speed, but Sinclair has used a special facility of the Z80 CPU — its ability to refresh dynamic memory — to work a neat trick.

Dynamic memory is simply a block of memory cells in which a logic '1' is stored as a charge on a tiny capacitor, which is itself part of the memory IC (*dynamic memory was explained in greater detail in Components For Computing, February 1983 issue of Hobby Electronics*). However the charge leaks away fairly rapidly, so that data must be 'refreshed' from time to time. This capability is built into the Z80 CPU and normally it refreshes dynamic memory about once every microsecond, during the second half of each machine cycle. At these times the top half of the refresh address is equal to the contents of the CPU's I register and always remains the same, while the bottom half is equal to the contents of the R register and is incremented each cycle.

This refresh ability is put to full use by the Sinclair Logic Chip, a Ferranti ULA (Uncommited Logic Array). Normally in the first half of a machine cycle the CPU fetches the next instruction to be executed. However the Logic Chip periodically tricks the CPU into putting out the address of the next character to be displayed,

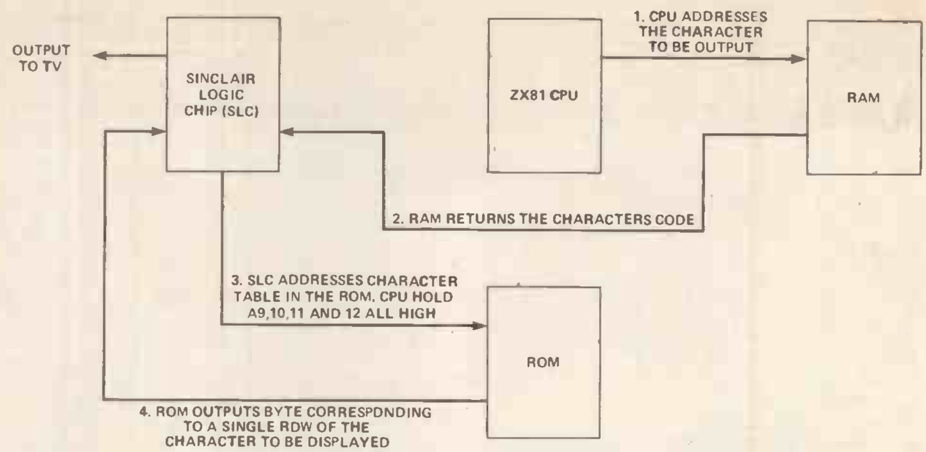


Figure 1. This block diagram shows, in simplified form, how the display is generated.

instead of an instruction, and the RAM returns a character code from the display section of memory. This would be treated as an instruction to be executed, except that the Logic Chip once more fools the CPU by overwriting the data lines, forcing them all 'low' so that the CPU effectively receives a No Operation (NOP) instruction.

Meanwhile the Logic Chip is using the character code data to generate the address in ROM where is located the dot pattern for the selected character. During the second half of the machine cycle — the Refresh cycle — the Sinclair Logic Chip puts out this address on the lower nine address bus lines, overwriting the CPU's lower refresh address bits so that the Logic Chip addresses masquerades as the lower half of the refresh address! The upper bits come, as usual, from the CPU's I register, and together these bits address a memory location in the top 500 bytes of ROM, where the character dot tables are held. The data from the ROM is then sent directly to the display and forms the top row of the displayed character. The Logic Chip address is then changed successively to output the other seven rows of dots.

High Resolution

The ZX HRG board allows the programmer to choose for himself the pattern that will appear on the screen when the Sinclair prints a character. Quite simply, it overwrites that part of ROM which contains the character data — memory locations 7680 to 8191 — by disabling the ROM whenever the address is within that range. So, instead of reading this part of the ROM, the Sinclair is instead directed to the HRG RAM, which has been set up by the programmer to provide the desired high resolution character. For increased flexibility, the HRG system is completely software controlled, allowing rapid selection of either user-defined or normal Sinclair graphics, and of course the two can be combined if the Sinclair ROM data is first transferred to the HRG RAM.

Table 1.

CONTROL NUMBER	HRG FUNCTION
0	HRG OFF.
8	DISPLAY LOWER HALF OF HRG RAM.
10	DISPLAY UPPER HALF OF HRG RAM.
12	LOAD LOWER HALF OF HRG RAM
14	LOAD TOP HALF OF HRG RAM

The Circuit Resolved

The HRG circuit consists of a control section, ICs 1 to 5, the HRG RAM in IC6 and 7, and the Sinclair ROM, which is unplugged from the ZX81 and re-mounted on the HRG board. All the signal lines and the +5V and 0V supply rails are taken from the ZX81 ROM socket to the HRG unit via a length of ribbon cable and a DIP Leader.

The HRG is located in memory at 7679 (one byte below the start of the Sinclair ROM's character data tables) and it is controlled by POKEing this address with an appropriate control number — either 0, 8, 10, 12 or 14 — as shown in **Table 1**.

The address is decoded by the 13-input NAND gate, IC5; 7679 corresponds to address lines A0-A8 and A10-A12 all high so, with A9 inverted by IC3f, IC5's output will go low only when this address is present on the bus. The Sinclair logic chip also recognises the address, which is within the ROM space, so at the same time it takes the ROM Chip Select ($\overline{ROMCS}$) line low. This signal is inverted by IC3d and forms one input to the NAND gate IC2c. The other input is from IC5, inverted by IC3e, and since these are both high, pin 8 of IC2 will go low.

The purpose of all this is to store the control number in IC1, a 4-bit latch. But because the ZX81 itself

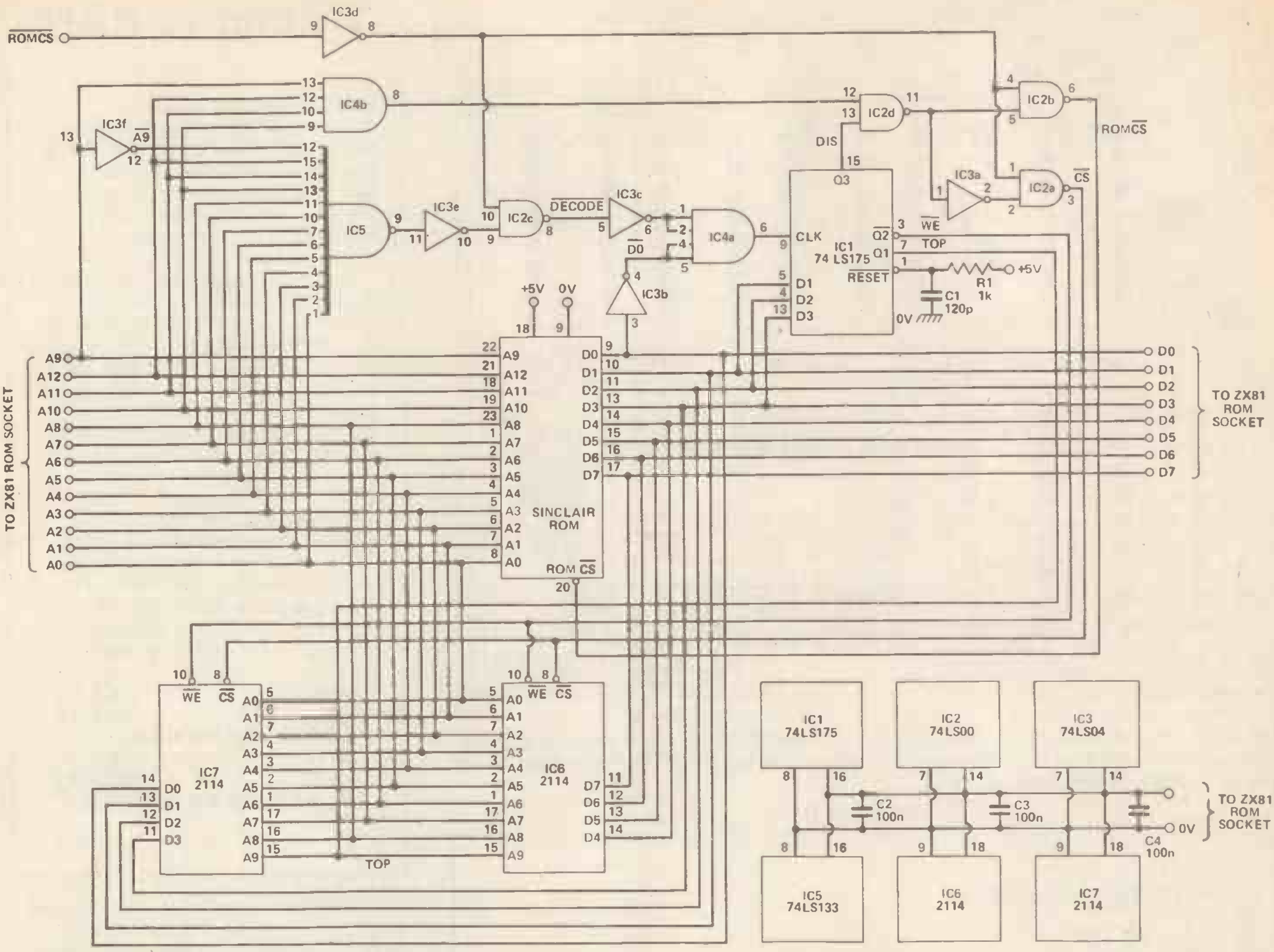


Figure 2. The complete circuit of the High Resolution Graphics Board. The ROMCS signal is also from the ZX81 ROM.

periodically puts into the HRG address, (approximately once every five minutes, when the system variable FRAMES takes on this value — see the ZX81 BASIC manual, page 179), it is necessary to prevent the ZX81 from accidentally activating the HRG board.

This is achieved by using only *even* control numbers so that data bit DO is always zero when the HRG is being addressed by the user. The data lines are all taken high during the times when FRAMES is active, so the ZX81 cannot accidentally address the HRG.

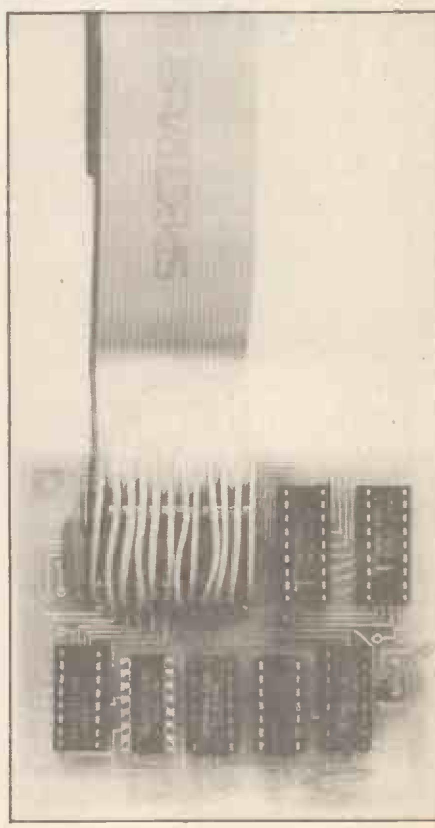
DO is inverted by IC3b and together with the inverted DECODE signal produces a high output from AND gate IC4a, which latches D1, D2 and D3 into IC1. The latch outputs, now labelled TOP, WE and DIS, are then used to control the HRG function. Note that TOP follows D1, WE follows D2 and DIS follows D3.

The DIS line is used to select either normal Sinclair graphics or the user-defined characters previously stored in RAM. The output of IC4b goes high whenever address lines A9-A12 are high (ie, whenever the address is in the range 7680-8191), but if the control number 0 has been POKEd then DIS will be low and hence IC2d output will be high. The inverted ROMCS signal will also be high at this time, so the ROMCS signal, the output from IC2b, will be low and the Sinclair ROM will be enabled. At the same time the output from IC2a will go high and since this is connected to the Chip Select (CS) inputs of ICs 6 and 7, the HRG RAM is disabled and normal graphics characters will be displayed.

However if any other control number is POKEd the DIS line will be high, ROMCS will go high to disable normal graphics, while CS will go low, allowing the user-defined graphics to be displayed.

When the computer is first switched on it is obviously desirable that normal characters are enabled, so R1 and C1 are connected to the latch's Master Reset input and they produce a brief low-going pulse when power is first switched on, clearing all the latch outputs to zero.

The operation of the other two control lines is quite simple by comparison. That WE line is tied to the RAM Write Enable inputs and whenever the control number equals 12 or 14, WE goes low and this will enable data to be written to the RAM, ICs 6 and 7. Any other control number will keep WE high so that the RAMs can only be read.



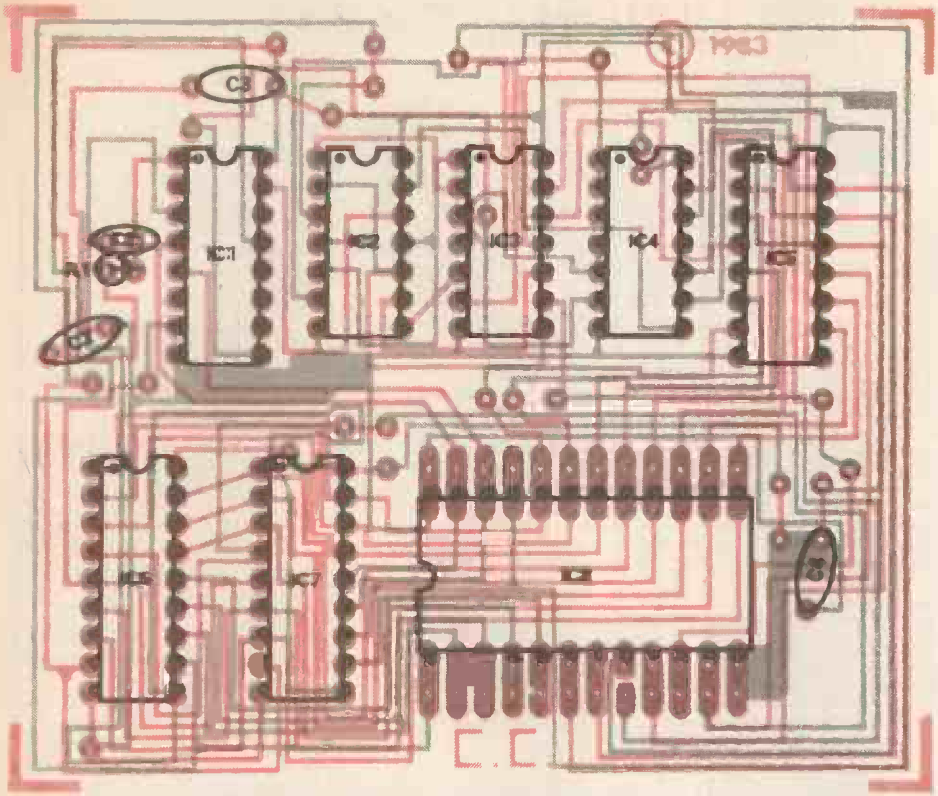


Figure 3. The double-sided, through-hole-plated PCB and component overlay. Readers making up a board themselves will need to wire through-links to connect the two sides of the printed circuit.

Writing to RAM

BEFORE loading character-definition information into the HRG RAM, it is first necessary to change the value in the ZX81 CPU's I register as described in the text. This operation can only be performed by a section of machine code program.

The actual operation of writing to the HRG RAM can be carried out either by a BASIC routine, or by machine code. If BASIC is used the m/c program must first be called, then the HRG RAM loaded using POKE commands to the appropriate addresses, then the I register restored to its original value by calling the second section of m/c program. The display will be corrupted while BASIC is loading the RAM data.

The program listing below, in Hex and Decimal, performs the necessary operations on the I register. It must also be used if loading under machine code.

```
3E00                      62,00
ED47                     237,71
C9 RETURN TO BASIC       201
3E1E                      62,30
ED47                     235,71
C9 RETURN TO BASIC       201
```

Program 0

```
  1 REM "X zeroes"
 10 PRINT"FIRST ADDRESS"
 20 INPUT A
 30 PRINT AT 15,0; "";
 40 LET X$=""
 50 IF X$="" THEN INPUT X$
 60 POKE A, 16*CODE X$+CODE X$(2)-476
 70 PRINT CHR$ INT (PEEK A/16+28);CHR$ (PEEK A-INT (PEEK A/16)*16+28)
 80 LET A=A+1
 90 LET X$=X$ (3 TO)
100 SCROLL
110 GOTO 50
```

Machine Code Loader routine; enter in the REM statement (Line 1) the number of zeroes specified for the program you wish to use.

However there is a slight complication in writing to the character RAMs. During the second half of each machine cycle the CPU's I register puts out the top half of a refresh address. Normally this is of no consequence, but if the user is attempting to write to RAM then the HRG WE line will be low, so whatever appears on the data bus at these times will over-write the character data. The solution to this problem is carried out in the operating software: before the Write Enable is taken low the contents of the I register are simply changed so that it is no longer addressing the character RAM space!

Finally, the TOP signal is taken directly to the A9 address input of each RAM IC so that taking this line high (control numbers 10 or 14) addresses the top 512 bytes of the HRG RAM; this facility allows two completely different character sets to be created and displayed.

Construction

There should be no particular difficulty in building the HRG project. All components are mounted on the double-sided through-hole-plated printed circuit board and can either be soldered directly or inserted in IC sockets for safety. The ribbon cable which connects to the ZX81 is soldered to the PCB. No special handling precautions are necessary in the construction — but some care is required at the next stage.

Installation

The Sinclair ROM must be removed from the ZX81 and re-mounted on the HRG board, and the DIP header from the project plugged into the ROM socket. This leaves the edge connector free for use with other accessories.

To open the ZX81 first remove all leads and add-ons and peel off the rubber pads on the base of the computer, making sure that the adhesive film remains attached to the pads. Next remove the five screws now visible and note their order so they can be correctly replaced. The base can now be removed, exposing the copper side of the PCB. Remove the two screws holding it in place and carefully fold back the board, being *very* careful not to damage the ribbon cable leading to the keyboard, or its connections on the PCB. DO NOT attempt to remove the cable from the PCB, and take note of the direction of the fold in the cable so that it can be correctly repositioned.

Identify the Sinclair ROM (Figure Z) and note its orientation in the socket; then use a small screwdriver to carefully lever the ROM from its socket; work from both ends and be careful not to bend the pins! Now plug the DIP header into the ROM socket, taking care that it goes in at the right end! It is advisable to gently wipe the header pins with a cloth soaked in alcohol or white spirit before plugging in, and check for loose connections or short circuits.

The ribbon cable is best lead out of a narrow slot filed into the rear of the base. Alternatively it can be taken through the edge connector slot, but it may interfere with some add-ons. In either case it will be necessary to fold the cable through 90° so that it sits flat under the PCB when this is remounted.

Re-assemble the ZX81, then plug the ROM into its socket on the HRG board. Mount the board in the case,

Parts List

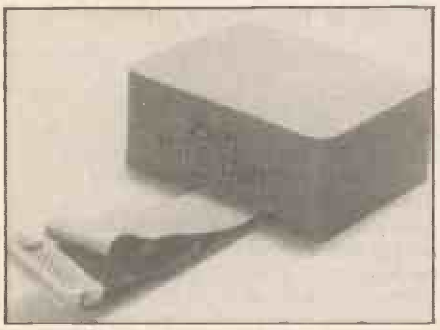
RESISTORS
R1 .... 1kR
10% ¼ watt carbon

CAPACITORS
C1 .... 120p
ceramic
C2,3,4 .... 100n
ceramic

SEMICONDUCTORS
IC1 .... 74LS175
TTL Quad D-type latch
IC2 .... 74LS00
TTL Quad 2-in NAND
IC3 .... 74LS04
TTL Hex Inverter
IC4 .... 74LS21
TTL Dual 4-in AND
IC5 .... 74LS133
TTL 13-in NAND
IC6,7 2114
NMOS 1024x4-bit RAM

MISCELLANEOUS
3 x 14-pin, 2 x 16-pin, 2 x 18-pin, 1 x 24-pin DIL sockets; 1 x 24-pin DIL header and approx. 9" x 24 ribbon cable; PCB; case; wire, solder etc.

BUYLINES .... page 34



screw it all together and you're reading for action.

Testing

If a 'K' fails to appear when the power has been switched on, check all the connections from the ribbon cable to the HRG board, and remove the ROM and gently wipe the pins to remove any grease. If these measures fail to restore correct operation the ZX81 will have to be stripped and the DIL header checked again; there is very little that can go wrong on the project board, except for putting the ICs in wrong way around!

Software To Sample

Four programs are provided to allow you to explore the capabilities of the HRG Board. They all use a section of machine code which, at the very least, changes the value in the CPU's I register (for the reason mentioned earlier).

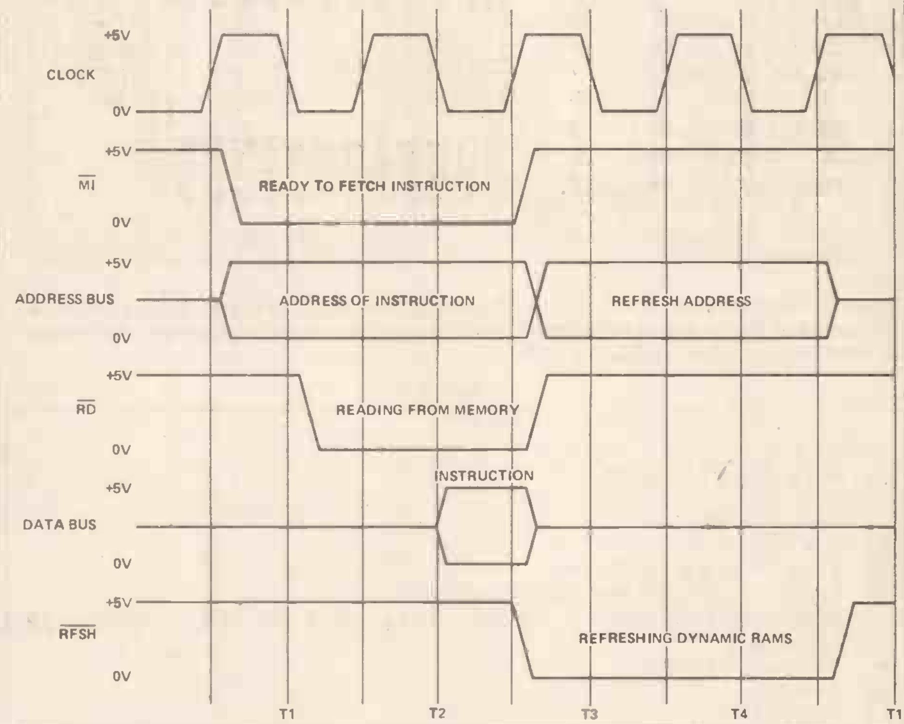
These programs also use m/c to write data to the RAM (see box) and to perform other functions, too. A "machine code loader" program is listed as Program 0 for those who

Clocking The Z80

TO ensure that all parts of a micro based system are working together, it is essential that all the activities take place at clearly defined times. To enable this synchronisation the CPU is fed with a clock signal, running at 3.25 MHz in the case of the Sinclair Z80 CPU.

To understand how the CPU uses the clock cycles, consider what happens when it goes to memory to fetch its next instruction (see figure). The top line shows the regular clock frequency and the line below that the $\overline{MI}$ output from the CPU, which signals the beginning of an instruction fetch from memory. During the first two clock cycles the address of the instruction to be fetched is output on the address lines, along with a low on $\overline{RD}$ indicating a read operation. The memory returns the instruction on the data bus, and in the next two clock cycles, the CPU decodes and executes it, simultaneously putting out a refresh address and sending $\overline{RFSH}$ low.

This group of four clock cycles is called a machine cycle and simple instructions (such as LD A,B) only require one machine cycle for completion. More complicated instructions may require more than one machine cycle.



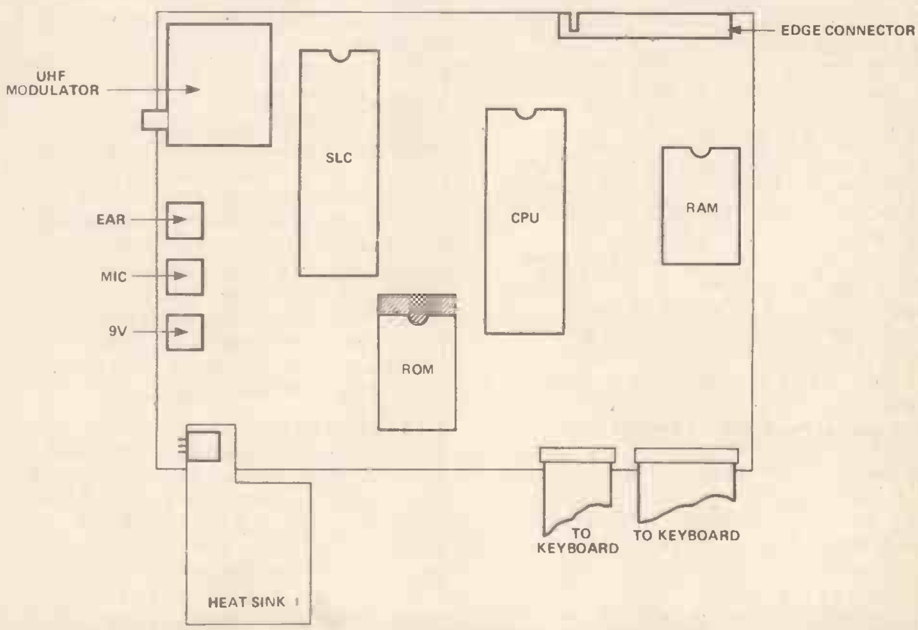


Figure 4. The component layout inside the ZX81. The 24-pin ROM is mounted in a 28-pin socket; the hatched area indicates the unused pins.

don't already have a favourite routine of their own. The m/c is stored in memory on locations reserved by the REM statement of Line 1; eg if the machine code is four bytes long, then this space is reversed by typing

1 REM "0000"

To load the code, type in the Loader (making sure you have entered the specified number of 0s in Line 1) then RUN it. When prompted, enter the starting address of the m/c routine ("FIRST ADDRESS"), then enter the code one line (two, three or four bytes) at a time; the Loader routine will give a prompt ("L") after each NEWLINE.

When all the Loader has been entered, delete lines 10 to 100 — DO NOT remove Line 1, which contains all the m/c you have just labouriously typed in! Line 1 of the Loader now becomes the first line of whichever program you now wish to try.

The Programs

Except for Program 4, these are all intended to run in 1K, and with most the display will be limited to an 8x8 character block at the top left corner of the screen. The final listing will only run in 16K, and gives a full screen display.

Program 1 is a simple routine for testing the HRG Board. It's not terribly exciting (it simply displays 32 thin vertical lines in the top two rows of the screen) but if you'd rather be sure that all is in order before typing in a longer program, try this one first!

Load the machine code first, using the Loader program. The first two lines of code change the value of the CPU's I register, and the next few lines enable the HRG for storing data by loading the control number 12 (OC in Hexadecimal) into the control latch. The middle section of code stores new character data in successive memory locations corresponding to the ROM locations of CHR$ 0-63 (see page 181 of the Sinclair BASIC manual for the "regular" characters that are being replaced!). The last half-dozen lines of m/c turn off the HRG and restore the original value of the I register.

The BASIC program (which is entered after lines 10-110 of the Loader have been removed) first calls the machine code routine in Line 20; this sets up the character RAM as described. The remainder of the program turns on the HRG in Display Lower RAM mode and prints the new characters before pausing, after which the HRG is turned off by POKEing 0 into the latch.

Characters To Order

Program 2 is a general routine that will probably be used continually, if not frequently! It allows the user to define a character using normal ZX81 block graphics, after which the new character is stored in the HRG RAM.

The pattern of dots which make up each character is held in eight consecutive bytes, each representing one row of the character. The 8 x 8 grid depicted in **Figure 5**, with each bit equal to a one representing a dot and each bit equal to zero, a blank, will be familiar to most readers.

Program 2 first draws a 8 x 8 block-character grid on the screen, together with a row and column references. The dots which will make up the new pattern are then entered by specifying the row number and the letter corresponding to the column, eg "2C" enters a dot in the second column, third row. Mistakes can be erased by entering the co-ordinates followed by the letter R; eg "2CR" will remove the dot just entered. Entering STOP produces a prompt (L) and the next step is to enter the character-code of the symbol you wish to replace by the new dot-pattern.

The program does all this by storing eight variables, one for each row of the grid, then transferring them to the appropriate eight bytes of the HRG RAM at the address normally occupied by the character being replaced. The character table in the Sinclair ROM starts at location 7680 with Code 0, a blank, and since each character requires eight bytes the next (Code 1) starts at location 7688. In general, the character with Code 'X' starts a location (7680 + 8 * Code 'X'). Thus if the new character shown in **Figure 6** was to replace 'E' (Code 42) it would be stored in RAM at

Program Notes

All machine code must be entered using the machine code loader program. The listings commence at the top left and read down the columns. The decimal number at the start of each m/c listing is the "FIRST ADDRESS".

Program 1

```
 1 REM"44 zeroes"
20 RAND USR 16514
30 POKE 7679,8
40 FOR N=O TO63
50 Print CHR$ N;
60 NEXT N
70 PAUSE 500
80 POKE 7679,0
```

16514	ED42
3E01	2803
ED47	03
21FF1D	18F3
OEOC	21FF1D
71	0E00
01001E	71
21FF1F	3E1E
02	ED47
C600	C9

A simple test routine for checking the operation of the HRG Board project.

Program 2

```
  1 REM "90 zeroes"
 20 FOR N=0 TO 7
 30 PRINT AT 7,1; "12345678"; AT 8+N,O; CHR$ (N+38)
 40 POKE 16514+N,0
 50 NEXT N
 60 POKE 16566,0
 70 INPUT X$
 80 GOTO 150
 80 IF LEN X$=3 THEN POKE 16566,1
100 POKE 16563,CODE X$(2)
110 POKE 16565,8-VAL X$(1)
120 RAND USR 16567
130 PRINT AT CODE X$(2)-30, VAL X$(1); CHR$ (384-LEN X$*128)
140 GOTO 70
150 IF X$(1)="S" THEN GOTO 180
160 IF CODE X$(2)=45 THEN GOTO 70
170 GOTO 90
180 INPUT X
190 POKE 16522,X
200 RAND USR 16524
```

16514	2A8940	C9	47
00	29	00	3AB540
00	29	00	FE01
00	29	00	2804
00	01001E	00	7E
00	09	2AB340	B0
00	010800	015C40	77
00	54	09	C9
00	5D	3AB540	3EFF
00	218240	3C	A8
00	EDB0	47	46
3E00	21FF1D	3E01	A0
ED47	3608	CB27	77
21FF1D	3E1E	10FC	C9
360C	ED47	IF	

The listing for Program 2, which can be used to define any new character on an 8x8 grid.

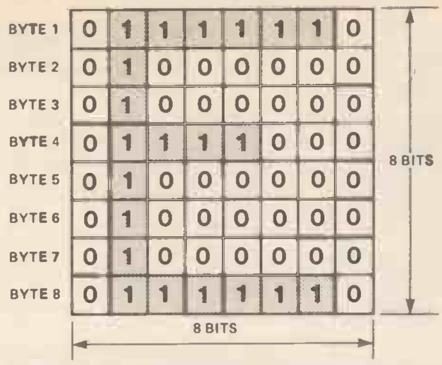


Figure 5. Character information is stored in memory as a sequence of eight bytes. Bits set to 'one' produce a dot, while bits left at 'zero' are not displayed.

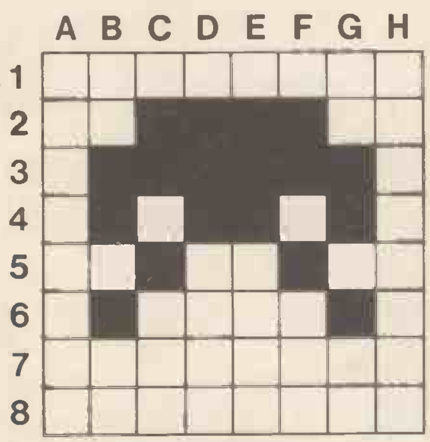


Figure 6. Program 2 allows new characters to be defined and displayed. This figure shows the set-up for defining new characters; in use, the new character 'shrinks' to normal size.

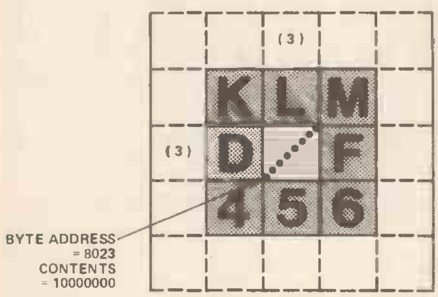


Figure 7. Illustrating the display method for graph plotting. The character ('E' in this example) is replaced by a dot pattern corresponding to the line segment to be plotted. Extended plots can be formed by joining line segments.

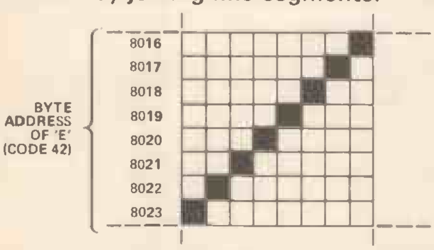


Figure 8. Detail of the line segment shown in Figure 7. The memory location of each byte can be calculated as described in the text.

Program 3

```
  1 REM"169 zeroes"
 10 RAND USR 16514
 20 FOR X=0 TO 63
 30 LET Y=X
 40 IF Y>63 THEN GOTO 90
 50 IF Y<0 THEN GO TO 90
 60 POKE 16507,X
 70 POKE 16508,Y
 80 RAND USR 16556
 90 NEXT X
100 POKE 7679,8
110 FOR C=0 TO 7
120 FOR N=0 TO 7
130 PRINT AT C,N; CHR$ (56+N-
C*8)
140 NEXT N
150 NEXT C
160 IF INKEY$ ="" THEN GOTO
160
170 CLS
180 POKE 7679,0

    16514       90
    D3FD        47
    3E00        3E07
    ED47        90
    21FF1D      47
    0E0C        CB24
    71          CB24
    01001E      CB24
    21FF1F      7C
    02          81
    C600        8F
    ED42        2600
    2803        29
    03          29
    18F3        29
    21FF1D      48
    0E00        0600
    71          09
    3E1E        01001E
    ED47        09
    D3FE        E5
    C9          0605
    00          21FF1D
    3A7B40      0E08
    47          71
    CB38        10F8
    CB38        E1
    CB38        B2
    48          E5
    CB20        57
    CB20        D3FD
    CB20        3E00
    90          ED47
    47          0605
    3E07        21FF1D
    90          0E0C
    1601        71
    2805        10F8
    CB22        E17A
    3D          7A
    20FB        77
    3A7C40      0605
    47          21FF1D
    CB38        0E00
    CB38        71
    CB38        10F8
    60          3E1E
    CB20        ED47
    CB20        D3FE
    CB20        C9
```

The small-screen graph plotter program; to plot any other graph just change the function in Line 30; eg to LET Y= SIN X to plot a sine curve.

location (8 * 42 + 7680) = 8016. Then every time that the HRG unit was turned on by POKEing 7679 with 8, the new symbol would be printed on the screen whenever the program would normally have printed 'E'.

Graph Plotting

Programs 3 and **4** are essentially the same — both plot a high resolution graph — except that Program 3 runs in 1K and uses only a portion of the screen while Program 4 needs 16K and displays over the whole screen. The resolution is the same for both.

Since they are so similar, we will briefly describe only Program 3. It works by consecutively printing a block of the first 64 charcters from the ZX81 set in an 8 x 8 grid at the top left of the screen, so that each character has a specific screen location (actually these 'characters' are printed as blanks, but each corresponds to a specific characer-code, so the effect is as described).

Then the blanks are filled in with dots corresponding to the points to be plotted. This is done by calculating the location in memory of each of the eight bytes defining a character, then storing a new byte there depending on whether or not there are points to be plotted.

For example, the character 'E' (Code 42) will be 'located' on the screen at a postion three rows down and three rows across. The bottom row of dots making up this character is located in memory at

$$7680 + 8 * 42 + 7 = 8023.$$

Now if a single dot is required to be plotted at a postion corresponding to the first dot on the left, all that is required is for the byte 10000000 to be stored at location 8023, and the required point will be plotted.

The difference between the 1K and the 16K programs is that instead of arranging all 64 Sinclair characters in a grid, it first calculates the screen position where the point is to be plotted. A 'blank' character is then printed at that position, and the appropriate byte filled in to produce a single dot at the required co-ordinates.

All 64 characters are used, so that when the 64th has been printed on the screen, no more points can be plotted — easily, that is. It *is* possible to re-use characters, eg to create a line drawing such as the one on the cover of this issue by joining line sections together. However this is not the place to explore these possibilities — the technique requires fairly clever programming, however — something that will keep HRG owners busy for some time!

STOP PRESS: Owners of late-model ZX81s may find that the ROM is soldered directly into the PCB, rather than plugged into a socket. A different method of connecting the HRG board must be used with such computers – turn to Buylines, page 34, *for further* instructions. **HE**

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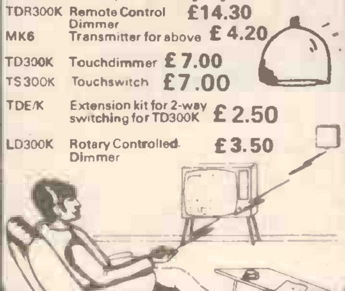

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This KIT contains a purpose designed lock IC, 10-way keyboard, PCBs and all components to construct a Digital Lock, requiring a 4-key sequence to open and providing over 5000 different combinations. The open sequence may be easily changed by means of a pre-wired plug. Size: 7 x 6 x 3 cms. Supply: 5V to 15V d.c. at 40uA. Output: 750mA max. Hundreds of uses for doors and garages, car anti-theft device, electronic equipment, etc. Will drive most relays direct. Full instructions supplied. **ONLY £10.50**

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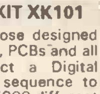

DLZ1000K
A lower cost version of the above, featuring undirectional channel sequence with speed variable by means of a pre-set pot. Outputs switched only at mains zero crossing points to reduce radio interference to a minimum. **Only £8.00**

Optional opto input DLA1
Allowing audio ("beat") —light response. **60p**

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ALL ELECTRONICS relies on electricity being controlled, and anything which we call electronic controls electricity; so, the best introduction to a series such as this must be to explain what electricity is. This is essential so that we can understand just how it *can* be controlled.

To make things as simple as possible let's think of electricity as being a 'flow' of 'something' through metal. It's just like water through a pipe really, like the pipe shown in **Figure 1**.

Water is flowing throught he pipe from left to right in the Figure, but it could run equally well from right to left — it all depends on whether the pressure of water is higher on the right (in which case the water flows from right to left) or on the left (when flow will be as in the Figure). Water will always flow from wherever the pressure is high to where the pressure is low. In a water system this pressure normally comes from the effects of gravity (**Figure 2**).

In **Figure 2** is a water tank similar to the one in your home. At a distance 'h' below this is a tap; when the tap is open, water will flow from the area of high pressure (the tank) to the area of low pressure (the tap). This pressure difference depends largely on the height, h. A good example of this can be seen in the rate of water flow between an upstairs water tap and a downstairs water tap in a house. Generally speaking the greater the distance h, the greater the flow rate of water out of the tap, because the greater is the pressure difference.

Another method of creating a pressure difference in a water system is to use a pump. A pump can make a pressure difference occur in a level system (**Figure 3**) or even uphill ie, against gravity (**Figure 4**).

The pump in a central heating system does just this, forcing hot water around

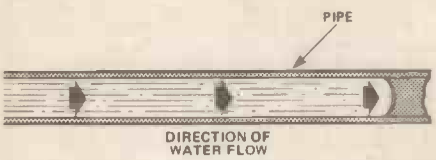


Figure 1. Water flowing along a pipe.

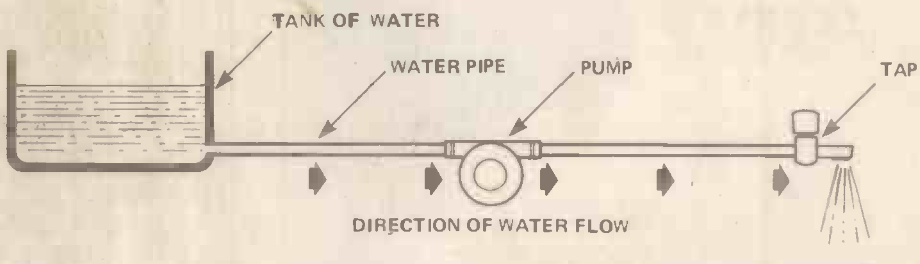


Figure 3. How a water pump can be used to create a pressure difference and cause water to flow along a pipe.

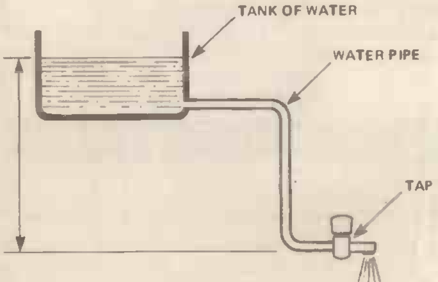


Figure 2. Simple domestic water system. The water tank is at a height, h, above the tap.

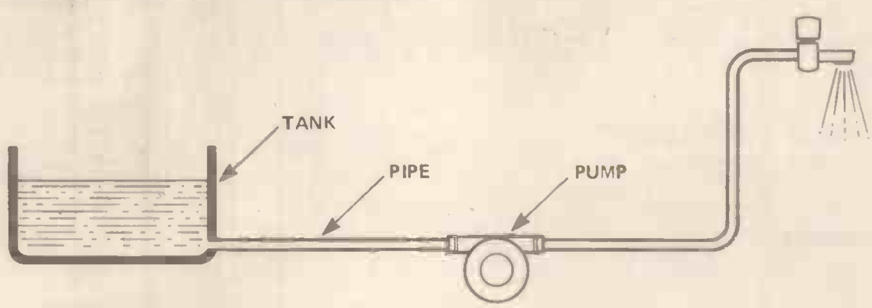


Figure 4. A water pump can also make water flow upwards, against gravity.

all the radiators in the system. In **Figure 3** and **4** of course, the pressure difference now largely depends on the strength of the pump and has little to do with the distance between pump and tap.

Things are very, very similar in an electric system. A simple one is shown in **Figure 5** with a battery and bulb along with connecting wires. If you remember, I said earlier on that electricity is simply a flow of 'something' through metal. Well, the connecting wires of the circuit are metal, and they are equivalent to the pipes in a water system. The battery is a source of electricity — in the same way that the tank in **Figure 2** is a source of water. The bulb is just an indicator to prove that there actually is something flowing through metal in our simple electrical system, just like the tap showed water flow. Of course the bulb should light — try it if you don't believe me — but why? What is actually flowing through the wire which can make the bulb light up?

Particularities

To find out the answer to this question we have to look at the structure of metal itself and of the individual atoms of the metal. Any atom — not just an atom of metal — has a central 'nucleus' containing a number of particles called neutrons and protons. Neutrons (as their name suggests) are electrically neutral; protons, however, each have a single positive (abbreviated to '+ve') electric charge. Now, I'm sure you'll have heard the saying "opposites attract". Well, it is true of atomic particles too. Associated with every postively charged proton in the nucleus is a negatively charged particle. These are much smaller and weigh much less (only about 1/2000th) than a proton, but each particle holds an equal and opposite charge. These particles are called electrons, and they fly around the nucleus much like satellites orbit the earth. The feature which makes a metal atom different to most other atoms is the fact that metal electrons are relatively free to move — a metal nucleus doesn't mind giving up one or more of its orbiting electrons to the next nucleus as long as its place can be taken by another electron. So, by making a 'pressure' difference between one end of a row of metal atoms and the other end, we can create a 'flow' of electrons along the row in exactly the same way that water can be made to flow along a pipe. This pressure difference, in electrical terms, is known as electromotive force (abbreviated EMF), ie a force which makes electrons move. Get it? The EMF in the circuit of **Figure 5** is provided, of course, by the battery, and EMF is commonly referred to as voltage, or sometimes potential difference when referring to the difference between two voltages.

Nuclei of other materials, eg wood, plastic, glass, hold on tightly to their electrons and so, even with a large applied EMF, electricity can't easily flow through those materials. We say that metals conduct electricity and those other materials are non-conductors of electricity.

Sizing It Up

Just to give a rough idea of the size of the particles we're talking about, it is worth noting their weight. Believe it or not, one proton weighs:

0.0000000000000000-
00000000001672 kg.

That is, 1.672×10^{-27} kg. That's not a lot! A neutron weighs the same, but an electron weighs only 0.00056 of that, or 9×10^{-31} kg.

Little wonder we can't 'see' electricity if it consists of a movement of electrons. We can only see its effects — for example the lighted bulb in the circuit of **Figure 5**.

An EMF-atic Force

Electromotive force can be derived in a number of ways, the usual methods being:

i Chemical — dissimilar metals, immersed in a chemical solution eg, lead-acid car batteries, dry cells.

ii Thermo-electric — dissimilar metals are placed in contact and the junction is heated; the size of the EMF is dependent on the temperature of the junction.

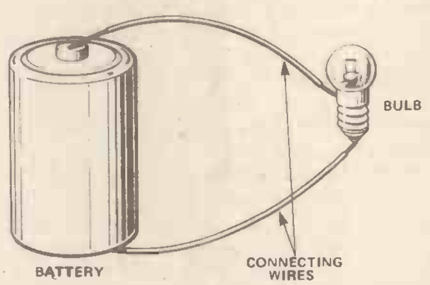


Figure 5. A simple electric system. A source of electricity (the battery) is connected to an indicator of electricity flow (the bulb) with metal connecting wires.

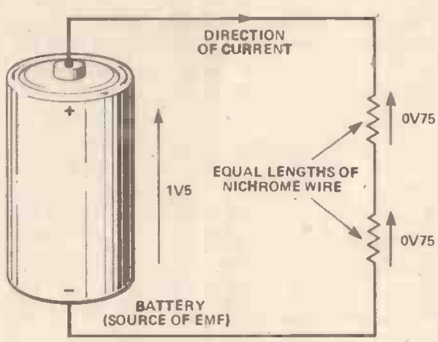


Figure 6. The battery, as a source of EMF, creates a current which in turn causes potential differences to occur across the two lengths of nichrome wire.

iii Electrostatic — friction can create free electric charges on the surface of a non-conductor, eg the old trick of rubbing a plastic ruler with a piece of cloth for a few seconds and then picking up small bits of paper with the electrostatically charged ruler.

iv Electromagnetic — when a conductor is placed in a changing magnetic field we say an EMF is induced in the conductor, eg a dynamo.

The term "electromotive force" is normally only used when we talk about the *sources* of electricity, such as a battery or dynamo. Where an electricity flow causes different voltages in a circuit then we call this voltage a potential difference (abbreviated PD). The general order of things then, is that an EMF creates an electric flow (more commonly called a current) which later on in a circuit produces a PD between different points in the circuit; an example is shown in **Figure 6**.

The EMF source is a dry-cell battery which has an EMF of 1.5 Volts (abbreviated 1V5). The battery has a positive (+ve) terminal and a negative (–ve) terminal. The voltage of 1V5 is shown diagrammatically with an arrow — we will show voltages between points in the circuit by arrows across the points, with the actual value of the voltage at the side and the arrow-head indicating which point is at a more positive potential.

There is another arrow-head in the figure — it indicates the direction of the electric current. But does it mean that the electrons are flowing from the positive battery terminal to the negative battery terminal? Think about it! Electrons are negatively charged, remember so no, it certainly does not mean this. Electrons must come from the negative battery terminal and go to the positive terminal (opposites attracting!) so, why do we show current flow as being in the other direction? The answer is that, long ago, when the effects of electricity were first observed, nobody knew the cause so they could not know the true direction of the current. Scientists of the time took an educated guess, defined positive and negative sides of an EMF and decided that it would be logical to presume that electricity flows from a more positive potential to a lower, more negative potential. They were wrong!

Electron flow is from negative to positive but, *by convention*, current flow is from positive to negative. It sound tricky, and sometimes causes problems, but you'll get the hang of it soon enough.

Back to **Figure 6** now, and you will see that there are two new things in the circuits, ie the two equal lengths of nichrome wire. Nichrome is an alloy of two metals, nickel and chromium, which displays an odd property — it doesn't conduct electricity as well as most metals. But there again, it is not a non-conductor. It's somewhere in between the two extremes, so that we say that it *resists* the flow of electricity.

Resistance

Because the two lengths of nichrome wire are equal, then the amounts of resistance to current flow in each length are also equal. We'll learn a lot more about resistance later on, but all we need to know about it now is that it is the property of part of an electrical circuit, which changes current back to PD in the general order of circuits which I've already told you about ie,

EMF ⟶ current ⟶ PD

Remembering that if two resistances in our circuit are equal, we can say that the PD created by the current flowing *through* each length of nichrome wire will also be equal *across* each length, and so we have 0V75 across each length of nichrome wire.

There are four important points which I'll stress before going any further, which are all illustrated by **Figure 6**.

1) Current flows *through* things, voltages (PD or EMF) are *across* things — don't get mixed up!
2) PDs in a circuit always add up to the EMF at the input of the circuit.
3) Current flow through a resistor causes a voltage to occur across the resistor.

Also, generally speaking, inputs to a circuit should be drawn on the left of any diagram of that circuit; outputs (or the effects of the inputs) should be drawn on the right.

Now let's take a closer look at the three new things we've learned about so far: current, voltage and resistance. These three things are inextricably tied together by such a basic electronic law that, in order to get anywhere in electronics, you must know how to use the law and you must also know what the three things actually mean. The law is called Ohm's law and is named after the discovering scientist. But before we look at Ohm's law let's study another, even simpler circuit — it's shown in **Figure 7**.

In the circuit you can see that the picture of a battery has been replaced by the standard circuit symbol for a battery. In electronics circuits symbols are always used because they provide a neat and standard way of drawing components — it's easy to understand and also easy to draw. For your reference there is a list of some of the more common components in **Figure 13**. Incidentally the resistors drawn in **Figure 6** and **7** were already symbolised, in case you hadn't noticed!

The EMF of the battery in **Figure 7** is 10V and the current is labelled by the symbol I; the arrow head beside I shows current direction. The resistance we'll call R for the time being. Now, if R is a measure of the resistor's resistance to current flow, it stands to reason that if we increase R we automatically decrease the current, I. In terms of a mathematical formula it just so happens that:

$I \propto \frac{1}{R}$ ($\propto$ means 'is proportional to')

In other words, if the resistance is doubled the current is halved, or if the resistance is quartered the current increases fourfold etc etc.

We can include the voltage across the resistor in this discussion, now, by considering what happens to the current if the voltage changes. Logically, we would expect the current to increase if the 'pushing-force', ie the EMF, increases. The change is in fact directly proportional and so:

$$I \propto V$$

Putting the two formulae together we can conclude that:

$$I = \frac{V}{R}$$

And, by multiplying both sides of the equation by R:

$$V = IR$$

Likewise, by dividing both sides by I:

$$R = \frac{V}{I}$$

So, what we've done is work out a set of formulae which, given any two of the three variables of current, potential difference or resistance, will provide us with the third.

Ohm's Law Rules

These written formulae are a convenient and useful way to remind us of the law I spoke about earlier on: Ohm's Law. The law actually states that the voltage across something is directly proportional to the current through it, and the constant of proportionality is its resistance! I'm sure you'll agree that the three forms of the formula:

$$V = IR, \text{ or, } I = V/R, \text{ or, } R = V/I$$

give us a much simpler method of remembering and using the law.

If you recall, way back in **Figure 6** the EMF (ie the voltage) of the battery was defined as 1V5 (where 'V' stands for the unit, Volts). But, up to now, there has been no mention of the units of current and resistance. The units were simply named after two scientists of the time who had done some of the great pioneering work in the study of electricity. The units of current are 'amperes' (abbreviated to 'amps') and those of resistance are 'ohms' (named after — guess who). Actually the units of EMF and PD, volts, are also named after a scientist — Volta — but in practice we tend to simply use 'volts' and 'voltage', whether speaking of a PD or an EMF.

We can now put values into the circuit of **Figure 7** to show how the three terms of voltage, current and resistance are interdependent. For example, let's have a resistance, R, of 5 ohms (written as 5R because 'O' is ambiguous). We know that the EMF of the battery, and hence the voltage across the resistor, is 10V and so, using one of the three formulae which can be used to express Ohm's law:

$$I = \frac{V}{R} = \frac{10}{5} = 2 \text{ amps (abbreviated to 2A).}$$

Similarly, if we know the current and the voltage we can calculate the resistance. For example if the current I, = 0A1 then:

$$R = \frac{V}{I} = \frac{10}{0.1} = 100 \text{ ohms (ie, 100R)}$$

Easy isn't it?

In electrical terms, quantities like 2A and 100R are commonplace, but when we get into the world of electronics, things differ. High amperage currents cause quite a heating effect, for example in an electric bar fire or even a simple light bulb (it's the filament glowing white hot which causes the bulb to light up). In electronics we're not at all interested in the heating effect and in most cases we want to reduce this as much as possible, so we use very low currents and very high resistances. Currents in milliamps, ie 1/1000ths of an amp or even microamps, ie millionths of an amp, are commonplace. Likewise resistances of thousands of ohms or even millions of ohms are often used. It's as well to get used to using such values in Ohm's Law calculations. For instance the current in a simple circuit, like that in **Figure 7** if a 50,000R resistor is used, is:

$$I = \frac{V}{R} = \frac{10}{50000} = \frac{2}{10000} = 2 \times 10^{-3}A$$

Incidentally, the usual abbreviation in electronics for a value such as 50000R is 50k, where the symbol 'k' tells you that the value is whatever the number is (ie, 50) multiplied by one thousand. The term '50k' stands for 'fifty kilohms'. Similarly, 'million' is represented by the letter M and stands for 'megohm'.

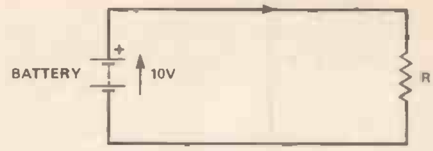


Figure 7. Showing an electric circuit, but using symbols for each component, not drawings.

Figure 8. Output voltage of a dry-cell battery is steady with time. We call this a direct current (DC) voltage.

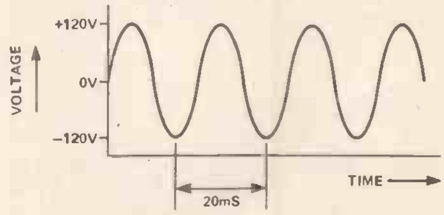


Figure 9. A graph of the voltage obtained from the mains supply. This is an alternating current (AC) voltage with a frequency of 50Hz.

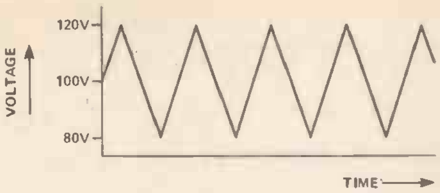


Figure 10. A triangular AC voltage of 40V, with a DC bias of 100V added to it.

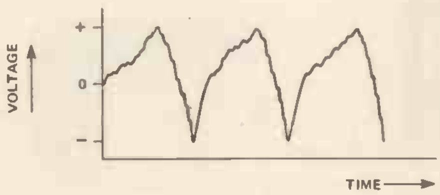


Figure 11. A 'piano-wave' AC voltage. It's the shape of the waveform which makes it sound like a piano.

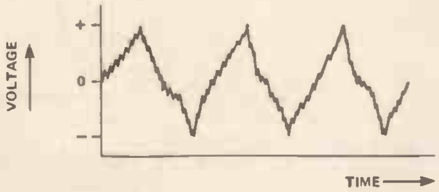


Figure 12. The waveform obtained from a violin.

In the same vein small values such as 1/1000 and 1/1000000 have letters: 'm' for 'milli' and μ (usually a printed 'u') for 'micro'. It probably all seems a bit daunting now, but don't worry you *will* get used to it — eventually it will become second nature to you.

AC/DC: Which Way To Turn?

So far we have discussed only one particular type of EMF. It's the type we get from a battery, where one terminal is always positive and the other is always negative. If we plotted the EMF on a graph with time along the bottom we would see something like that in **Figure 8**.

The voltage remains the same at all times; it is steady, and we call the current this type of EMF produces a Direct Current (DC). Similarly we call the EMF that produces such a current a DC voltage, because it creates a steady DC current.

But there is another type of current called Alternating Current (AC). A typical form of AC is that supplied on the national grid electric system, ie that used in house electric systems. The graph of the house electric EMF would be similar to that in **Figure 9**.

From this graph you'll see that the voltage swings between positive and negative peaks of 120V; it is constantly changing, or oscillating. One 'cycle' of the voltage starts at 0V, then goes positive, then back to 0V, then goes negative and finally back to 0V. If this takes 20ms (ie 20/1000ths of a second) then with a quick bit of mental arithmetic we can calculate that there are 50 cycles of the waveform in one second. This is the frequency of the waveform and is expressed as 50 Hertz (abbreviated to 50Hz), named after a famous scientist (no, he didn't invent rental cars).

The sort of voltage used in mains electricity supplies has a 'smooth' alternation of the style shown in **Figure 9** and is known as a sinewave voltage. There are other types, as you might expect, and they don't always oscillate around 0V: sometimes an AC voltage can have a DC component in them and could, for example, oscillate around 100V, as in **Figure 10**. Here you can see a triangular shaped waveform of 40V peak to peak (ie from top to bottom), but oscillating around 100V, so that we say that the waveform has a DC bias of 100V. There are obviously thousands of possibilities, many of which we'll explore in the months to come.

Sound Scene

The sound we hear is caused by minute differences in pressure being transmitted through the air. Our ears detect these air pressure variations and change them into signals which the brain can respond to, so we know that one sound is the sound of breaking glass, or another is a piano playing, for example. Now if we had a device which could change the air pressure variations which correspond to a sound into electrical signals, we could then plot a graph, which could be something like those in **Figures 9** and **10**. The device does exist, by the way, and is called a microphone. If we plotted the graphs for different sounds, we would then find that each sound produces a distinctive graph. Take, for example, a single piano note: its waveform might look a bit like that in **Figure 11**.

Yes, it's another form of AC waveform, but it's certainly not a sinewave or a triangular wave. In fact, we would be quite correct in calling it a 'piano wave', because all notes played on a piano, anywhere on its keyboard, would create a waveform similar in appearance to our example. It's the shape of the waveform which gives the sound the special characteristics (known as timbre) which allows us to say definitely "Yes, that's a note played on a piano". A note played on a different musical instrument, for example a violin, might look something like that in **Figure 12**. It's still AC, but is different again in appearance and hence sound, to that of a piano.

Electric Versus Electronic

We've now looked at a few typical circuits which are very common when studying electricity. But of course, this series isn't just about electricity is it? It's about electronics. One question you should have been asking yourselves all the while you have been reading this is — what is the difference between an electric and an electronic circuit? They are obviously very similar because they both rely on the flow of electricity, so where do we draw the dividing line?

Well, the answer is not simple. It is very difficult to give a cut and dried statement, but here are a few guidelines which will help:

- Electric systems are usually, but not always, high-voltage AC (eg, house mains systems) and electronic systems tend to be, but again are not always, low-voltage DC.

- Certain devices are used in both systems to control the flow of electric current. In electric systems these are always 'passive' devices (because they are *acted upon*) whereas electronic systems also use 'active' devices, which can positively influence a voltage or a current.

- In electric systems, inputs are generally EMFs which are used to create physical effects such as to heat a bar fire, turn a motor or light a bulb. In electronic systems, inputs can be *signals* (such as that from a microphone when a piano note is played).

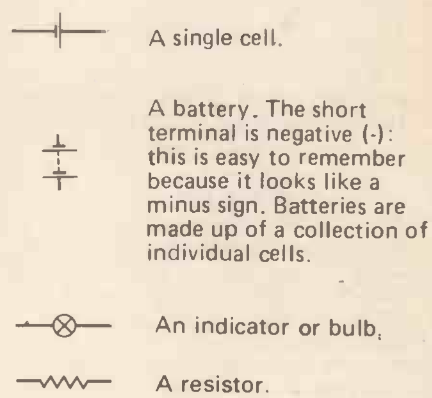


Figure 13. Symbols we've met in this instalment.

Summary

That's a lot, this month, especially if you've never studied electronics before, and there's an awful lot more to go. But the world of electronics is fascinating, and that always makes learning that much easier, because it's enjoyable.

All the topics we've looked at so far will be studied in greater depth over the months to come, so if there's anything you are not too sure about — don't worry — you'll get another crack at it later. You will find that everything in electronics has a simple explanation and the things which appear a mystery now will all become clear as you learn All About Electronics. **HE**

FORWARD BIAS

Questions, answers and errata from readers and writers.

EVER SINCE physical science established that the electron flows around the electronic circuit in exactly the reverse direction to the one adopted for the sake of convenience by physical scientists, electronics has proved a contrary art. The precision implied by Boolean algebra, Ohm's Law and M.O.D. specifications has very little in common with the everyday constructor (or, come to that, the everyday designer) labouring painstakingly with off-the-shelf components.

Things have been known not to work! And despite the most careful testing, debugging and resoldering, things have been known to continue not to work.

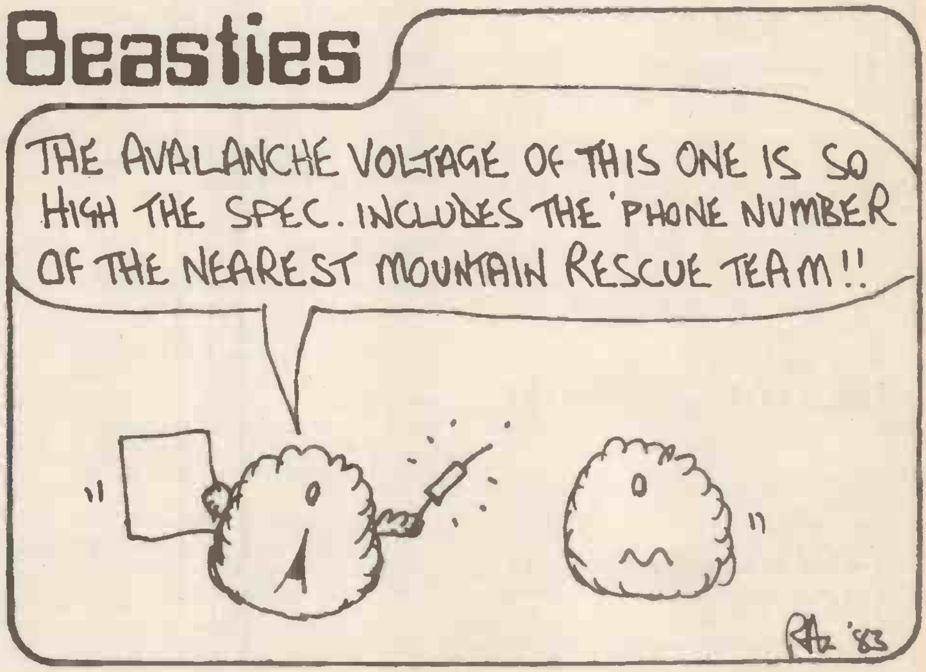
Mysterious grollies have been known to creep undetected into Hobby Electronics projects, no less, without even mentioning the dreaded scrambled circuit layout which rises up to haunt editors and designers, both of them striving to produce a perfect project to an economically viable deadline (bring on the violins!).

The agonies of the backroom boys are of little consolation to Hobby readers, trying to shake the bugs out of their precious projects without a clue to where the bugs are hiding. Very often, curing the obvious error dosen't provide the answer, and progress becomes (seemingly incurably) arrested.

The aim of this page is to help unstick the stuck by bringing together on one page circuit errors, readers' queries, modifications, readers' solutions and general advice directly relating to Hobby Electronics projects.

So that everyone can benefit from the feedback, we would like readers to write in not only with queries about projects but also with news of any successful or unsuccessful tussles they have had with a Hobby project, any methods or minor modifications they have adopted to get a project to work or work better, any responses to other readers' queries, or any errors they think they have detected which we may not know about. As many of the most useful letters as possible will be recorded here, along with any modifications from our own designers and any errata which we become aware of. This will include a regular listing of errata published in recent months to aid the occasional reader.

So don't keep your agonies to yourself. Share them! For personal replies please send an SAE as usual with technical enquiries (make it second class — first class is a trifle optimistic for this overworked office); we will still publish your communique if it's generally interesting.



And for a kickoff; a note from Owen Bishop, designer of the **BBC Micro/HEBOT Interface** (HE May '83). Owen writes:

"Yesterday we put HEBOT through its paces with the BBC micro again. It works very well, but looking back I think that one point needs clarifying."

"The input from HEBOT's sensors arrives at the computer along data lines D0 and D3. Data lines D4 to D7 carry no information at this time. Normally, a data line which is not connected behaves as if it has a high input, but it has been found that there is a tendency for unconnected data lines on the BBC machine to float when used with this interface. That is to say, the line may sometimes read as 1 and sometimes as a 0. It is 1 more often than it is 0, and there is a tendency for the effect to be most noticeable on line D4. This is possibly due to electromagnetic disturbances picked up from adjacent line D2 of the cable."

"This effect is easily eliminated by bit-wise ANDing of the data input with the value 15 (0000 1111, in binary). Variations in the most significant four bits thus disappear and we are left with a number which indicates the states of the lower four bits only."

"If the address of HEBOT is represented by the variable HEBOT, as in the sample programms, the command for reading HEBOT's sensors becomes:

X = ?HEBOT AND 15

The variable X then takes a value between 0 and 10, depending upon which sensors are activated (see Table 2, p. 11, HE November '82)."

Recent Errata

HE Starburst (HE September '79) see *Projects From The Past,* Points of View HE May '83.
Big Ear (HE December '82) see *Ear Errata*, Points of View HE March '83.
Microlog (HE December '82) see *Microlog Mistake*, Points of View HE March '83, and *Microlog Errata,* Monitor and PCB Printout HE January '83.
HE Echo-Reverb (HE May '82) see *Designer On The Dole*, Points of View, HE December '82.

Past Project Progress

There is now a PCB available from our PCB service for the **Low Cost Alarm** (HE December '82) — see the PCB Printout, HE June '83.
The troublesome **Telephone Timer** (HE June/July '82) is being re-examined from the bottom up by our technical team (all of him), but the solution is not yet on schedule for publication and probably won't be for some time. The **Echo Reverb** (HE May '82 may also be coming in for scrutiny shortly.

HE

BUYLINES

HRG Board

A complete kit, which includes all the components, the PCB and a case for the project along with a software tape, is being made available by **Cambridge Computing**, 1 Benson Street, Cambridge. The total cost of the package, including VAT, post and packaging, is £17.50.

The tape includes programs both for technical purposes and for games, and enables the user to immediately use the HRG unit to its full extent. Machine code programs for SAVEing and LOADing user-defined graphics, such as those generated by the Program 2 listing in the article, are included on the tape.

If any reader cannot successfully build the HRG Project, it may be sent back to Cambridge Computing, and for a nominal fee of £8.00 they will return it in working order.

In some Sinclair ZX81s the ROM is soldered directly to the board rather than plugged into a socket, so an alternative method of connecting the HRG unit must be used. The simplest safe method is to solder a 24-pin DIL header on top of the ROM; the DIL plug leading to the HRG can then be plugged in and the board itself tucked away neatly under the keyboard. In addition another wire must be run from the HRG board and soldered into the ZX81 PCB. Full instructions for this modification will be provided with the kit of parts supplied by Cambridge Computing.

Soft Fuzz

With a simple (but interesting!) project like this, all the components can easily be obtained from one supplier such as **Cricklewood Electronics**.

Everything is more or less standard and the usual substitituions can be made for the specified transistors if required — BC157, 177 or 307 for the BC212 or a BC237 or 317 for the BC182.

The component costs work out at around £5.00 excluding the PCB, case and the smaller odds and ends. The PCB can be obtained from the HE PCB Service (or you could make it yourself) and a suitable aluminium case (type RB1, 150x120x45mm) will come out at £2.70.

Stereo Spreader

No problem with this one, either. Around £5.00 will buy all the parts and components, including the case — and that's cheaper than rearranging the walls! Try **Europa Electronics**, 160 High Road, Willesden NW10 2PB, who stock all the components needed. Their cases are aluminium rather than plastic, but this is preferable, anyway, as a measure of insurance against hum.

Pop Amps

All of the components and parts used for these simple circuits are readily available from suppliers advertising in HE. Dedicated experimentors will already have most of the bits and pieces in their 'junk box', but newcomers trying out these circuits for the first time should try to build up a collection of components and parts; the best buys are available from bargain-pack dealers such as **BI-PAK**, who provide low-cost selections of resistors, capacitors and so on to the electronics world at large. Their address is **BI-PAK**, PO Box 6, Ware, Herts., or phone 0920 3182.

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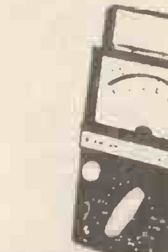

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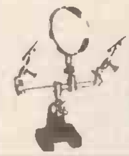

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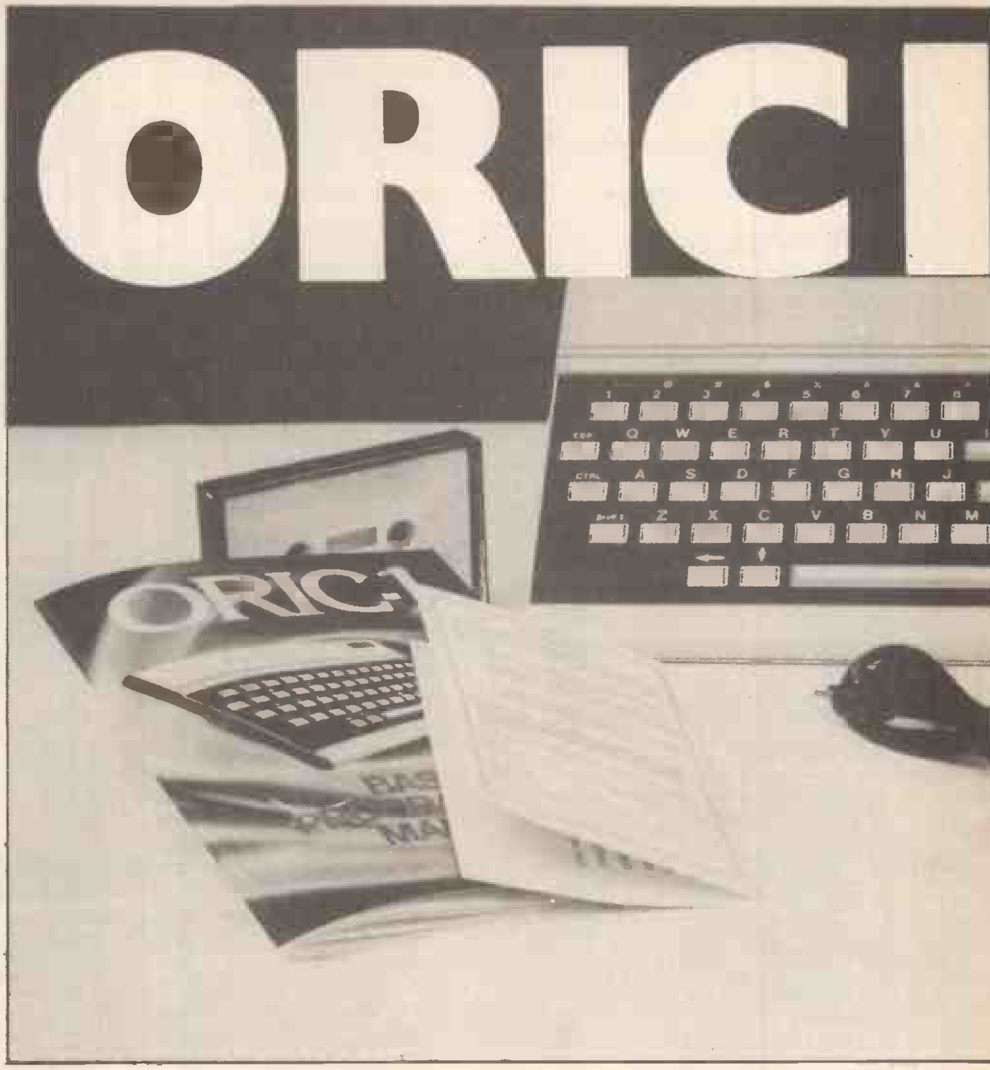
Mike Lord

WHEN Sinclair released the Spectrum in April 1982, the smell of sour grapes quickly filled the air. Several manufacturers immediately announced "me too" products to be available within six months. But now — over a year later — the only serious competitors to the Spectrum that have emerged are the Dragon and the ORIC-1.

The ORIC-1 is manufactured by a new company, Oric Products International, but the design was by Tangerine, who have been active in the computing scene for some time. Up the the time of writing this review, ORIC had been sold by mail order as well as through retail shops. But Oric are dropping the mail order side, presumably because of the growing sophistication of the buying public who are now realising that "Delivery within 28 days" is computer jargon for "Sometime this year or next" and therefore prefer to purchase what is actually available at their local computer shops.

A consequence of this move away from mail order will be a rise in the price of the 16K version to give sufficient margin to the retailer. It had been advertised (although not actually available) for £99.95, which was a lot lower than the £169.95 being asked for the 48K machines, or than could be explained by an estimated £15 difference in manufacturing costs.

One last comment before looking at the ORIC-1 in detail. Because of a natural desire to get the news to their readers as quickly as possible, most reviews of new machines are done on "pre-release" or "production prototype" models. This review is different; it has been written from experience with two real "production" machines, one purchased by mail order, the other from a local retailer. Any deficiencies reported will also have been experienced by the general buying public.



The Hardware

The first thing that strikes most people about ORIC-1 is the styling of the case and keyboard: it looks very smart. The case is a tough injection moulded assembly in light grey plastic with a black area for the keyboard legends and blue "go faster" stripes. The top of the case is tilted forwards — making the keyboard easier to use — by a wedge shaped piece which houses most of the electronics.

As usual, power is provided by a separate mains adaptor; in this case it comes with an integral 13A mains plug. Contrary to usual practice with small computers, ORIC-1 runs cool, with no signs of any overheating problems. One word of warning to anyone who has both an ORIC and a Spectrum; although their mains adaptors both give about nine volts out and both use the same type of plug to connect with the computer, *they are NOT compatible.* The polarity of the plug connections to the computer differs, so using the wrong adaptor with the wrong computer is bound to blow up something!

Key Facts

The keyboard layout is similar to that of a normal typewriter, with a proper space bar and the shift keys roughly where a typist would expect them. But you can't touch type on it; the hard plastic keytops are too small and you have to press each key with a slow, deliberate, action. The key legends are very clear and — like a normal typewriter — each key is normally only used to produce two symbols, shifted and unshifted. ORIC-1 hasn't adopted Sinclair's "single key" entry for BASIC words, which must be typed in letter by letter; the only abbreviation allowed is the use of ? for PRINT. All of the keys auto-repeat if you keep them held down.

As well as the normal shift keys, ORIC-1 has a CTRL key that can be used in conjunction with other keys to perform certain functions. For example CTRL/F switches the rather loud keyboard click on and off, and CTRL/T switches the keyboard between the Caps Lock and Typewriter modes. There are some potentially annoying combinations here for someone who accidentally presses the CTRL key instead of the SHIFT key below it; CTRL/O for example, which turns off the output to the display. These CTRL functions are not shown on the keyboard.

The keyboard also has four cursor movement keys — placed two at each end of the spacebar — which are used in program editing but could also be useful in the games programs.

An ESCAPE key lets you halt a BASIC program, but to halt the computer when it is running a machine code program or when it has hung-up because you have inadvertently POKEd one of the critical system variables, a Reset switch is cunningly hidden where it can only be operated by pushing a pencil through a small hole, cut for this purpose in the bottom of the case. It doesn't always work. Similarly, the power-on reset circuitry doesn't work properly on the author's machine, so after switching on the mains it is usually necessary to pull the power plug out of the socket on the back of the computer and plug it in again before ORIC-1 will set itself up properly.

Lighting Up

The display has two basic modes; a low resolution one which uses just over 1K of RAM, and a high resolution mode which takes up about 8K.

In the low resolution mode the hardware actually produces a display of 28 rows of 40 characters each, but the top row is reserved for an annoying

Hobby Electronics reviews the long-awaited new low-cost microcomputer.

CAPS message to show whether or not the keyboard is in the Caps Lock mode (as if you couldn't guess from looking at what you have typed in), and you can't normally print in the two left hand columns. When you reach the bottom of the screen it automatically scrolls up to make room for a new line.

ORIC-1 has two character sets, each of 96 characters plus their inverse video versions. At power-on one character set contains alpha-numeric characters — including both upper and lower case letters — and the other holds 'chunky' graphics symbols. Both sets use a 6 x 8 dot pattern for each character, and these are held in RAM so that you can easily define your own characters to replace any of the standard ones. You can select either one or the other of the character sets as "standard" for the whole screen or — by using a slightly complicated procedure — you can mix the two.

There are actually three variants of the low resolution mode: TEXT, in which you can get black printing on a white background, and LORES0 and LORES1, which set the screen up for white printing on a black background using one or the other of the character sets. There are other differences but they are minor, and anyway the new lines introduced when the screen scrolls up are always in TEXT mode.

Characters can be made to appear in any combination of double height and flashing, and in different colours.

The unusual feature of ORIC's display is the way these various attributes (colour, flashing etc.) are produced. Computers such as the Spectrum divide the screen areas of RAM into two parts, one containing the character to be displayed, the other containing data about the attributes to be used in displaying that character. To generate the TV signal, the hardware reads the contents of both areas in parallel.

The ORIC, on the other hand, has only one area of RAM to hold all of the information about the screen. Each byte of this memory area corresponds to one character position on the screen, and contains either the code of the character to be displayed or an "attribute" code. In generating the display, the hardware reads each byte in turn. If it sees a character code, it sends the pattern of dots which make up that character to the TV screen, but if it reads an attribute code, it uses the new value of that attribute for all of the following characters in that row. The character position on the screen corresponding to that byte in memory is shown as a blank space of the current background colour.

This technique — known as "serial attributes" — is used in Prestel and Viewdata and has the advantage of using the least memory space, but is more limited in terms of display versatility, as a blank space is left on the screen each time an attribute is changed.

In the HIRES mode you get a high resolution (200 x 240 pixel) graphics screen on which you can plot points, lines, or circles, with three rows of text at the bottom of the screen. These three text lines can be scrolled without affecting the high resolution area. The high resolution screen uses one byte of RAM for each six pixels, ie 40 bytes for each row of dots, or 40 x 200 bytes altogether. When you select HIRES mode, the screen background colour is set to black and the foreground colour to white, although you can change these using serial attributes just as in the low resolution modes; each attribute byte, then, gives a blank space six dots wide in that dot row on the screen.

In all modes, you have eight colours available for background or foreground: Black, White, Red, Green, Yellow, Blue, Magenta and Cyan. The border around the display area is always black. The TV display is clear and very stable except when a loud sound is being produced. The colour on a standard TV set is good when the TV and ORIC have both been tuned properly, but to tune ORIC's colour modulator takes very careful adjustment through a very small hole in the bottom of the case using a proper trimming tool. Hopefully this should not normally be necessary.

Sounding Out

Sound comes from an internal loudspeaker driven by the three channel 8912 sound generator chip. The level is more than adequate, and a wide range of sounds can be produced by an experienced programmer. For the less experienced, pre-defined sounds can be produced by the delightfully named words ZAP, PING, SHOOT and EXPLODE. Once programmed, the 8912 chip will generate all but the most complex sounds by itself, leaving the computer to get on with something else.

Like all other low priced machines, ORIC-1 uses your cassette recorder for back-up storage, and as with its competitors you need to experiment with the recorder settings to get reliable performance. A DIN-to-DIN cassette recorder connecting lead is provided, but you may have to modify it if you have one of those recorders that doesn't like simultaneous connections to input and output. Relay contacts are connected to the socket to control the cassette motor, where this is allowed by your recorder. Two recording rates are provided: the normal 1200 baud (about 150 bytes/second) and the "Super Reliable" 300 baud (30 bytes/second).

Surprisingly, there is no provision for verifying what has been recorded, although ORIC does appear to do some form of check when loading, as a poor quality recording will often give you a FILE ERROR — LOAD ABORTED message. You can save programs and defined memory areas (including the screen and character set areas of RAM) but the only way to save data is by working out where the variables are being held in memory.

Back Of The Bus

The back of the case holds the connectors for the mains adaptor and UHF TV output, plus two circular DIN connectors and two good quality ribbon cable connectors. One of the DIN connectors is used for the cassette recorder, the other provides TTL level R,G,B and Sync outputs for driving a colour monitor.

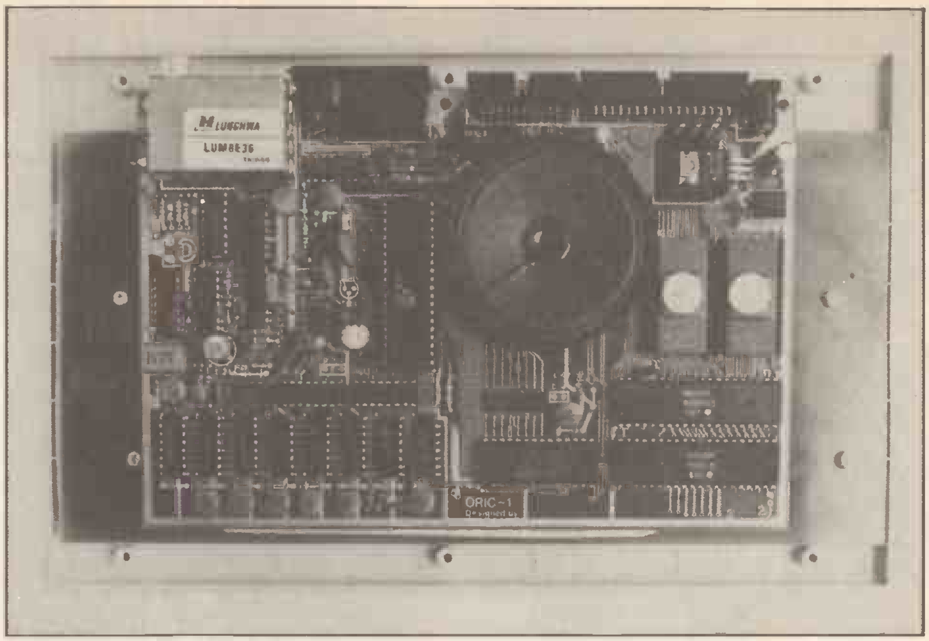
One of the ribbon cable connectors is intended for use with a printer having a standard Centronics interface, but on the models tested it wouldn't work properly with any of the three types of printer available unless the keyboard scanning routine was diabled by invoking a special machine language routine.

The other ribbon cable connector carries the system bus, and will be very useful for adding external devices. Control lines on this bus let you turn off the internal 16K ROM, and it would seem possible to replace it with external memory or with the "spare" 16K of RAM from inside the ORIC (48K ORICs use 64K RAM chips, the top 16K being normally disabled to make room for the ROM).

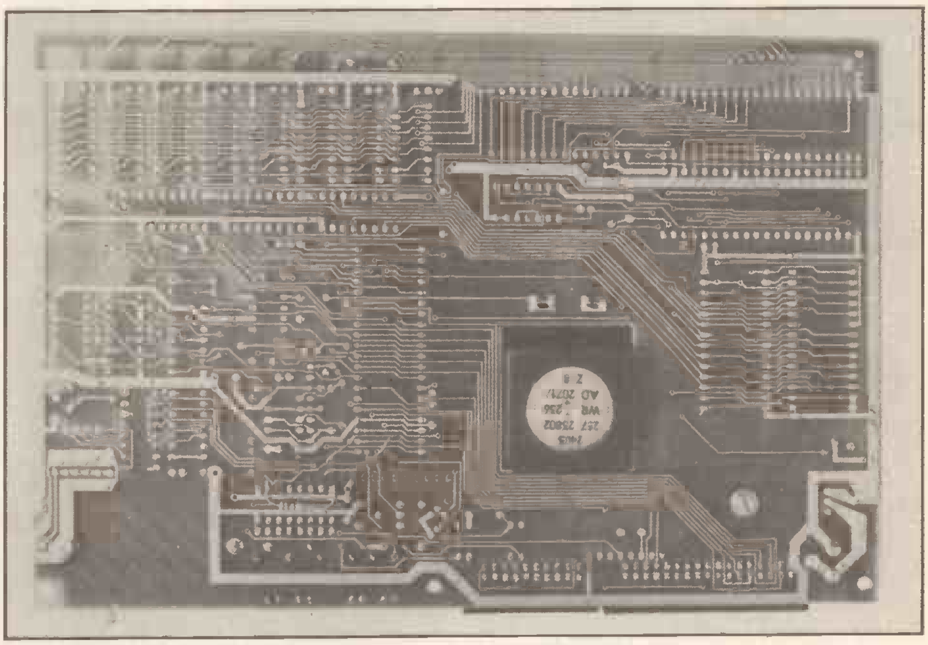
If you ignore the warning label and open up the case, you will find a very clean layout inside. The keyboard is on a large single-sided PCB which carries a smaller double sided plated through board holding most of the electronics.

ORIC-1 uses the 6502 processor chip, running at 1MHz, supported by a 6522 VIA to handle most of the I/O, the 8912 sound generator, and a 40-pin custom

IC which looks after the RAM refresh and the display. Memory is provided by eight 64K-bit dynamic RAM chips — presumably the 16K models will be fitted with 16K-bit chips — and two 8K byte ROMs. There are also several smaller chips used for various miscellaneous functions, an ASTEC UHF modulator, and a robust looking loudspeaker. Overall it looks as if ORIC-1 is more expensive to produce than the Spectrum, which could prove an important point when the price wars start in earnest!



The component side of Oric's PCB, with their custom RAM refresh chip to the left of the loudspeaker.



The elegantly laid-out track side.

ORIC BASIC

Is a bit like my garden: some nice spots, some that should have been done differently, and a fair population of bugs. It is a Microsoft-style BASIC with a considerable number of "enhancements".

Multi-statement lines can be used, but you are limited to a maximum of 78 characters; if you attempt to enter more ORIC beeps at you then — if you persist — ignores the whole line. The facilities for editing a program line are rather old-fashioned and much more error prone than the techniques used by the Spectrum or BBC machines; they are similar to those used on the Apple II. You edit by using the cursor movement keys to position the flashing cursor to the start of the line you want to change, then copy the good bits by typing CTRL/A and change the bits you want changed by typing in the new character(s). If you want to insert something in to the middle of a line you must first use CTRL/A to copy the line up to the point where you want to insert, then move the cursor to a spare part of the screen where you can type in the new part, then move the cursor back to copy the remainder of the original title line. Unlike the BBC machine, ORIC doesn't show you a 'fresh' version of what you are doing, so having edited a line it is always prudent to list it again to make sure that you have done what you wanted to do. You can list a single line, or part or all of the program, but there is no DELETE command.

Variables can be Floating Point, 16-bit Integer, or strings of up to 255 characters, and both numeric and string multi-dimension arrays may be used. Strings — even in array form — only take as many memory bytes as are actually needed; you don't have to declare the maximum length of strings. Variable names can be any numbers of characters long, but ORIC only uses the first two so that HE and HELL would be treated as the same variable. Lower case letters can't be used in variable names.

If you don't need high resolution graphics, you can GRAB the area of RAM it uses for your program and its variables. But it tends to GRAB too much, so that any strings used will overwrite the character sets!

REPEAT-UNTIL loops are provided as well as FOR-NEXT, but there is no WHILE construct. As seems common with most 6502 based BASICs, you are limited in the amount of nesting of FOR-NEXT or REPEAT-UNTIL loops or subroutines, and to the complexity of expressions, but in practice the restriction doesn't appear to be a very stringent one. PULL and POP instructions are provided to clean up the stack if you have to jump out of REPEAT loops or subroutines.

As well as IF-THEN, you can also use the IF-THEN-ELSE construct, but its use is limited by the number of characters you can have in a program line and because you have to be careful about exactly what you put before the ELSE word:

```
IF A>9 THEN END ELSE GOTO 100
```

for example, will never stop the program regardless of the value of A.

READ, DATA and RESTORE commands are provided for handling lists of fixed data, but you can only RESTORE the data pointer to the start of the first DATA statement in the program, not to the start of any chosen DATA line. Single line user-defined functions are provided by DEF FN.

Some new words have been added to BASIC to control the 8912 sound chip. As well as ZAP, PING, SHOOT and EXPLODE, there are three general purpose words: SOUND, which lets you set any of the three sound channels to produce a tone of defined frequency and amplitude, or noise; MUSIC, which is similar but uses musical note and octave numbers to define the frequency, and PLAY which is more complex but lets you control the 8912 chip's envelope generator.

Some nice features of ORIC-1 BASIC

for the machine code enthusiast are DEEK and DOKE, which are like PEEK and POKE but operate on two consecutive memory locations to handle a 16-bit value, and the ability to input or print numbers in either decimal or hexadecimal. You can invoke a machine code routine with either CALL(X), which runs a machine code routine starting at location X, or with USR(0) which runs a machine code routine that returns a value to the calling program.

Even nicer are the "words" '!' and '&'. The first is interpreted as a command to execute the machine code whose starting address is held at 2F5/6, while '&' is interpreted as an instruction to perform the machine code routine whose starting address is held at 2FC/D and which returns a value to the calling BASIC program. Using these two words, a skilled 6502 machine code programmer could extend ORIC-1 BASIC to include new commands and functions.

Print Where?

Perhaps the worst part of ORIC-1 BASIC is that concerned with printing onto the screen. The PRINT command itself does not have any equivalent to AT (although a machine code routine to partially overcome this lack is included in the manual), and there are bugs with TAB and with using commas as print item separators, so it is very difficult to print in a defined position on the screen. You can get round this by using the PLOT statement (!) as this puts a single character or a string at a defined position on the low resolution screen, but this means that you have to use something like:

```
PLOT 18,13 STR$(V)
```

to just print the value of the variable V in the middle of the screen, and it doesn't control the printing positions used by INPUT statements. I can't fall in love with a BASIC that forces you to do things like this! In the high resolution mode, the only way to print characters on the screen above the bottom three text lines is by using the CHAR command which plots a single character at a defined position.

The other high resolution mode commands are CURMOV and CURSET, which move the high resolution plotting cursor to a new position; DRAW, which draws a straight line; CIRCLE, which draws a squashed circle, and PATTERN, which is a fascinating new command that lets you draw different types of dotted lines. A FILL command is also documented and is supposed to fill in a rectangular area of the high resolution screen, but I am unable to get it to work sensibly. POINT tells you whether a given pixel of the high resolution screen is set to the foreground or the background colour.

PAPER and INK commands are available in the low resolution modes, but they only work properly in the TEXT mode, where they change the colour of the whole screen at once. To do anything more sophisticated, you have to include attribute control codes in PRINT statements as letters preceeded by CHR$(27), eg

```
PRINT CHR$(27); "AX";CHR$(27);"@"
```

to print a red X, or POKE or PLOT the control codes directly into the right positions in the screen RAM.

Unlike the Sinclair BASIC, the ORIC doesn't do any checking of the program when you key it in, although it does translate any BASIC words it can find to single byte "tokens". Once you are ready to run the program, ORIC's "Trace" feature can help you check it out by displaying the line number of each line executed in part or all of the program as it runs. In practice, the most likely causes of problems will be ORIC's habit of only taking notice of the first two characters of a variable name — so that what you casually think of as two separate variables are actually being treated as the same one — and the diligent way in which it searches for BASIC words in your line, even to the extent of ignoring the presence or absence of spaces, so that the line

```
10 LET VIOLET$="BLUE"
```

gives an error because ORIC mistakenly sees two occurences of the word LET, interpreting the line as

```
10 LET V10 LET $="BLUE".
```

As far as other features are concerned, ORIC-1 BASIC has the usual mathematical, trigonometrical and string functions, and seems to run about 50% faster than Spectrum BASIC — although, that machine is not noted for its speed.

The Manual

Apparently the ORIC manual had to be produced in a hurry, just before the first machines were due to be shipped. As a result it contains a fair number of errors, but the company were quick to include an errata sheet.

Because of the speed with which it had to be produced, the manual is quite brief for such a complex machine, and sometimes you wish that more information had been included. But, overall it is well written and quite humourous; the section on Using a Printer advises you on what to do if you get Japanese characters appearing!

To Come

Oric have been advertising a Communications Modem to go with the computer for some months now, but nothing has yet appeared. Similarly the FORTH language cassette which should have accompanied the computer didn't — but we live in hope. For the more distant future, Oric are talking of a fairly cheap disc drive and printer.

In Conclusion

It is a pity that ORIC had to be rushed out with a number of deficiencies in the software, and it will be interesting to see whether they simply ignore them or — as Acorn do with the BBC machine — charge you a "nominal" fee to replace the ROM with an updated version.

In theory, the ORIC-1 should appeal most to machine code and hardware enthusiasts who will be prepared to put up with the messiness of the BASIC to get a computer with a reliable bus connector and one in which machine code routines can be easily mixed with — or even replace — the ROM firmware. And given a good range of supporting software, its price and styling should also make ORIC-1 attractive to those whose primary interest is in playing games.

But because of the intricacies and inconsistencies of ORIC BASIC, I can't unreservedly recommend it to anyone whose main reason for buying a computer is to learn about BASIC — it may well put him off computing for life!

HE

READER'S PROJECT

Simple, untested circuits straight from Hobby readers

Simple Tremolo

G. V. Whitney, G8RSI

TREMOLO EFFECT is suitable for most electric guitars or organs, and it has the virtues of being both simple and cheap to build, using only two integrated circuits and a handful of components.

Circuit Description

IC1, a 566, is a digital waveform generator device that can be used as a VCO; normally it can deliver both triangular and square waveshapes but in this application only the former shape is used.

The repetition rate of the waveform is set by RV1 and C3, and with the chosen components a range of one to ten cylces is available — probably adequate for most applications.

IC2 is an MC3340 electronic attenuator IC, originally designed as a remote volume control for TVs etc., with a 50k pot attached via a long length of cable; however attenuation can also be achieved by varying the voltage on pin 2.

The output of IC1 is applied to IC2 via RV2, which allows the depth of tremolo to be adjusted for the best effect; the decoupling capacitor, C5, is deliberately large to allow operation down to low settings of RV1. The value of R1 is a compromise between maximum gain from IC2 (with SW1 open) and best variation of depth.

Component Selection

The prototype unit was constructed in a die-cast box, which happened to be about at the time! It actually had more holes in it than metal, so the largest hole was used to mount the foot switch (this was obtained during a local garage clearance and was intended as the "Dip-Main" headlamp switch on a Morris Minor! This type of switch is to be recommended as it is very strong!) Whatever type of switch or box is used, though, it must be capable of being abused: remember, you're going to stand on it!

In the prototype unit the on/off switch was combined with the input jack socket by modifying the earthing contacts on the socket; the negative battery connection was attached to the fixed switch contact and the moving "finger" arranged to contact with it when the plug was inserted. If you do not need this convenience, the switch can be combined with RV1 or RV2.

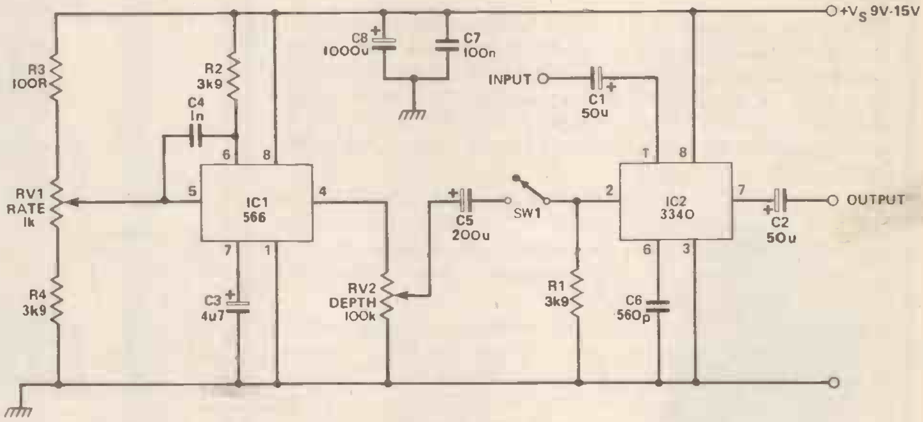
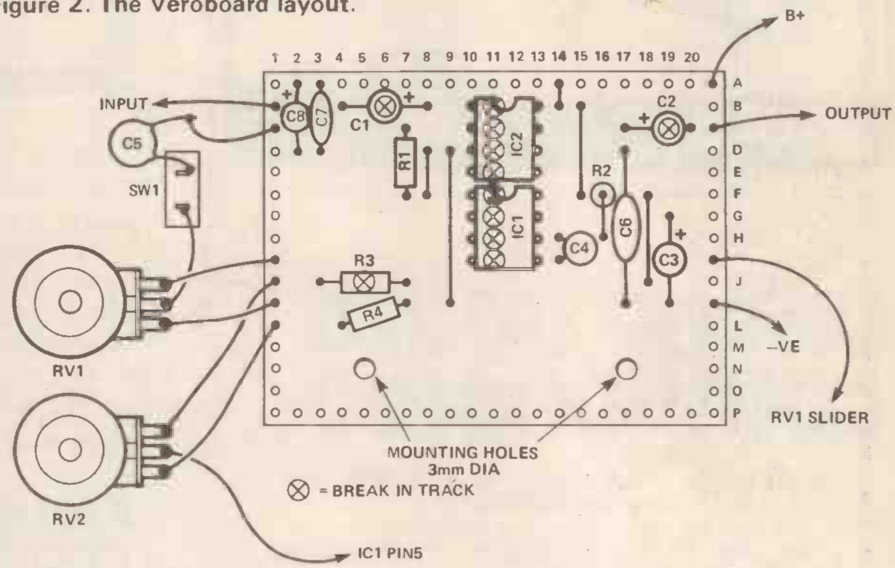


Figure 1. The circuit.

Figure 2. The Veroboard layout.



Hobby Electronics cannot undertake to answer queries on Reader's Projects.

Parts List

RESISTORS
(All ¼ W, 5% carbon)
R1, 2, 4 .... 3k9
R3 .... 100R

POTENTIOMETERS
RV1 .... 1k linear
RV2 .... 100k linear

CAPACITORS
C1, 2 .... 50u 10V aerial electro
C3 .... 4u7 16V axial electro
C4 .... 1n disc ceramic
C5 .... 220u 10V axial electro
C6 .... 560p polystyrene
C7 .... 100n polyester
C8 .... 1000u 16V axial electro

SEMICONDUCTORS
IC1 .... 566 VCO/waveform generator
IC2 .... 3340 VCA

MISCELLANEOUS
SW1 .... SPST heavy-duty foot switch
SK1, 2 .... ¼" jack sockets
SW2 .... see text
Case, approx. 110 x 100 x 50mm; Veroboard, 21 holes x 16 strips (110 x 90mm); nuts, bolts, wire, solder etc.

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7401	11p	7428	26p	7475	26p
7402	11p	7430	13p	7476	25p
7403	12p	7432	20p	7480	45p
7404	12p	7433	20p	7482	65p
7405	14p	7437	23p	7483	30p
7406	19p	7438	24p	7485	60p
7407	19p	7440	14p	7486	19p
7408	13p	7442	30p	7489	180p
7409	13p	7444	85p	7490	19p
7410	13p	7446	58p	7491	34p
7411	15p	7447	36p	7491	24p
7412	17p	7448	43p	7493	24p
7413	17p	7450	14p	7494	33p
7414	23p	7451	14p	7495	33p
7416	19p	7453	14p	7496	38p
7417	19p	7454	14p	7497	86p
7420	14p	7460	14p	74100	78p
7421	19p	7472	22p	74107	22p
7422	19p	7473	24p	74109	24p

CMOS

4000	10p	4020	42p	4042	38p
4001	10p	4021	40p	4043	40p
4002	12p	4022	45p	4044	40p
4006	50p	4023	16p	4046	40p
4007	14p	4024	33p	4047	35p
4008	36p	4025	12p	4048	38p
4009	24p	4026	75p	4049	21p
4010	24p	4027	20p	4050	21p
4011	10p	4028	40p	4051	42p
4012	15p	4029	45p	4052	48p
4013	20p	4030	14p	4053	48p
4014	45p	4031	125p	4054	78p
4015	40p	4034	140p	4055	80p
4016	20p	4036	249p	4059	430p
4017	30p	4039	280p	4060	42p
4018	45p	4040	40p	4063	80p
4019	25p	4041	40p	4066	22p

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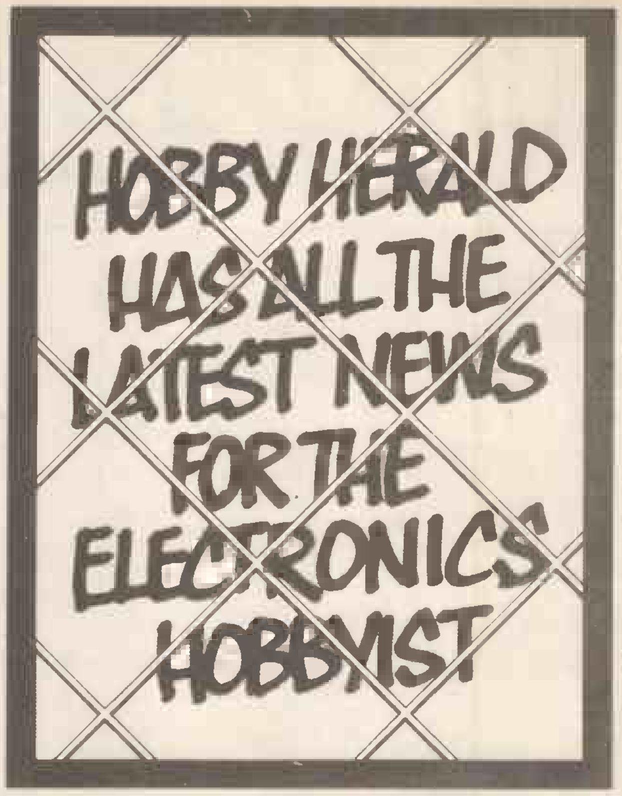

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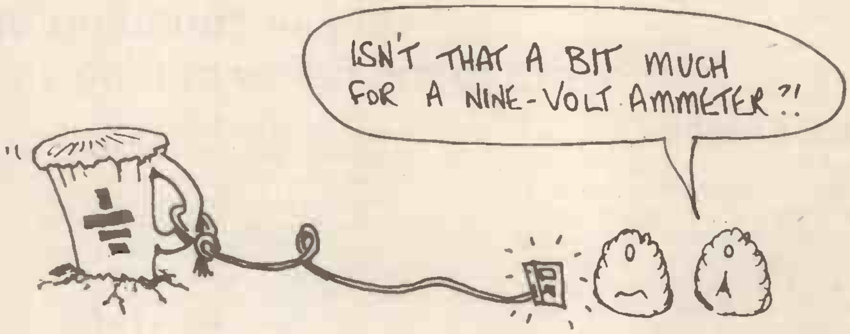
READERS' SERVICES

Feeling stumped? Looking for the right connection? It must be time to reach for HOBBY ELECTRONICS! Here's how . . .



Letters

While we are always happy to receive correspondence from readers, it is simply not possible for the editorial staff to reply to every letter. Because of staff limitations and the fact that producing the monthly editions of HE must take precedence, *we cannot even guarantee to answer letters accompanied by an SAE*. Hopefully this situation will prove temporary and we can shortly resume a full service to readers.

In the meantime, to reduce the amount of mail to which we attempt a reply, certain guidelines have had to be imposed:

- Letters from readers who have been unable to successfully build a Hobby project will receive first claim on our attention. But we urge readers to first make sure they understand the problem, and to read all parts of the article thoroughly: it is wasting our time (which is better spent ensuring that current projects are error free) to reply (to pick a common case) that the supplier of certain components is given in Buylines, on page 34.
- Many enquiries are concerned with drafting errors in circuit diagrams or component overlays; corrections for most errors have been published in subsequent issues, so please check your back numbers before writing to us — the information may already be in your hands.
- Where there is a definite problem, we ask that readers first try to solve the problem themselves: again, reading the article carefully will often resolve what appears to be a contradiction between, say a Veroboard layout and the circuit diagram.
- If it is necessary to write, please try to supply useful information: it is impossible to give constructive advice to the reader who says "My project doesn't work. Can you help?". The short answer, and the only one possible, is *no*!
- We would like to hear from any reader who has had difficulty with a Hobby project and who has come up with a solution, but we cannot advise when a project has been modified and fails to work: if you decide to make changes you will have to live with the consequences. Similarly, we are pleased to take readers suggestions for projects they would like to see in the magazine, or for modifications to improve a published project, but we cannot design circuits on request or re-design a project to suit the requirements of a single reader.
- We will try to answer any readers' questions on electronics in general, to suggest sources for components for old projects or to offer whatever advice we can when circumstances permit; however, we cannot advise on the purchase, use or modification of commercial equipment.
- We are unable to advise on the purchase of components in foreign countries; overseas readers are advised to read carefully the advertisements placed in HE by mail-order component suppliers and to write to them directly (this advice also applies to many UK readers wishing to obtain components for projects!).
- Unless specifically requested to the contrary, any letter to Hobby Electronics may be selected for publication in the magazine, including letters with an SAE if they are sufficiently interesting; in such a case a copy of the editorial comment will be returned to the reader prior to publication.
- Letters not accompanied by a stamped, self-addressed envelope may be selected for publication but will not receive a personal reply. We will attempt to reply to all enquiries backed by an SAE (if writing from outside the UK please include the correct number of International Reply Coupons, available from Post Offices) but we cannot guarantee a reply, nor can the publishers, Argus Specialist Publications, be held legally responsible for the accuracy of the information supplied.

Writing For HE

- Hobby Electronics' editor is continually looking for good projects, ideas for projects and designers to develop an idea into working project.

However unless you are already a seasoned contributor, it is unlikely that your first effort will reach the standard required for publication in the magazine. So if you have an idea or a design and you personally think it would be suitable as a Hobby project, write and tell us about it — and please include a telephone number (night or day, we're open all hours here) where you can be contacted.

Similarly if you are a designer, perhaps with time to develop someone else's ideas, please write or phone the editor!

Any Old Rope?

We will also undertake to publish any suitable but undeveloped ideas as experimental "Reader's Projects". The article will generally fill one page when published and should include a circuit diagram and description, parts list, component overlay (the projects should generally be on Veroboard) and some brief suggestions as to how the device might be constructed by the adventurous reader! A working prototype will not be needed, and the flat rate for Reader's Projects will be £20.

Simple circuits are also needed for publication as "Short Circuits"; no constructional information is needed, and contributors of "Shorts" will be rewarded with £10 per idea.

The Back-Log

The above guidelines for writing to Hobby Electronics have had to be drawn up in response to the growing pile of yet un-answered letters from readers.

We apologise to all those still awaiting a reply; we are doing everything possible to clear the jam, but to enable us to do so in reasonable time we are retrospectively imposing the above restrictions on the type of enquiry with which we will deal. Therefore, any letter or question not relating to a Hobby Electronics project or a general electronics enquiry will be returned, with the SAE, to the reader. HE

POINTS OF VIEW

Feel like sounding off? Then write to the Editor stating your Point of View!

Gerbil Grumbles

Dear Sir,
Our team have recently acquired a copy of the April edition of your electronics magazine. One project detailed caused some very grave concern and is now receiving attention in our laboratories. We understand that "Hobby Electronics" is mainly aimed at the amateur enthusiast and, in view of this, we would like to draw your attention to the "Radio-controlled Gerbil" article, which we consider highly unsuitable for the average constructor. Insufficient construction data is given and we consider the advice on a Grid power supply unsafe and irresponsible on your part.

It is no wonder that British Technology cannot progress if this project reflects the standard of British engineering. Furthermore, we can assure you and your readers that NATO missiles have sufficient fail-safe devices to prevent any blanket radio signal from launching them prematurely.

Finally, we would appreciate any information as to where we can obtain the old bed spring.
Yours faithfully,
Winston Weinberger,
Shuttle Command Navigation Lab.,
National Aeronautics and Space Administration,
Alabama,
USA.
via Wimbledon, SW19

We're deeply honoured that the Shuttle Command Navigation Team from NASA have found the Radio-Controlled Gerbil fascinating. Yes, boys! We have a lot in common — they said the gerbil would never get off the ground, either.

About the power supply: our technical teams make a point of scouring junk shops and dumps for inexpensive components, and I have it on good authority that we obtained the last dozen or so of this unit; everyone else will have to make do with digital watch batteries.

As for the old bed springs, we must stress *old*: new springs are too powerful for the bounce/weight ratio of the gerbil and are only suitable for Radio-Controlled Fleas, a project I would not recommend to anybody who does not have a gerbil. So it's back to the dump. If you should meet Mr. Bradshaw there, please introduce yourself. He may be able to help you on the subject of valve technology.

As I said, we are deeply honoured and humbled by your kind interest and would like to mail this reply to you personally, but what can you do with people who just won't send an SAE?

Bearing that in mind, please pass on the following messages: To Mr. Scuttle: well done! You are only the second person, after my six-year-old niece, to spot our little joke about the Eprom Programmer! All the rest of our readers have taken it quite literally, and most of them have actually got it working, poor ignorant fools! To Mr. Bumphrey: Go on! See if we care. It'll hurt you more than it hurts us. To Mr. Smyth of British Telecom: why don't you sort out the Ham and CB interference before you pick on defenceless rodents? To Miss Hopeful: The Editor has his gerbil working nicely, thank you, and so gracefully declines your own offer to nibble his toes for him. As for the so-called Mr. Wakely of Wimbledon: You don't expect us to be taken in by a stupid pseudonym like that do you? And someone who sends his binders to the vet? Do us a favour. Stick to getting your shuttles off the ground and don't try to fool the experts. Now, onto some real business:

Dear Sir,
As a regular reader of your mag, I bought a copy of the April '83 issue while dashing for the train. The bit that caught my eye was that round red bit on the cover. I've been into radio control models for some time, and thought to educate myself some more. If I'd required the mickey taken, I would have bought a comic. As it is I think you should refund my money for selling me something under false pretences. I expect that a lot of other readers like me will think twice before buying rubbish like this again.
Yours most sincerely,
G. G. Bullivant,
Gosport,
Hants.

Dear Sir or Madam,
I have two sons both at school, both interested in electronics including electrical circuits. In fact one spends most weekends tinkering about with such things.

His pocket money is £1.50 per week plus any money he saves by walking to school rather than taking the bus; most is spent on basic things which I know little about such as capacitors, transistors, copper enamelled wire, etc.

However, older son sees March issue of Hobby Electronics, and buys same for the first time, seeing that on page 18 that there is a "Radio Controlled Gerbil" project for next month, great, thinks young son, waits for publication, beamingly walks into paper shop and buys April issue, what disappointment, whole thing appears to be a joke. Perhaps to ardent publication supporters it is and they expected it, however, I wonder whether they would feel the same had they spent 53% of their weekly wage on something treasured in the imagination, only to find it was a let down.

Your serious observations would be most welcome as I draw this matter to your attention. I wonder whether you are aware of such young subscribers and indeed their gullibility with regard to such matters having indeed not become part of our adult world yet.
Yours sincerely,
J. Hedger, Assoc. Mem. ASEE, Dip. Eng. Man.
Abbey Wood,
London SE2.

Speaking as one who has never bought so much as a copy of *The Beano* since the age of nine without first inspecting the contents, I think this may be a problem related to personal philosphy rather than age. Mr. Bullivant's plight seems to bear this out; in fact the adult commuter may be the most vulnerable of all periodical buyers, as the alternative, being stuck on a train with no reading matter, is too terrible to contemplate. But we do take your point, and hope you will forgive us for taking the mickey just once a year. Of course, every little bit helps to keep our printers, typesetters, designers, sales team — not to mention we editors — from becoming digits in the unemployment statistics, so we need you!

We would like to offer both Mr. Bullivant and Master Hedger consolation in the form of any one of our back issues, or forthcoming issues, as a replacement for the April issue, so if you will let us know which one you would like, we'll send it on to you.

Don't everybody rush! These good readers can claim their consolation prize for the determined initiative they showed in making their feelings felt. The complaints departments is now closed!

PS. We don't want mail from everybody else who has spent 53% of their weekly wage on something treasured in the imagination, only to find it was a let-down, either . . . even people who bought the Men at Work album.

(Thinks: we wonder how the gentlemen at the RS Components Technical Department are getting on with the Gerbil? can we expect to see the correctly rated liquorice allsorts in the next edition of their Catalogue?)

Shock! Horror!

Dear Sir,
Many years ago as a lad we could buy Shocking Coils run on a 4V5 battery, with a trembler and two wires and on the end two bits of brass tube.
Have you any plans for the same, or know where I could get the same?
Yours faithfully,
F. S. Clarke,
Horsham,
Sussex.

Don't tempt us! We like pranks as much as the next person (as long as we aren't the victims, of course . . .) but as celebrities and responsible members of the community we can't, alas, condone or advise on the administering of electric shocks to innocent parties (this does not include members of the Video Today staff) in case somebody has a heart attack and sues us. Besides, we have our hands full already with the Radio Controlled Gerbil terrorising the public!

Attention All Beginners

Dear Sirs,
I have been fascinated by electronics for years, but until recently all my time has been taken up by building up my own small business.
As a new reader of HE I wonder if you could recommend a method of learning about electronics, starting at the most elementary level that I could study at home, at my own pace.
I would also be very pleased if you could recommend any suitable books for the adult absolute beginner, thank you.
M Gadd.
Dudley,

Well, a new series for the complete beginner — whatever his or her age — will be starting in HE very soon. And then there was the first series of all, Into Electronics, which appeared in HE between November '78 and June '79 (inclusive). These issues are out of print, but photostats are available at £1.50 per article (ie per issue) from our Backnumbers service (see page 47 in this issue). That series was aimed mainly at 'O' level students and was extremely popular. If you write to Bernard Babani (Publishing) Ltd., The Grampians, Shepherds Bush Rd., London W6 7NF and ask for their catalogue, you will find many small books of circuits for inexperienced constructors there and you can choose at your leisure. And there is absolutely no subsititue for 'hands on' experience in construction. A book of breadboard projects is a good place to start because you can build up the circuits and tear them down again without hours of desoldering. And don't be too reluctant to check out books aimed at younger readers — they are sometimes the best and easiest way to get a good grasp of the fundamentals of any new subject. Good hunting!

Solar Panels Again

A reader writes:

Referring to Points of View March 1983, 'Heat But No Light', if Mr. O'Neill is referring to the BPX47A panel, I notice that the panels which are identical to the BPX47A (except that they have thirty-six cells instead of the BPX47A's thirty-four) are used in Chichester Harbour for charging up batteries on navigation beacons. I believe the harbour is under the control of the Portsmouth Harbour Authorities who might be able to tell you where they got the panels from. If it appears that they do not maintain the lights, then try Trinity House.

EPROM Interfacing

Dear Sir,
I would like to know the way to interface the EPROM programmer to my BBC Model B. As a regular reader of Hobby Electronics, I find that article most interesting. I have already bought all the parts for the project, but now I am confused because I don't know how to interface the programmer to my BBC micro and I don't know how to write a simple software to drive it.
Thanks.
Yours faithfully,
Joseph Obi,
London N16.

We do have plans for a variety of interfaces for the HE EPROM Programmer in due course, so keep watching.

Personal Project

Dear Sir,
I'm a regular reader of your magazine, ever since I picked up your November '82 issue at the local newsagent. Your magazine is very interesting, especially your page.
I haven't built any of your projects so far because I haven't found any that suit my requirements. I'm particularly interested in the personal stereo cassette recorder and I'm looking forward to building one. I hope my idea will be considered. It will be different to play a machine that you made yourself!
Yours sincerely,
Wing Lee.

Certainly no shortage of ambition here! What can I say to this determined gent, who not only reads his Hobby even when he isn't building a project, but plans to build his own personal stereo? I positively quail to admit that we are not very likely to do a personal stereo project, because the commercial companies have got it down to such a fine art that no magazine could possible compete with them — not a hope! By the time all the parts which are too complicated to make at home had been provided (including the case) there would be little left but the assembly, and it would still be more expensive and less reliable than the ones you can buy in the shops. So it's not feasible as a magazine project. Sorry!

Looking At TV

Dear Sir,
Recently I came across an article on Narrow Band TV. Unfortunately it was only the first article.
I have developed an interest in NBTV. Therefore, I wonder if you can supply me with any information or with a source of information.
Yours faithfully,
R E Dixon,
Putnoe,
Bedford.

Two articles in HE April and May '80 will tell you how to set up and use NBTV. You can purchase these articles for £1.50 each from our Backnumbers service. Alternatively, try the Encyclopaedia Britannica at your nearest library — they have detailed information on many technical subjects.

Soldering Iron Kit

Dear Sir,
Wishing to build the temperature controlled soldering iron (HE October '80) I wrote to the address given in Buylines at the end of the article, enquiring if the kit was still available.
Although I enclosed an SAE I have received no reply to my letter.
I'd be grateful if you would inform me (a) if Compu-Tech are still in business and (b) where the kit can be obtained if they are no longer in a position to supply it?
Yours faithfully,
H J Holland,
Salisbury,
Wilts.

Enquiries have revealed that Compu-Tech are still alive and well but have changed address. They are now at Worstead Labs, North Walsham, Norfolk NR28 9FA. Tel: (0692) 405600. They tell me that the kit now costs £15.38. Try giving them a call to start with; they may have received your letter by now. If no joy, write again.

Well, isn't that nice! A happy ending, by the look of it.

HE

BACKNUMBERS

February 1980
Passion Meter, Win Indicator, Short Circuit Special, Kit Review Special, Into Electronics Construction Part 1.

May 1980
MiniClocks, 5080 Preamp, Model Railway Track Cleaner, 5080 Loudspeakers, Loudspeaker Crossover Design, Radio Controlled Model Survey.

June 1980
Microbe Radio Control System, Egg Timer, Two Watt Amplifier, Fog Horn, Short Circuits, LEDs and LED Displays.

July 1980
Sound-Operated Flash Trigger, 18 + 18 Car Stereo Booster, Hazard Flasher, Electronics in Photography, Electronic Espionage, Piezo Electricity.

August 1980
EquiTone Car Equaliser, Pass-The-Loop Game, Gaztec Gas Detector, OP-Amp Checker, In-Car Entertainment Survey, Introducing Microprocessors.

September 1980
MicroMixer, Reaction Tester, Guitar Phaser, Development Timer, Teletext Explained, Into Digital Electronics Part 1.

October 1980
Kitchen Timer, Tug 'o' War Game, Light Dimmer, Freezer Alarm, Intruder Alarm, Temperature-Controlled Soldering Iron.

January 1981
Car Rev-Counter, Bench Amplifier, Sound-Into-Light Converter, Chuffer, Electronic Games reviewed.

February 1981
Heartbeat Monitor, High-Impedance Voltmeter, Medium Wave Radio, Two-Tone Train Horn, Audio Signal Generator.

March 1981
Public Address Amplifier, Windscreen Wiper Controller, Bicycle Speedometer, Photographic Timer, Microcassettes.

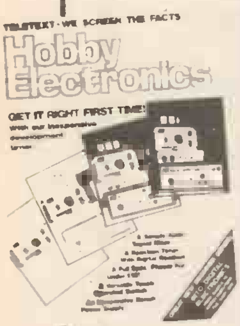
April 1981
Pre-Amplifier Part 1, Super Siren, Guitar Tremolo, Russian Roulette Game, Doorbell Monitor, Anatomy of a Space Shuttle.

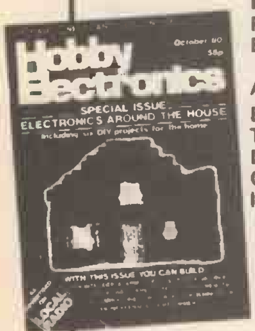
May 1981
Electronic Organ, Voice-Operated Switch, Infra-Red Controller, Pre-Amplifier Part 2, Audio Millivoltmeter.

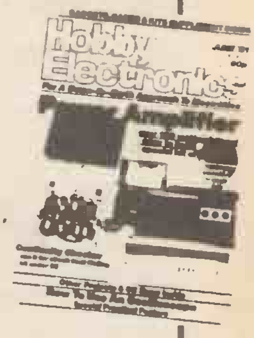
June 1981
Power Amplifier Part 1, Continuity Checker, Envelope Generator, Early Radio, Gadgets, Games and Kits Supplement.

July 1981
Burglar Alarm, Doorbuzzer, Treble Booster, Electronic Aids for the Disabled, Power Amplifier Part 2.

August 1981
Electronic Ignition, Thermometer, Electronic Organ (final part), RPM Meter, Bench Power Supply, Radio Control Survey, Into Electronic Components Part 1.







All of the 1980 issues, except January and April, are still available together with the remaining issues from 1981.

All backnumbers cost £1.50 each. For those of you who only want copies of articles, we do offer a photocopying service. Each copy costs £1.50 and information as to its title and publication date should be given. Ordering backnumbers and photocopies could hardly be easier, just fill in the coupon, cut it out and send it to the appropriate address.

HOBBY ELECTRONICS BACKNUMBER ORDER FORM TO:

513, London Road,
Thornton Heath,
Surrey, CR4 6AR
England.

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145 Charing Cross Road,
London,
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CAREERS IN ELECTRONICS '83

This month we look at the multi-layered career opportunities in British Telecom.

Graham McMorrin
British Telecom Features Bureau

THERE IS a great deal more to the telephone business than installing 'phones and chasing up faulty lines. British Telecom is an extremely large and diverse organisation at the forefront of world telecommunications. It offers a vast range of technical, engineering and electronics opportunities, as well as the scope to develop these skills further, both on the management side, and the purely technical. The convergence of telephony, computing and television technologies made possible by silicon chips microelectronics and advanced "macroelectronic" systems promises to make the next decade one of the most exciting in the history of telecommunications. British Telecom reckons itself to be well-equipped to meet the challenges that lie ahead: operating the world's fourth largest telecommunications system, Telecom is responsible for the planning, provision and maintenance of the country's local, trunk and international networks. It employs 246,000 people and invests £1,500 *million* a year. Technological developments have moved so fast over the past decade that today's telecommunications industry embraces a great variety of products, services and facilities — everything from satellite transmission to aids for the diabled; from radiopaging to installing domestic telephones — as well as executive technical management and high technology research programmes.

Telephone Numbers

There are already 28.5 million telephones throughout the country, as well as 6,600 telephone exchanges, 93,000 telex and 95,000 data connections, 77,000 public kiosks, and 300,000 rented payphones. A further 2,200 new telephones are installed every hour of the working day. About 57 million inland telephone calls are made every day.

Many skills and disciplines are needed to operate a business on such a scale, especially since British Telecom's current exchange modernisation programme means that four new electronic exchanges are being brought into service each week. As Britain's telecommunications system becomes fully digital, with the introduction of computerised System X switching systems, a faster and more flexible network will evolve, able to carry speech, text, data and television pictures. The importance of the electronics technician and research engineer will accordingly increase in proportion. In order to compete in a tough, rapidly evolving market, British Telecom has structured its business into four main divisions: Inland, Major Systems, British Telecom International (BTI) and British Telecom Enterprises, with further specialised sections in each. These are self-contained units, each demanding different combinations of technical and electronics expertise; together they represent a comprehensive approach to electronic telecommunications.

Planning Ahead

The Inland Division is the largest element, working on Telecom's existing electro-mechanical exchange systems, which will have to cope with the new microprocessor-controlled applications, making the best use of the massive financial investments which the organisation represents. Specialised technical and electronic engineering skills are also needed for the specification and definition of the planned Integrated Services Digital Network (ISDN), evaluating its possibilities and launching new services.

Another main technical role is preparing for a totally digital network by maintaining the performance of the existing transmission networks. Inland's engineering and scientific staff also provide sophisticated power supplies capable of the higher performance and efficiency required by modern digital switching sytems. Generally, this division has the responsibility for developing policies to ensure that British Telecom's network makes a smooth transition towards its own microelectronics revolution.

The Major Systems Division covers the broad disciplines needed for Research and Development, Procurement, Overseas Liaison and Consultancy. Its aim is to research, identify and exploit major new openings in communications technology, and its

BT runs a motor fleet of over 75,000 vehicles, from heavy duty maintenance trucks to delivery vans. Their 650 motor transport workshops are run by over 6,500 staff, most of whom are trained in their own Motor Transport Training School.

An engineer feeds a new page showing the now well-known British Telecom logo into the update computer centre for Prestel, the world's first public viewdata service, developed at BT's Research Laboratories at Martlesham.

work is centred at British Telecom's Research Laboratories at Martlesham Heath, near Ipswich.

Over 2,000 staff at the laboratories are involved in research; this includes the Advanced Switching Unit or Systems Evolution and Standards Department, and small formations of staff on other projects. The range of skills involved is vast, from objective and applied research, through advanced development, up to field trials, and the testing of new techniques, services and systems.

A Choice Of Fields

Current work includes: advanced semiconductor devices, materials, submarine cable systems, digital radio and line systems, telephone design, electronic office automation, video services, optical fibre systems, Prestel viewdata development, voice synthesis for computer-controlled exchanges, advanced Private Automatic Branch Exchanges (PABXs), packet switching, and general reliability studies.

Other centres for British Telecom's development handle such major projects as the entire System X development programme, signalling system development, local, junction and trunk transmission studies, and external plant and general customer apparatus. The development and co-ordination of Systems Evolution and Standards includes skilled staff necessary to establish the architecture and topology of future signal switching and related systems, with responsibility for engineering such services and Radiopaging and small digital exchanges and sub systems that are part of the System X family of exchanges.

Technicians representing the broad spectrum of computing and electronics are engaged in determining the best standards for components' manufacturers and suppliers, establishing servicing practices for daily use by Telecom's 126,000 general engineers, systems software engineering and designing data processing equipment. British Telecom designs are internationally competitive, so that as well as serving UK customers, a foundation is also laid for British exports. Teams of technical specialists are maintained to advise overseas administrations on British Telecom's technology, and to seek, develop and enhance UK export opportunities.

Across The Waves

The planning, provision and effective running of Britain's international and maritime telecommunications is the responsibility of British Telecom International (BTI). BTI's services range from international telephony, telex, telegram and Telemessage services, direct, privately-leased circuits from Britain to most parts of the world, data transmission via IPSS (the International Packet Switching Service), to Europe and North America, to the provision of specialist business communications with Western Europe, using satellites and small dish aerials located close to customers' premises.

In the field of maritime communications, BTI provides main telecommunications to and from ships at sea using conventional radio, and by satellite to suitably equipped vessels. Oil and gas in the North Sea are linked to the shore by trans-horizon microwave radio. To carry out its job efficiently BTI has developed a growing range of facilities, including operator exchanges and automatic switching centres for telephone and telex services, a variety of specialist coastal radio stations, satellite earth stations and a fleet of cable ships.

Covering such a range of activities, BTI needs a complete collection of engineering disciplines. Much of the engineering work is similar to that done by the Inland Division, including day to day running of the communication network, re-configuration and planning its growth and technical advancement. But there are also several specialist areas such as satellite communications.

Other jobs include the maintenance of submarine cables, servicing the dish aerials at Goonhilly Downs and Madley, and general administration. Each international service has its own management team and technical support staff.

Business Services

British Telecom Enterprises covers a variety of specialised national business services, including Radiopaging, Radiophone, Prestel, Yellow Pages, new range and extension telephones and the installation of PABXs and office automation. BTE itself consists of four major, separate businesses.

Firstly, British Telecom Information Services runs Yellow Pages and Prestel viewdata, and uses these as a core for a growing business in publishing, information and advertising (both on paper and in electronic form). The latter is rapidly expanding as publishing costs increase, and the technology is developing to meet the change in advertising markets away from general to highly specialised campaigns, using different media for differing target audiences.

Secondly, Business Products and Systems provides all the telecommunications equipment business customers need on their own sites. Engineering staff install fully electronic PABXs, telex terminals, modems for data transfer between computers, and a complete range of new microprocessor controlled integrated office communications terminals and systems. These office systems are designed to meet the rapid growth in the data handling needs of businesses.

The third section BT Spectrum, provides value added services such as Telecom Gold's electronic mail and Telecom Tan's computerised business answering service. Other Spectrum services include Telecom Silver's Cardcheck service, for the verification of credit card transactions, and Telecom Red's security alarm services, where a central station receives alarm calls automatically and forwards them to the appropriate emergency service. Telecom Violet provides teleconferencing and high-quality multi-audio-conferencing over normal telephone lines. All of these new facilities use microelectronic circuitry to provide a series of services more sophisticated and elaborate then the main telephone network.

Lastly, Customer Services deals with what can be bought from any British Telecom Phoneshop — new telephones and small attachments (answering machines and call makers) meeting a growing demand for more complex telephones with intelligence, memory and display facilities. In all these areas British Telecom engineers are actively involved in product development, from initial specification through to finished product. To do the job effectively, engineers have to be able to co-ordinate eletronic design, mechanical layout, selection of materials and software design — quite a challenge.

Going up in the world: many different kinds of long-distance communications receivers fall within British Telecom's territory. Testing and maintaining them calls for skills which can be put to use in the open air, as well as in a workshop!

An organisation like British Telecom is continually updating its equipment to compete on the world communications market, and digital electronics skills are increasingly important as more systems become computer-controlled.

Just The Job

Telecom's technicians are also called upon to evaluate existing products and, if necessary, make modifications to meet the required standards. Electronic engineering plays a leading role in today's microchip telecommunications, and engineers are needed to design new integrated circuits for a vast array of functions. Such design work involves studying the latest research literature, writing programs for, and then using, both computer simulation and computer design aids, as well as building and testing prototype hardware models.

Qualifications needed differ according to the technical discipline involved and the age and experience of the applicant. Almost all A-level subjects are welcome as entrance qualifications for people who show some potential for management. In the areas of planning and customer service the minimum requirement is four GCE passes, at least two being at A-level, but at one level or other these must include English, Maths and a science subject — Physics or Chemistry or a combination of both. A-level passes in Maths and Physics are preferred.

For those interested in engineering, as highly-skilled technical officers. Apprentices are usually aged between 16 and 18, and British Telecom prefers them to have O-level or CSE grade 1 in Maths, and a technical or scientific subject. In engineering, in particular, there are courses leading to various formal qualifications. For graduates there are three main technical streams. Each of these streams also covers a number of work areas, and these may call for people with specialist training.

The first stream involves management, customer services, marketing, planning and forecasting, under the general title of Telecom Staff. Any degree is acceptable, so long as it is accompanied by GCE passes in Maths and English, and preferably Physics and Chemistry.

The second stream has the general title of Data Processing Staff, covering systems analysis and programming, and the preferred degree is Computer Science.

Finally, the Engineering stream covers all technical and research staff. The main work areas are research, development and the planning of switching and transmission systems. Degree qualifications should preferably be Electrical, Electronic or Communications Engineering.

Getting In Touch

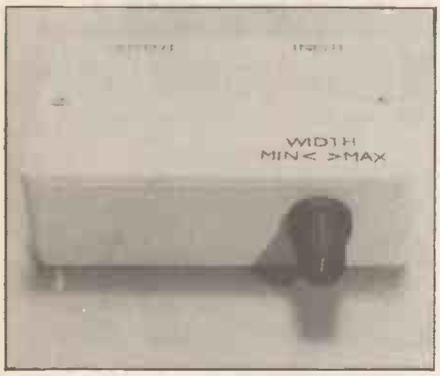
The era of the "information society" is upon us, and it is timely that British Telecom has been created as a corporation to meet the country's growing demand for telecommunications services. The information "explosion" means a growing and exciting list of products and services, and the promise of new concepts in communications such as home banking, electronic mail and the fully automated office.

The Government now allows private firms to compete with British Telecom in many of its activities, but Telecom can face the future with confidence, knowing that its knowledge and experience of telecommunications is unrivalled and its staff highly skilled to meet the challenges of the future.

If you are interested in joining Telecom, your first move is to contact your local Telecom Recruitment Manager's office at the Regional Headquarters. You will find the phone number in the introductory pages to your telephone directory, or dialling code book. Tell them what you are looking for and what qualifications or training you already have, or hope to gain. They will tell you where to proceed. It all starts with a phone call. **HE**

STEREO SPREADER

Geoff Macaulay



A little more treble on the West Wing, please!

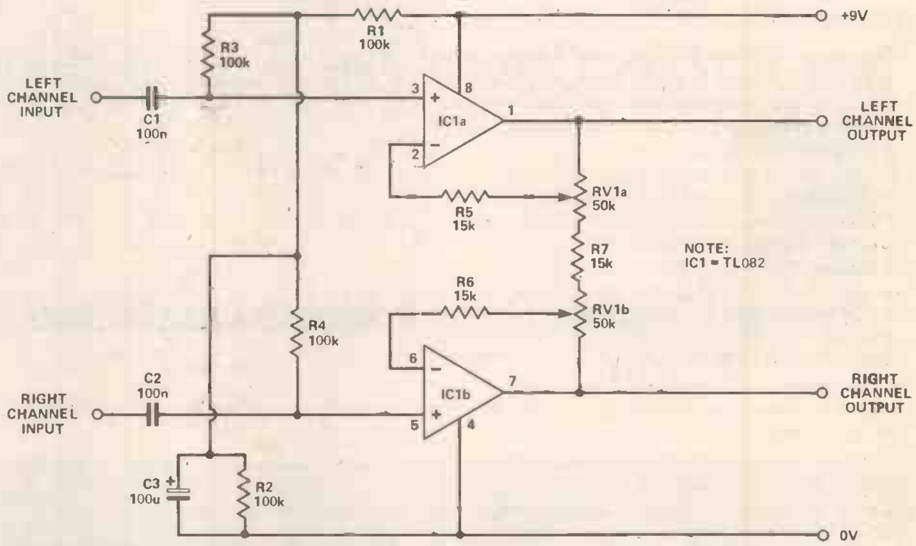


Figure 1. The circuit.

IN the early days of stereo, the channel separation used to be enormous. Stereo effect records can still be found in second hand shops that demonstrate this; a table-tennis match recorded so that the sound ping-pongs from side to side, or trains that pass through the middle of the house and so on. And anyone who has an early Beatles album in their collection will know that the vocals sound out from one side and the instruments from the other!

In those days, however, separate speakers were a novelty and the maximum separation of the speakers in a 'hifi' radiogram was of the order of a few feet; then, they needed all the electronic spacing they could cram onto a record. Since then the physical separation of the speakers has increased, while the electronic separation has decreased. So much so that many modern recordings sound like they were made by dedicated member of the "Back-to-Mono" club.

Since one cannot easily pull the walls apart to get increased separation, speaker placement is generally a matter of compromise between acceptable channel separation and the size and shape of the listening room. There is an alternative, however. It is possible to electronically separate the channels during playback, and this has the same effect as physically spacing out the speakers.

Sound In Space

A simple but effective circuit for achieving this is the subject of this article. But first to understand how it works it is necessary to understand the difference between stereo and mono sound recordings.

A mono recording is quite simple; all the information — vocals, instruments etc — are all recorded as one signal. A stereo recording on the other hand consists of two signals or channels, which between them contain all the information. When the recording is made a single instrument can be placed on either the left channel or the right channel by means of a 'Pan' control, (actually a simple potentiometer); rotating the Pan pot to the left puts all that signal onto the left channel, while rotating it hard to the right puts the sound on the right. Leaving the control set to the middle position effectively places the sound in the centre of the stereo image because the sound levels recorded on the left and right channels are equal.

However the perception of stereophony also depends on the phase difference between the signals on each channel and it is this phase difference, which is imparted when the instrument is recorded in stereo, that enables us to further separate the sound *after* it has been recorded; if these phase differences are emphasised we can effectively increase the stereo separation.

Spaced Out Circuit

The diagram of **Figure 1** shows the complete circuit of the Stereo Spreader. The Left and Right channel inputs are directly coupled by C1 and C2 to the non-inverting inputs of op-amps IC1a and IC1b. To avoid the use of two batteries the op-amps are biased to half-supply by the resistive divider network R1, 2 and 3; capacitor C3 by-passes to ground any AC signal at the junction.

The op-amp outputs are connected together via the two halves of RV1 and R7. Now both are connected as non-inverting amplifiers, with feedback from each output to the respective inverting input via RV1a or b. Like all op-amps, they will attempt to keep their inputs balanced by adjusting the output until the voltage fed back to the inverting input equals that present at the non-inverting input.

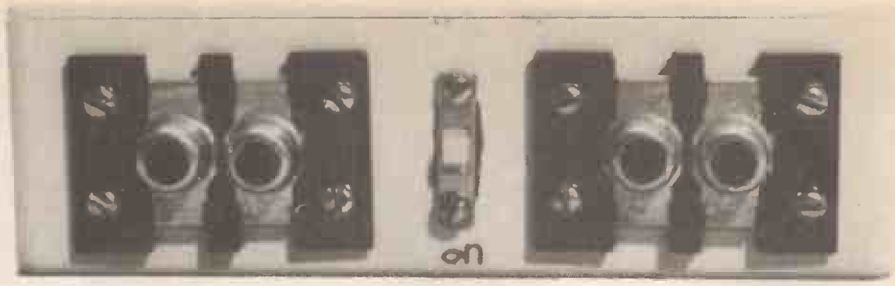
If the input to both op-amps is the same — ie, in phase — then the outputs will be the same and normal op-amp action will apply. However if the inputs are out of phase then the outputs will no longer be indentical, so that part of the output of one op-amp will be coupled via RV1a, b and R7 to the inverting input of the other amplifier. This will then compensate for the extra voltage and, in doing so, will produce a larger out-of-phase 'difference' signal.

The amount by which the difference signal is amplified is determined by RV1, which sets the amount of difference signal coupled from one op-amp to the other and therefore functions as a width control. A dual potentiometer is used here for convenience, so that it is not necessary to have to adjust two controls.

Construction

The Veroboard layout is shown in **Figure 2** and, as long as the cuts are made in the right places and the board checked after assembly for unwanted solder bridges across tracks, there should be no difficulty in completing this part of the project.

For maximum flexibility the unit has been designed to be connected between the audio system's pre-amplifier output and the power amp input. If these are not separate components in your set, check the back of the amplifier; most modern amps bring out the preamp outputs and the main amp inputs on pairs of phono sockets on the rear panel. If there is no way you can connect the Stereo Spreader between preamp and power amp, you will have to consider some other method of increasing your stereo separation, such as moving house or demolishing some walls! The only other alternative is to use the spreader with taped music only, in which case it can be connected between the recorder output and the amplifier inputs.



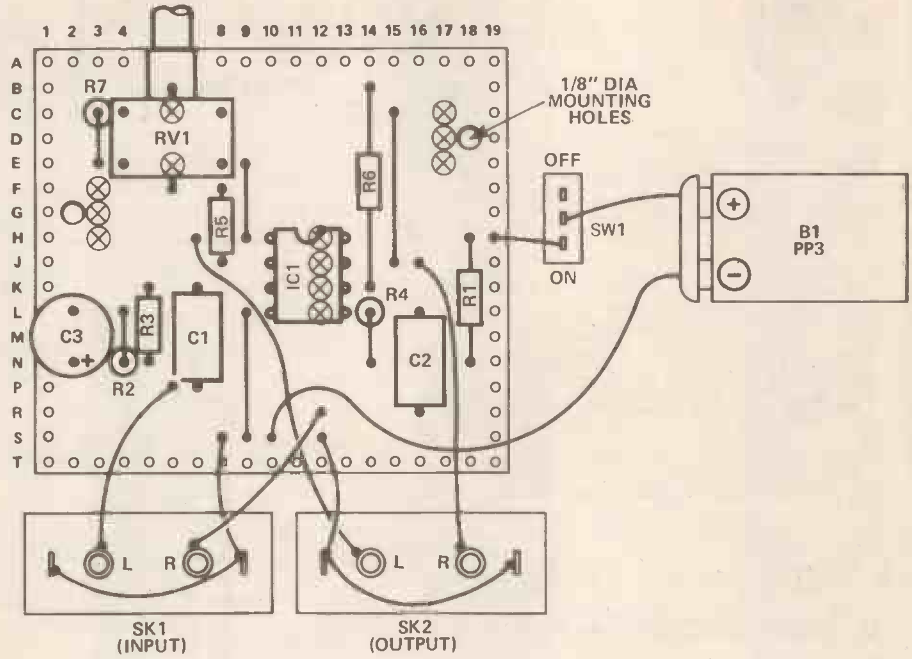
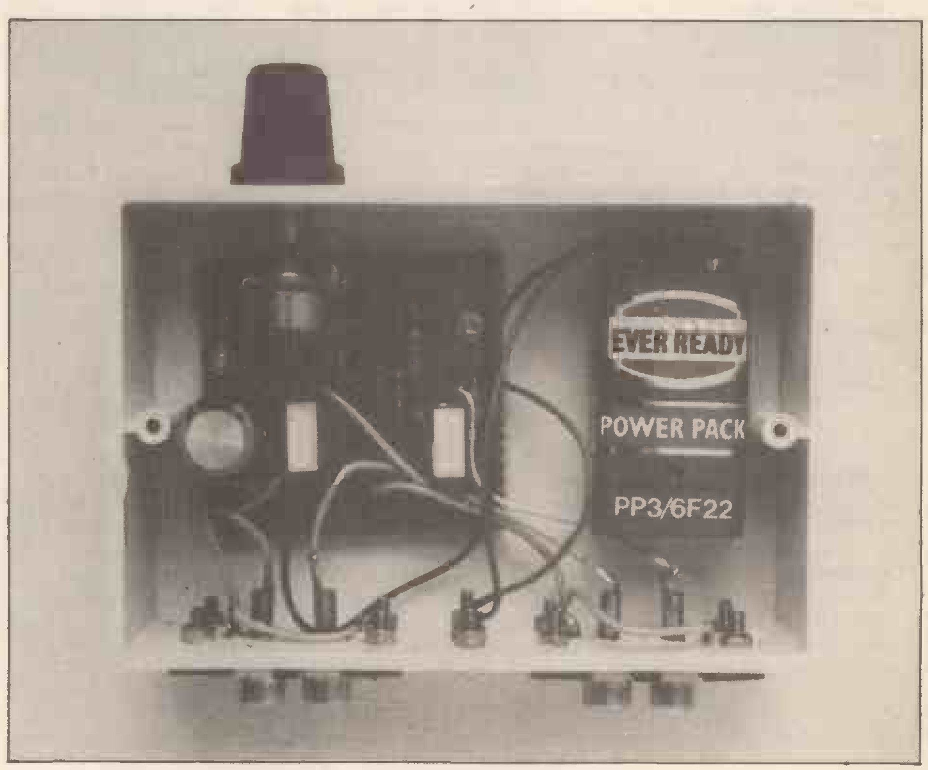


Figure 2. The Veroboard layout. The Stereo Spreader must be connected between the preamp and the power amp.



Parts List

RESISTORS
(All ¼ watt 5% carbon)
R1, 2, 3, 4 .... 100k
R5, 6, 7 .... 15k

POTENTIOMETERS
RV1 .... 50k

CAPACITORS
C1, 2 .... 100n polyester
C3 .... 100u 10V radial electro

SEMICONDUCTORS
IC1 .... TL082 dual BIFET op-amp

MISCELLANEOUS
Veroboard, 17 strips x 20 holes; 4 x phono (RCA) sockets; case, 115 x 80 x 35mm; wire, solder, nuts and bolts etc.

BUYLINES ....page 34

HE

Bookshelf

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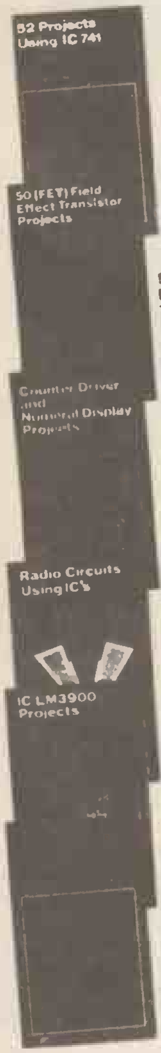

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David Sarnoff

Ian Sinclair

Very much a name belonging to twentieth century electronics.

WHO WAS DAVID SARNOFF? His name isn't familiar to British ears, yet this was a man who was in contact with every important electronics development of our time. In addition, his life story is almost the classic rags-to-riches American dream, the story of the poor immigrant who by hard work and the ability to recognise a unique opportunity, made a million dollars — but Sarnoff made nearer a billion!

He was born in Minsk in Russia, to an orthodox Jewish family, and was educated as a religious scholar. Russia at the turn of the century, as now, was no place for a Jewish family, and the Sarnoffs emigrated to Albany, New York, in 1900. David, sent to a school in which the language was unfamiliar, worked hard, and earned extra money by selling papers, running errands, and by singing in the synagogue.

By 1906 his school days were over, and he became a messenger boy for a telegraph company. Sensing that skill was the key to success, he used his first wages to buy a telegraph key so that he could teach himself Morse Code, the essential skill of the telegraph operator.

A Self-Made Man

Through constant practice, he became thoroughly proficient at Morse Code, and jumped at the opportunity to join the New York branch of the Marconi Wireless Telegraph Company. Wireless Telegraphy was by then considered to be a glamourous career, and a Marconi operator in those days had the sort of standing that a Concorde pilot might enjoy now. The Marconi Company took his training seriously (a tradition that is still maintained), with several spells at sea and on various shore stations.

His proficiency was such that he landed the plum job, the aim of every Marconi operator in the USA. The site was the world's most powerful radio station, on top of the Wanamaker store in Manhattan, and it was there that David Sarnoff became overnight the world's most famous radio operator.

On the night of April 14th, 1912, the "unsinkable" Titanic, on its first voyage, hit an iceberg and sank. The Titanic was a vast ship, built with a large number of watertight compartments, and fitted out in the most lavish way — a style we now find almost unimaginable. You can get a whiff of it from Walter Lord's famous book "A Night To Remember". Among its luxurious fittings was the latest device — a Marconi transmitter and receiver. At the first sign that the

A far, far cry from Wireless Telegraphy: David Sarnoff's company, American consumer electronics giant RCA, laboured to put domestic radio and TV on the road, laying the path for the 80s video boom.

'unsinkable' ship was in distress the radio operator started to send out calls, hoping that one of the number of ships in the neighbourhood would respond.

They didn't, because they were busy sending and receiving congratulations telegrams. David Sarnoff, in his cabin at the top of the Wanamaker Store, did. He remained on duty for 72 hours, receiving and passing on messages which were eventually to lead to survivors being picked up.

Up And Away

He was rewarded by the Marconi Company with rapid promotion — there's a joke among present day Marconi men that they're all waiting for the next Titanic. Curiously enough, this was to lead to a disagreement which would lead Sarnoff to immense wealth and opportunity. In 1915, Sarnoff, now managing the Marconi business in the U.S.A., and also acting for the Army Signals Corps proposed what he called a 'music box'. This was to be a domestic radio.

Marconi himself, who saw radio as a method of saving lives and maintaining essential communications, thought that this suggestion was trivial, and an unworthy use of radio. The two argued fiercely, neither giving ground. Sarnoff resigned to form his own Company, the Radio Corporation of America (RCA). Marconi would never agree to any proposal to manufacture domestic radio, and the company even sold its rights in the name of Marconi as far as receivers were concerned — which is why Marconi transmitters are made by Marconi, and Marconi receivers by Thorn-EMI!

As general manager of RCA, Sarnoff immediately started constructing radio transmitters and receivers. In 1921, he created a sensation by broadcasting the big fight, Dempsey versus Carpentier, so that radio owners knew the result many hours before the papers hit the streets. America went radio mad. By 1924 RCA had sold receivers to a value of $80,000,000. The radio boom had started.

In 1926, Sarnoff formed the National Broadcasting Company (NBC), with the aim of covering the whole of the USA by a chain of radio stations. The first portable radios and car radios appeared, and the boom continued. Sarnoff saw that the new technology would never stay still, and in 1928 built the first experimental NBC TV station.

Towards TV

The development of television was to be slower than he anticipated, to some extent because of the false tracks laid by Baird, who by reproducing a picture of sorts with mechanical equipment diverted attention from the real research which was needed. In 1939, however, at the New York World's Fair, RCA were able to demonstrate live television, using the all-electronic system which was already in use in London, and which was continued after the War.

In the 1940-46 period, Sarnoff, with the rank of Brigadier-General, served on General Eisenhower's staff. His work at RCA had not ceased, however, because the team which developed colour TV was already being assembled in the RCA research laboratories. The painstaking efforts of these researchers developed the shadowmask tube and the NTSC colour system, which laid the foundations for all the colour TV systems used all over the world. None of this could have happened had Sarnoff not supported the research effort wholeheartedly.

No-one knows how much it cost RCA to put colour TV on the road. One guess is that over $80,000,000 was sunk into research and production before a cent was recouped in sales — and it was a long uphill struggle before the immense investment paid off. Once again, however, Sarnoff's foresight had resulted in an immense success.

He retired in 1970, and like so many men whose tireless drive has sustained them, died in the next year. His monuments, RCA and NCB, live on. HE

CLEVER DICK

The publishers of Hobby Electronics wish to offer their sincere apologies to the reader who missed Clever Dick's column in the last issue. He missed it too.

Alright, I'm back.

But did anyone notice that I went away? Do I hear screams in the night, the lamenting of women and the pitiful wailing of strong men crying in their beer because Clever Dick did not appear in last month's Hobby Electronics? No, I must be imagining it.

Our first correspondent this month would like to fly the flag . . .

Dear Clever Dick,
Recently the public have been asked to Buy British, where this is possible. Now, can you tell me if there is any British built hand-held multimeter on the market?
By British I mean built in Britain, using British components, by a British company which is not a subsidiary of a foreign company. The kind of accuracy I am looking for is about 0.5%, or less on a digital meter.
I hope such an instrument can be found. Thank you for your help.
W. Jackson,
Cirencester,
Glos.

Unfortunately I can't help you directly, but perhaps some patriotic-minded reader out there will be able to tell us where such a paragon of British craftsmanship may be purchased. Any takers?

And since we're into the matter of assistance from readers, here's another.

Dear Sir Dick,
There I was probing about inside my latest Hobby project with the probe of my oscilloscope when the trace faded from the screen and a puff of blue smoke rose from the back of the 'scope. A short time later the back was off and my AVO was put into service. The problem - a burnt out transformer.
*As you will appreciate this is the worst thing that could have gone wrong, as no-one sells them off the shelf. Now here comes the plea: does anyone know where I can get a transformer for an ELMAC 4810 Oscilloscope, distributed by Elex Control Systems and made by Yizreel (*sic*) Electronics?*
Unfortunately the manufacturer has not seen fit to put his address anywhere on the thing.
Yours Hopefully,
S. Rainey,
Latham,
Lancs.

PS Keep up the good work.
PPS Notice, not a grovel in sight.
PPSP How about a binder, as I'll not be able to afford one after buying a new transformer.

Indeed, finding new transformers for old 'scopes is about as hopeless an enterprise as could be attempted. Nevertheless, we have had some success in such quests in the past, so how about it, readers? Someone must know Elex Control Systems, or possibly even Yizreel Electronics (that's how it was spelt, I swear).

I say, I say. What ho, pip pip and all that . . .

Dear Dickie old chap,
Could you possibly tell me where I can obtain a spiffing one volt FSD moving coil meter and how much the jolly thing would cost, as I can't seem to find any jolly mail order companies that do them.
Keep up the good work old bean.
Yours spiffingly,
P. Roberts,
Yeovil,
Somerset.

PS You're always complaining about people not using typewriters to type their letters, so I hope you are satisfied with me old chap.
PPS I would't mind one of those spiffing binders.

Terribly sorry, old man, but a quick flip through our catalogue collection has completely failed to turn up the item you're looking for. No one lists a "spiffing 1V FAD meter". You could try your local electrical shop — I happened to notice the other day that the other one near me carries quite a range of meters. On the other hand you could convert an easily obtainable 1mA FSD meter to read 1V by adding sufficient resistance in series with the coil to raise the total to 1000R. Then, by Ohm's Law, one volt will produce a current of 1mA for a full scale reading. Easy when you know how, isn't it old bean.

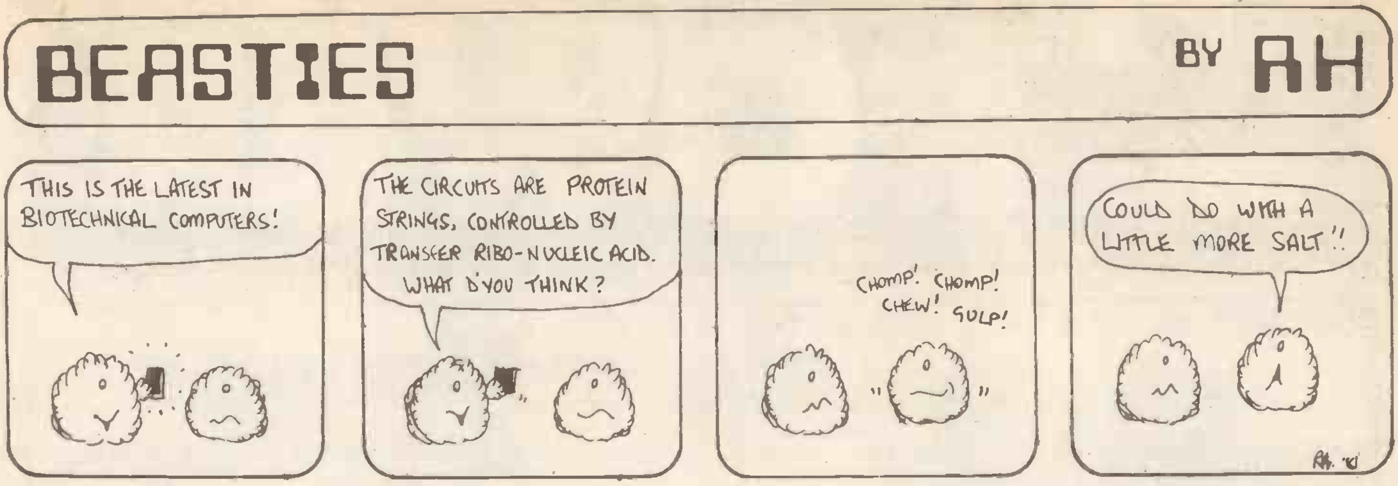
Dear C.D.,
I built the Switch Tuned Radio featured in the January issue of HE and when I switched it on, all I got was a very faint constant hiss, even after adjusting RV1.
When you touch the centre pin of the volume control you get a strong whirring noise. I used an oscilloscope to check the output of the IC1 and there was only a very small signal on the lowest possible range.
I am using two general purpose diodes instead of the 1N4148s and a ferrite aerial out of an old transistor radio. I wonder if you might help me — what is wrong with it?
P.R. Brown,
Bristol.

What a mess. Just imagine all the complaints I'd get if I decided to change the components . . . . well. alright then.

First of all, check that the audio stage is working correctly by injecting a low-level audio signal (about 0.5 mV) into IC2. Next, check the DC voltage on pin 5 (the output) of IC1; it should be around 1V3. Now check that the voltage on the wipers of the preset potentiometers are all inteh range OV65 to 7 V. Check that the voltage at the centre-pin of the Varicap diode (the junction of the cathodes, in the circuit) also tracks as the switch is rotated. Now if the radio still doesn't work, after checking all these points and adjusting as necessary, the fault probably lies with your substitute aerial coil; try different taps, if it has them, or different windings, perhaps. If all else fails — GET THE ONE WE RECOMMENDED!

Components come and components go, but of some there is not a trace . . .

Dear Clever Dick,
In the August '82 issue of Hobby Electronics, there appeared in connection with the Digital Millivoltmeter project an IC type LH0070. This appeared in Figure 7 of the project.
I am writing to ask whether your back room boys could tell me where I could obtain this and another IC (Type LH0075) as soon as possible, and also would it be possible to include more technical information on the project?



I would like to say that Hobby Electronics is the best practical electronics magazine around.
S. Cairns,
Cleckheaton,
West Yorkshire.

I'm sorry but we can't re-write the article for you! However if you have specific questions we'll try to answer them through the (much overloaded) technical enquiry service.

The LH0070 is a precision voltage reference IC; unfortunately it doesn't appear in any of our retail catalogues, but is available from RS Components and so can be ordered through your local dealer. You could also try MS Components Ltd., Zephyr House, Waring Street, West Norwood, London SE27 9LH.

On the other hand, we can find no reference at all to an LH0075. Are you sure that's the number?

And now it's correction time (again). I can't help it if I'm old fashioned . . .

Dear Clever Dick,
Your answer to a reader's question in the March issue sent me into a state of shock from which I have only just recovered. Back to school, friend, to learn the unit of conductance. Please consult (or insult as the mood takes you) B.S.I. 1991 and IEC Symbols for Electrotechnics, where the conductance unit is SIEMENS, symbol G, unit-symbol S. Of course unit-symbol S clashes with the symbol for magnetic reluctance, also S. Are you confused enough to send me a binder? If not, it's a great magazine and please, no more out of character answers. It's not like you.
Yours faithfully,
G. Cox,
Southampton,
Hants.

PS Just seen your April issue: ref. cryptic comment, Paul Jenkin and six-pin DIL MOC 3020 8017. This is a triac opto-isolator/switch type MOC 3020. The number 8017 means it was manufactured in 1980, week 17. Consult R.S. Catalogue page 175 or Maplin's catalogue page 186, triac opto-isolator.

Who's confused? Not me, I can tell you. I know who **I** am . . . I think. However, it has to be admitted: the IEC term for conductance is truly Siemens, symbol G and unit-symbol S. It is not to be confused with reluctance, (symbol S), admittance (unit-symbol S); apparent power (symbol S); gain (symbol G); rating (symbol S, unit-symbol VA or W); or either the Poynting Vector symbol (S) or the symbol for Signal (S). Who's confused? Not me chief.

I have no idea why or how the gentlemen of the IEC chose this particular set of symbols, just that they seem to have been selected according to some obscure standard that has little to do with the day-to-day practice of electronics.
It may be old fashioned but the term 'mho' is both logical and mnemonic, and I'll stick to it.

And since we're on the subject, let's go for one mho time . . .

Dear Mr Clever Dick,
I was disgusted to see in the March issue of HE that you thought the unit of conductance is the 'mho' when, as you should know, it is measured in Siemens (symbol S). This is a disgusting error on your part and I feet that I should receive a Binder for pointing out your unforgivable mistake.
B. Voss,
Crewekerne,
Somerset.

PS Where can you find 240V/20W fluorescent tubes as used in your 12/240V inverter feature?

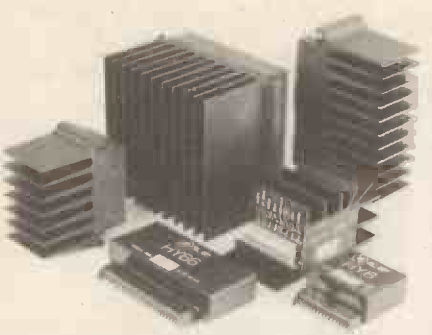
The most disgusting thing is the way some people try to scrounge a Binder. Where would you usually go for fluorescent tubes? Your local sparks, naturally. Disgusting.

What's this . . . ANOTHER jokester?

Dear Smarty Pants (or whatever),
Just a short note (♪) to correct a statement you made in the March issue of HE.
In answer to a query regarding the unit measurement of conductance, you wrongly suggested that the inverse of OHM was MHO. MHO is, in fact, the reverse of OHM. The inverse of OHM is OHW.
A little quiz:
If R = OHM, Я = MHO and 1/R + OHW, then;
what does 1/Я equal?
(Clue: What the editor said when first having the name Clever Dick mentioned to him.)
Also, I think your answer may have confused those who do not know the real unit measurement of conductance. The term slips my mind at the moment but, I recall, it has something to do with matelots, or something.
Having never purchased, borrowed, read, or been within a transistorised barge pole's distance of a copy of Hobby Electronics (a silly name anyway) I am not going to get down on one knee like the rest of your Plebeian, sycophantic writers and plead for a Binder. I simply cannot think of a use for . . . although, hang on. My favourite girlie magazine is roughly the same size as your Hobbit Electronics (though much more interesting). Therefore, I suppose, if pushed, I could take one of the wretched things off your hands; but only one! I will do anyone a favour, but there are limits.
May the source (gate, drain) be with you.
Paul Ure,
New Brighton,
Merseyside.

Give it a rest (𝄾). The *re*verse of OHM is obviously OHW, not MHO, and the symbol, it must be plain, is ᴚ. Your clue is therefore not only misleading but misplaced. And with all those references to silly sailors, barge poles and girlie magazines, I'm not sure if you're the kind of person I want reading my column, anyway. However, I'll make an exception just this once, on the condition that you immediately dispose of all those terrible magazines. Send them to me at once and I will see that they're destroyed. Then you can start collecting a morally pure, up-lifting and educational magazine: Video Today. **HE**

GET BIG POWER



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BIPOLAR MODULES

Module Number	Output Power Watts rms	Load Impedance Ω	DISTORTION T.H.D. Typ at 1KHz	I.M.D. 60Hz/ 7KHz 4:1	Supply Voltage Typ	Size mm	WT gms	Price inc. VAT
HY30	15	4-8	0.015%	<0.006%	± 18	76 x 68 x 40	240	£8.40
HY60	30	4-8	0.015%	<0.006%	± 25	76 x 68 x 40	240	£9.55
HY6060	30 + 30	4-8	0.015%	<0.006%	± 25	120 x 78 x 40	420	£18.69
HY124	60	4	0.01%	<0.006%	± 26	120 x 78 x 40	410	£20.75
HY128	60	8	0.01%	<0.006%	± 35	120 x 78 x 40	410	£20.75
HY244	120	4	0.01%	<0.006%	± 35	120 x 78 x 50	520	£25.47
HY248	120	8	0.01%	<0.006%	± 50	120 x 78 x 50	520	£25.47
HY364	180	4	0.01%	<0.006%	± 45	120 x 78 x 100	1030	£38.41
HY368	180	8	0.01%	<0.006%	± 60	120 x 78 x 100	1030	£38.41

Protection: Full load line. Slew Rate: 15v/µs. Risetime: 5µs. S/N ratio: 100db.
Frequency response (−3dB) 15Hz – 50KHz. Input sensitivity: 500mV rms.
Input Impedance: 100K Ω. Damping factor: 100Hz >400.

PRE-AMP SYSTEMS

Module Number	Module	Functions	Current Required	Price inc. VAT
HY6	Mono pre amp	Mic/Mag. Cartridge/Tuner/Tape/ Aux + Vol/Bass/Treble	10mA	£7.60
HY66	Stereo pre amp	Mic/Mag. Cartridge/Tuner/Tape/ Aux + Vol/Bass/Treble/Balance	20mA	£14.32
HY73	Guitar pre amp	Two Guitar (Bass Lead) and Mic + separate Volume Bass Treble + Mix	20mA	£15.36
HY78	Stereo pre amp	As HY66 less tone controls	20mA	£14.20

Most pre-amp modules can be driven by the PSU driving the main power amp. A separate PSU 30 is available purely for pre amp modules if required for £5.47 (inc. VAT). Pre-amp and mixing modules in 18 different variations. Please send for details.

Mounting Boards

For ease of construction we recommend the B6 for modules HY6–HY13 £1.05 (Inc. VAT) and the B66 for modules HY66–HY78 £1.29 (Inc. VAT).

MOSFET MODULES

Module Number	Output Power Watts rms	Load Impedance Ω	DISTORTION T.H.D. Typ at 1KHz	I.M.D. 60Hz/ 7KHz 4:1	Supply Voltage Typ	Size mm	WT gms	Price inc. VAT
MOS 128	60	4-8	<0.005%	<0.006%	± 45	120 x 78 x 40	420	£30.41
MOS 248	120	4-8	<0.005%	<0.006%	± 55	120 x 78 x 80	850	£39.86
MOS 364	180	4	<0.005%	<0.006%	± 55	120 x 78 x 100	1025	£45.54

Protection: Able to cope with complex loads without the need for very special protection circuitry (fuses will suffice).
Slew rate: 20v/µs. Rise time: 3µs. S/N ratio: 100db
Frequency response (−3dB): 15Hz – 100KHz. Input sensitivity: 500mV rms
Input impedance: 100K Ω. Damping factor: 100Hz > 400.

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C15

Mono Power Booster Amplifier to increase the output of your existing car radio or cassette player to a nominal 15 watts rms.

Very easy to use.

Robust construction. **£9.14 (inc. VAT)**

Mounts anywhere in car.

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Output power maximum 22w peak into 4Ω.
Frequency response (−3dB) 15Hz to 30KHz, T.H.D. 0.1% at 10w 1KHz
S/N ratio (DIN AUDIO) 80dB, Load Impedance 3Ω
Input Sensitivity and impedance (selectable) 700mV rms into 15K Ω 3V rms into 8 Ω
Size 95 x 48 x 50mm. Weight 256 gms.

C1515

Stereo version of C15. **£17.19 (inc. VAT)**

Size 95 x 40 x 80. Weight 410 gms.

POWER SUPPLY UNITS (Incorporating our own toroidal transformers)

Model Number	For Use With	Price inc. VAT
PSU 21X	1 or 2 HY30	£11.93
PSU 41X	1 or 2 HY60, 1 x HY6060, 1 x HY124	£13.83
PSU 42X	1 x HY128	£15.90
PSU 43X	1 x MOS128	£16.70
PSU 51X	2 x HY128, 1 x HY244	£17.07

Model Number	For Use With	Price inc. VAT
PSU 52X	2 x HY124	£17.07
PSU 53X	2 x MOS128	£17.86
PSU 54X	1 x HY248	£17.86
PSU 55X	1 x MOS248	£19.52
PSU 71X	2 x HY244	£21.75

Model Number	For Use With	Price inc. VAT
PSU 72X	2 x HY248	£22.54
PSU 73X	1 x HY364	£22.54
PSU 74X	1 x HY368	£24.20
PSU 75X	2 x MOS248, 1 x MOS368	£24.20

Please note: X in part no. indicates primary voltage. Please insert "0" in place of X for 110V, "1" in place of X for 220V, and "2" in place of X for 240V.

Pop Amps

Owen Bishop

Simple circuits based on operational amplifiers.

No. 9: High-Impedence AC Millivoltmeter

ONE of the troubles with AC is that it alternates! No sooner has the current rushed around the circuit in one direction than it changes its mind and starts surging around in the opposite direction. Thus if you have an ammeter connected in the circuit to measure the currents, or the voltages they generate, the needle of the meter has had no time to swing in one direction before it is being forced to swing in the opposite direction. Even the lightest of meter movements has a certain amount of inertia, so it can not respond to alternating current — unless the frequency happens to be about 1Hz or less. Consequently with most alternating currents, which have frequencies in the audio or radio ranges, the needle hovers more or less motionless at the zero point of the scale. There may be several amperes of current and several hundreds of volts in the circuit, yet the meter shows nothing of all this activity.

You *can* use a hot-wire ammeter or a moving-iron ammeter, but these have extremely non-linear scales and in any event cannot measure small currents. Most people prefer to use a multimeter, switched to an AC range!

When you switch to the AC range of a multimeter, this generally brings a rectifiying bridge of diodes into the circuit so that the current always passes through the meter in a constant direction. Currents or voltages then can be measured fairly easily but even so, there are errors introduced, due to the forward voltage drop across two diodes. With germanium diodes this amounts to an error of about 0V2 per diode. Now this does not matter if the voltages to be measured are in tens or hundreds, but makes it impossible to work in the millivolt range. Worse than that, the diodes refuse to conduct at all if the voltage across them is less than 200mV for germanium diodes or 700mV for silicon diodes. Then, when the voltage across the diode *is* enough to make them conduct but is still only a volt or so above the minimum, the ratio of current to voltage is non-linear. Such a meter will not measure voltages below about 200mV, and has a non-linear scale at its lower end.

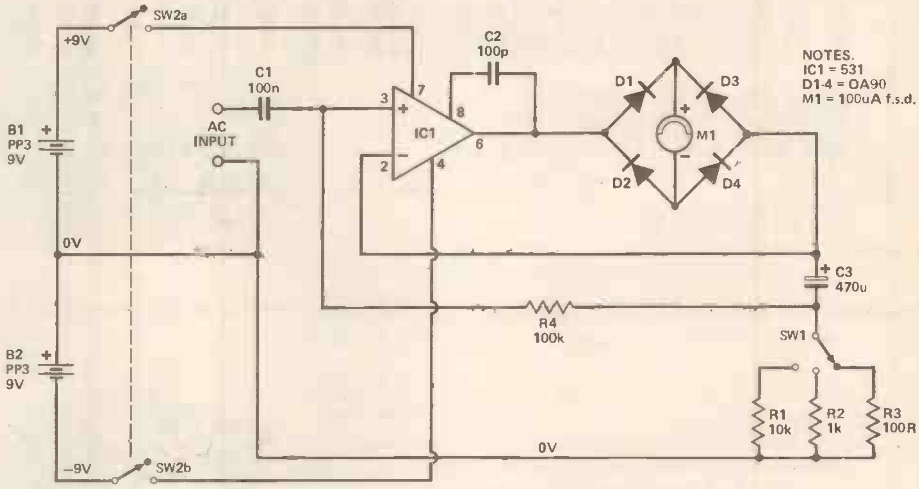


Figure 2. The circuit.

This Pop-Amp presents a simple circuit which has none of these disadvantages. It gives a linear reading of AC voltages in three ranges, 0-1V, 0-100mV and 0-10mV. As a bonus, it has very high imput impedance of the order of several tens of megohms. It is based on the 531 op-amp which has a slew rate (35v/ µs) considerably higher than most others. A typical op-amp, such as the popular 741, has a slew rate of only 0V5/ µ s. This ability to swing its output voltage at high speed means that it is able to respond better to high-frequency signals. As a result, the circuit does not show any fall-off due to frequency until about 500kHz — with a 741, the upper limit is about 10kHz!

How It Works

Ignoring the diodes for the moment, the output from the op-amp is fed directly back to the inverting input (**Figure 1**). In this connection, the op-amp is being used as a unity gain voltage follower, and it acts to maintain zero voltage difference between its input terminals. Thus, as the input voltage varies, its output voltage varies by exactly the same amount. This maintains the required zero difference between the two input terminals and the result is a gain of one. This may seem pointless, but we are not actually worried about gain here. The point is that the input of the op-amp has very high impedance, and so draws very little current from the signal source (eg, a crystal microphone). Yet the output of the op-amp has low impedance and can

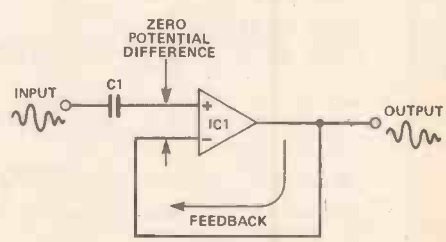


Figure 1. Block diagram of the op-amp unit.

provide more than enough current to drive the movement of a meter.

The input line has a capacitor (C1) which is there to prevent direct current voltages from reaching the amplifier; if the AC voltage we want to measure is a small signal superimposed on a steady DC level, the DC is blocked by the capacitor. Of course as far as the AC signal is concerned, the capacitor might just as well not be there.

This property of capacitors is also of use in another part of the circuit (**Figure 2**). As the output voltage varies (in sympathy with input voltage), the variations are passed *across* C3, causing a varying current to flow through one of the resistors R1-R3 to the 0V rail. However, the current flowing through the resistors gets there by way of the rectifying bridge and meter.

Now let us see what happens when R1 is switched into circuit. Suppose the input is 1V, then output is 1V, and a voltage of 1V appears across R1.

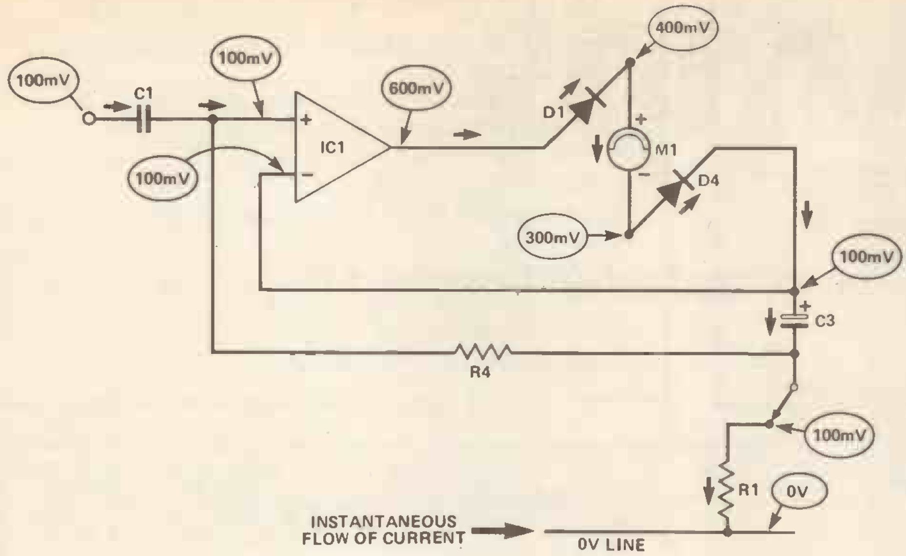
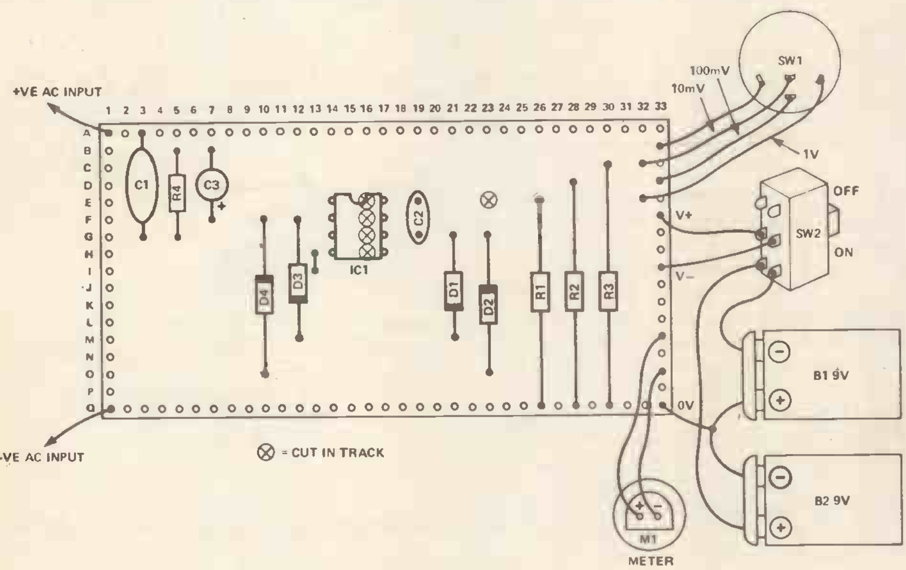


Figure 3. Voltages at various points in the millivoltmeter circuit.

Figure 4. The Veroboard layout. Take care that the diodes are correctly orientated.



The current through R1 is I = V/R = 1/10000 = 0.0001A, or 100A and this is just enough to give full scale deflection on the meter. Similar calculations show that with R2 or R3 switched into circuit, full-scale deflection is obtained with input voltages of 100mV and 10mV respectively. Thus, alternating input voltage causes an alternating current to flow from the op-amp (rectified while passing through the meter), in and out of the plates of the capacitor, and through one of the resistors. The reading shown on the meter is the root mean square (RMS) value of this current.

The input resistor R4 has an alternating voltage at one end of it (as the signal comes to it from C1) but since the amplifier has unity gain, an equal alternating voltage appears at its other end. Consequently, alternating signals cause no flow of current through R4 and as far as AC is concerned, R4 is an open circuit. Thus the circuit does not have the low input impedance that R4 would otherwise produce.

Bridging the Gap

So far, we have ignored the effects of the diodes which were mentioned earlier — their non-linear conduction at low voltages and their failure to conduct at all for voltages below 200mV: this problem is overcome by the op-amp! Suppose the input voltage increases to a value (say 100mV) which is not enough to make the diodes begin to conduct. The op-amp now has its non-inverting input at 100mV, but because the diodes are not conducting this increase has not got back to the inverting input, which is still at 0V. The op-amp has plenty of amplification available, so it increases its output voltage by as much as is necessary to bring its inverting input to the same level as the other input. If the voltage drops are taken to be 200mV across each of the germanium diodes and 100mV across the meter, the voltages at various points in the circuit are as shown in **Figure 3**. You can see that the input voltage, the PD across the meter and the PD across R1 are all equal to 100mV, so the effect of the diodes is eliminated! The same applies over the whole range of voltages, and also the non-linearity of diode conduction has no effect on the reading. Virtually no current flows to the inverting input because of its high impedance. None flows through R4 because both ends of it are at 100mV.

Parts List

RESISTORS
(All ¼ watt 5% carbon)
R1 .... 10k
R2 .... 1k
R3 .... 100R
R4 .... 100k

CAPACITORS
C1 .... 100n polyester
C2 .... 100p ceramic
C3 .... 470u 10V radial electro

SEMICONDUCTORS
IC1 .... 531 op-amp
D1,2,3,4 .... 0A90 or 0A91 germanium diodes

MISCELLANEOUS
SW1 .... rotary switch single pole, 3-way
SW2 .... DPST switch slide or toggle
M1 .... microammeter 100uA FSD, panel mounting
Stripboard, 85 x 45mm (17 strips x 33 holes); 8-pin IC socket; 12 x 1mm terminal pins; 2 x PP3 battery connectors; nuts and bolts, wire, solder etc.

BUYLINES .... **page 34**

Construction

The circuit is built up on a small piece of strip-board (**Figure 4**) housed in the case which carries the meter and the switches. The case will also hold the two PP3 batteries required for the power supply. It is advisable to use a heat-sink when soldering in the diodes, and take care to insert them with the correct orientation.

C2 is required for frequency stabilization of the op-amp; its precise value does not matter, so if you do not have a 100pf capacitor handy, it is in order to use one of lower value (for example, 56pF). We often use 1% or 2% tolerance resistors as standard resistors in measurement circuits, but such a degree of accuracy is not usually required in the applications of this circuit. This is why only 5% tolerance is specified, but use resistors of higher tolerance if you think you need them!

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6845	795p
6850	140p
6852	250p
6854	680p
6875	490p
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8T28	120p
8T95	90p
8T96	90p
8T97	90p
8T98	90p
8035L	340p
8039L	290p
8080A	360p
8085A	450p
8155	450p
8212	155p
8216	100p
8224	160p
8226	195p
8228	250p
8251	300p
8254	450p
8255	280p
8257	450p
8259	450p
8279	450p
75107	90p
75108	90p
75110	88p
75112	160p
75182	95p
75450	85p
75451	50p
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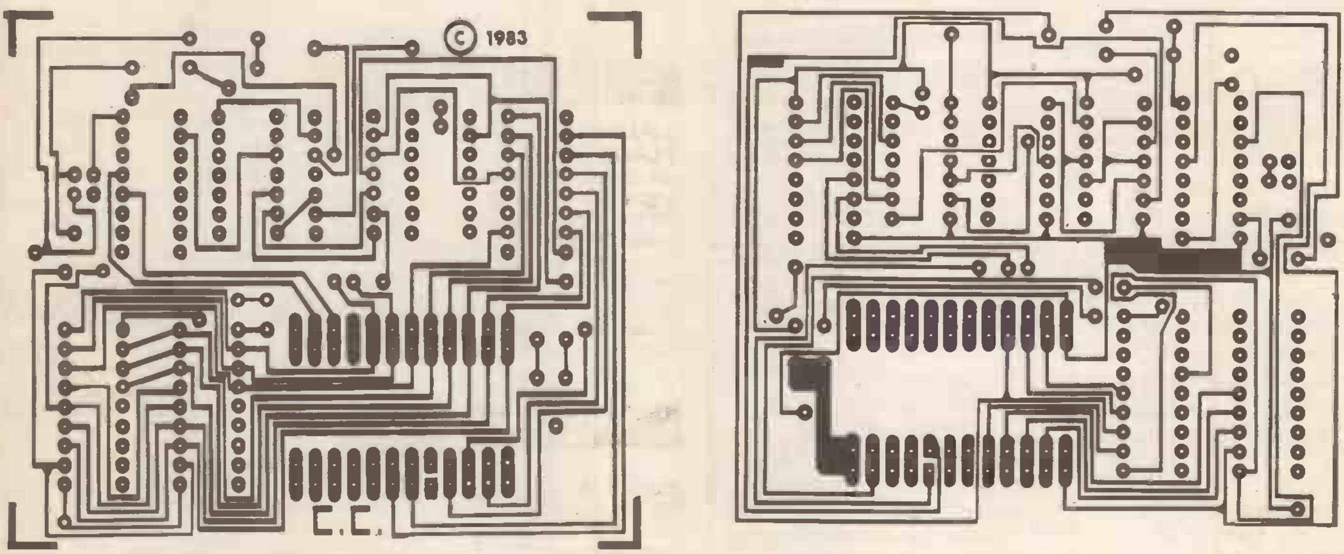
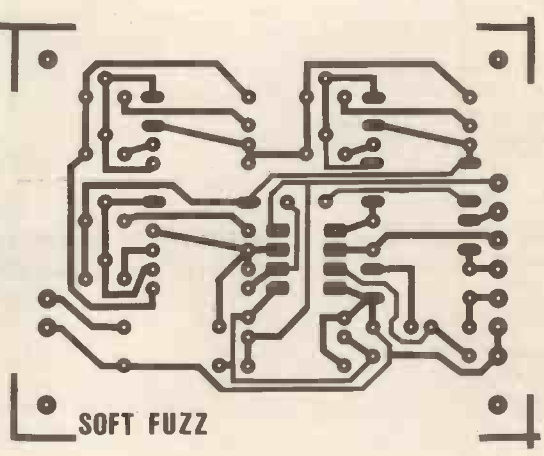


The printed circuit for the ZX81 High Resolution Graphics Project uses a double-sided board; on the left is the foil patter for the component side and on the right is the bottom foil pattern. The PCB supplied by Cambridge Computing will be a through-hole-plated type, but home constructors will need to solder links to connect the top and bottom tracks. Do this very carefully as faults, especially dry joints, can be extremely difficult to locate!



The copper pattern for the HE Soft Fuzz unit.

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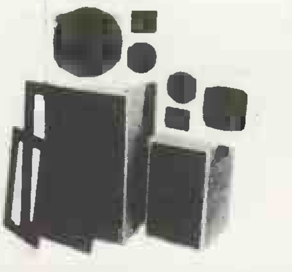
MULLARD SPEAKER KITS



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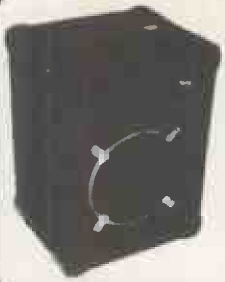

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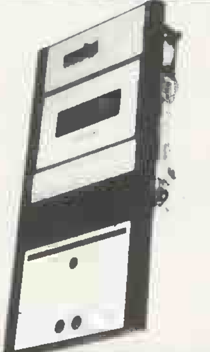

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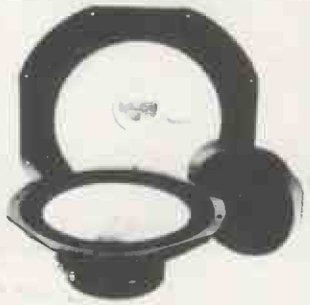

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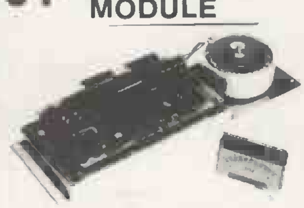

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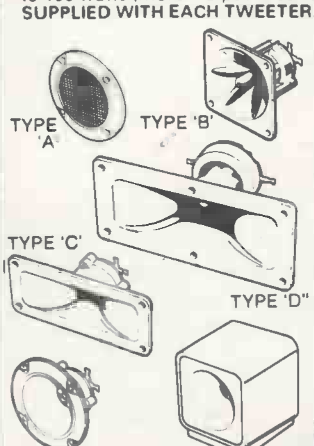

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