ISSN 0142-7229

electronics today INTERNATIONAL

MAY 1980

60p

THE ULTIMATE KIT SURVEY

CHORUS MACHINE

Infra-Red Remote Control

LED VU

Servo Tester

Calculated Watch Offer

. . .NEWS. . . .PROJECTS. . . .MICRO . . .RS. . . .AUDIO. . .

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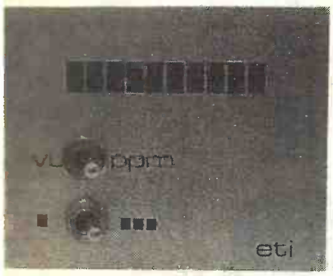
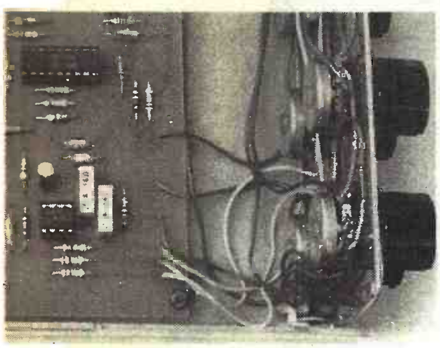
get kitted p.59



feeling peaky? p.78



cut off point p.20

FEATURES

PROJECTS

INFORMATION

OVERSEAS EDITIONS

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WATFORD ELECTRONICS

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POLYESTER CAPACITORS: Axial lead type.
400V: 1nF, 1n5, 2n2, 3n3, 4n7, 6n8, 10n, 15n **9p; 18n 10p;** 22n, 33n **11p;** 47n, 68n **14p;** 100n **17p;** 150n, 220n **24p;** 330n, 470n **41p;** 680n **48p;** 1μF **64p;** 2μ2 **82p.**
160V: 10nF, 12n, 39n, 100n, 150n, 220n **11p;** 330n, 470n **19p;** 680n 1μF **22p;** 2.2μF **32p;** 4.7μF **36p.**
1000V: 10n, 15n **20p;** 22n **22p;** 47n **26p;** 100n **38p;** 470n **53p;** 1μF **175p.**

POLYESTER RADIAL LEAD CAPACITORS: 250V:
10n, 15n, 22n, 27n **5p;** 33n, 47n, 68n, 100n **7p;** 150n **10p;** 220n, 330n 13p; 470n **17p;** 680n **19p;** 1μ **22p;** 1μ5 **30p;** 2μ2 **34p.**

FEEOTHROUGH CAPACITORS
1000pF/350V **8p**

ELECTRONIC CAPACITORS: (Values are in μF) **500V:** 10 **40p;** 47 **68p; 250V:** 100 **65p; 63V:** 0.47, 1.0, 1.5, 2.2, 3.3, 4.7, 6.8, **8p;** 47, 32, **11p;** 63, 100, **27p; 50V:** 50, 100, 220, **25p;** 470, **32p;** 1000, **60p; 40V:** 22, 33, **8p;** 100, **12p;** 2200, 3300, **85p;** 4700, **98p; 35V:** 10, 33, **7p;** 330, 470, **32p;** 1000, **50p; 25V:** 10, 22, 47, 80, 100 **8p;** 160, 220, 250, **15p;** 470 **25p;** 640, **35p;** 1000, **33p;** 1500, **40p;** 2200, **45p;** 3300, **77p;** 4700 **85p; 16V:** 10, 47, **7p;** 100, 125, **8p;** 220, 330, **14p;** 470, **20p;** 1000, 1500, **30p;** 2200 **36p; 10V:** 100, **7p;** 640, **12p;** 1000, **16p.**
TAG-END TYPE: 450V: 100μF **180p; 70V:** 4700, **165p; 64V:** 3300 **150p;** 2500 **110p; 50V:** 4700, **150p;** 3300 **135p;** 2200 **99p; 40V:** 15,000 **399p;** 4700 **130p;** 4000 **92p;** 3300 **98p;** 2500 **90p; 30V:** 4700 **110p; 25V:** 15000 **195p;** 6400 **120p;** 4700 **100p;** 3300 **80p;** 2200 **60p.**

TANTALUM BEAD CAPACITORS
35V: 0.1μF, 0.22, 0.33, 0.47, 0.68, 1.0, 2.2μF, 3.3, 4.7, 6.8 **25V:** 1.5, 10. **20V:** 1.5, **16V:** 10μF **13p** each
16V: 15, 22 **25p.** 47, 100 **50p.** 220 **70p.**
10V: 15, 22, 33, **20p.**
6V: 47, 68, 100 **30p; 3V:** 100 **20p.**

MYLAR FILM CAPACITORS

100V: 0.001, 0.002, 0.005, 0.01μF	**6p**
0.015, 0.02, 0.04, 0.05, 0.056μF	**7p**
0.1μF, **9p**, 0.2 **11p. 50V:** 0.47μF	**12p**

CERAMIC CAPACITORS 50V

Range: 0.5pF to 10,000pF	**4p**
0.015μF, 0.022μF, 0.033μF	**5p**
0.047μF **5p:** 0.1μF, 0.2μF	**7p**

SILVER MICA (Values in pF) 3.3, 4.7, 6.8, 10, 12, 18, 22, 33, 47, 50, 68, 75, 82, 85, 100, 120, 150, 220 **11p** each
250, 270, 300, 330, 360, 390, 470, 600, 800, 820 **16p** each
1000, 1200, 1800, 2000 **26p** each

POLYSTYRENE CAPACITORS:
10pF to 1nF **8p;** 1.5nF to 47nF **10p**

MINIATURE TYPE TRIMMERS

2.5-6pF; 3-10pF; 10-40pF	**22p**
5-25pF; 5-45pF; 60pF; 88pF	**30p**

COMPRESSION TRIMMERS
3-40pF; 10-80pF; 25-190pF **30p**
100-500pF **45p** 400-1250pF **58p**

GAS & SMOKE DETECTORS
TGS 812 & 813 **415p;** Socket **25p**

POTENTIOMETERS: Rotary, Carbon, Track. 0.25W Log & 0.5W Lin. 470Ω, 680Ω, 1KΩ & 2KΩ (Linear only) Single Gang **29p**

5KΩ-2MΩ Single Gang Log & Lin.	**29p**
5KΩ-2MΩ Single Gang D/P Switch	**69p**
5KΩ-2MΩ Double Gang Log & Lin	**88p**

SLIDER POTENTIOMETERS
0.25W log and linear values 60mm

5KΩ-500KΩ single gang	**60p**
10KΩ-500KΩ dual gang	**80p**
Self Stick Graduated Bezels	**30p**

PRESET POTENTIOMETERS

0.1W 50Ω—5MΩ Miniature Vertical & Horizontal	**7p**
0.25W 100Ω—3.3MΩ horiz. larger	**10p**
0.25W 200Ω—4.7MΩ Vert.	**10p**

RESISTORS — Erie make 5% Carbon Miniature High Stability. Low noise

	RANGE	VAL	1-99	100+
¼W	2.2Ω-4.7M	E24	**2p**	**1p**
½W	2.2Ω-4.7M	E12	**2p**	**1p**
1W	2.2Ω-10M	E12	**5p**	**4p**
2%Metal Film 10Ω-1MΩ			**6p**	**4p**
1%0.5W 51Ω-1M		E24	**8p**	**6p**

100+ price applies to Resistors of each type not mixed values.

THERMISTORS: VA1034, 1039, 1040, 1055, 1056, 1058, 1066, 1067, 1098, 1100 **24p** each.

COMPUTER ICs

2102-2	225
2111	195
2112-2	250
2114	396
2708	675
27L08	995
4116-16	1025
4047	750
6502	995
81LS95	125
81LS96	126
81LS97	135
AY-3-1015	550
AY-5-1013	399
AY-5-2376	920
MC1488	85
MC1489	90
MC14411	695
MC14412	1080
MK4027-2	470
MK4027-4	350
MK4116-4	1025
MK4118-4	2099
RO-3-2513	650
SFF96364E	1050
SFC71301	820
TMS2716 (3v)	1700
TMS4035	250
TMS4039	250
TMS4045	1083
TMS6011	355
Z80 CPU 2.5M	990
Z80 CPU 4M	1099
Z80 P10	660
Z0 CTC	595

TRANSISTORS

	p
AC125	35
AC126	25
AC127	22
AC128	20
AC141	27
AC142	28
AC176	25
ACY17	60
ACY18	60
ACY19	60
ACY20	53
ACY21	40
ACY22	60
ACY28	60
ACY39	80
ACY41	39
AD149	75
AD161	42
AD162	42
AF114	60
AF115	60
AF116	60
AF117	50
AF118	75
AF139	40
AF178	75
AF186	50
AF239	42
ASZ21	60
BC107	10
BC107B	10
BC108	10
BC108B	10
BC108C	12
BC109	10
BC109B	12
BC109C	12
BC114	20
BC115	20
BC117	20
BC119	28
BC140	26
BC142	26
BC143	26
BC147	9
BC147B	10
bc148	8
BC148B	10
BC149	9
BC149C	10
BC153	20
BC154	13
BC157	10
BC158	10
BC159	11
BC160	28
BC167A	11
BC168C	10
BC169C	10
BC170	15
BC172	11
BC177	15
BC178	14
BC179	15
BC182	10
BC183	10
BC184	10
BC182L	10
BC183L	10
BC184L	10
BC187	22
BC212	9
BC212L	9
BC213	9
BC213L	9
BC214	9
BC214L	10
BC307B	12
BC308	12
BC327	12
BC328	15
BC338	12
BC441	27
BC461	27
BC477	35
BC516	38
BC517	35
BC547	10
BC548	10
BC549C	15
BC556	15
BC557	10
BC558	10
BC559	10
BCY30	80
BCY39	78
BCY40	48
BCY42	14
BCY70	14
BCY71	16
BCY72	158
B0124	115
BD131	42
BD132	42
BD133	50
BD135	30
B0136	30
BD137	30
BD138	35
BD139	30
BD140	30
BD144	198
BD145	175
B0205	110
BD245	50
BD378	70
BD434	32
BD517	70
BD695A	85
BD696A	85
BF115	26
BF154	29
BF158	30
BF167	25
BF173	24
BF177	25
BF178	30
BF179	38
BF180	38
BF194	11
BF195	12
BF196	12
BF197	12
BF198	16
BF199	29
BF200	40
BF224A	24
BF244B	60
BF256A	50
BF256B	45
BF257	30
BF258	28
BF259	28
BF451	20
BF336	35
BF594	30
BF595	20
BFR39	25
BFR40	25
BFR41	24
BFR79	24
BFR80	24
BFR81	24
BFR98	105
BFX81	45
BFX84	26
BFX85	28
BFX86	28
BFX87	28
BFX88	28
BFY50	21
BFY51	21
BFY52	21
BFY53	28
BFY64	40
BFY71	20
BRY39	39
BSX20	20
BSX26	75
BSY95A	18
BU105	115
BU205	125
BU208	215
E421	158
MD8001	179
MJ491	175
MJ2955	105
MJE340	54
MJE370	58
MJE371	54
MJE520	65
MJE521	74
MJE2955	90
MJE3055	70
MPF102	66
MPF103	36
MPF104	36
MPF105	36
MPF106	40
MPSA05	15
MPSA06	16
MPSA12	22
MPSA55	22
MPSA56	22
MPSU02	58
MPSU05	50
MPSU06	50
MPSU52	65
MPSU55	55
MPSU56	60
OC26	170
OC28	120
OC35	125
OC36	130
OC41	125
OC42	48
OC43	55
OC44	55
OC45	30
OC70	35
OC71	28
OC72	35
OC74	50
OC75	45
OC76	36
OC77	76
OC81	35
OC82	50
OC83	48
OC84	45
OC140	110
OC170	85
OC171	45
OC200	48
TIP29	31
TIP29B	56
TIP29C	60
TIP30	32
TIP30B	40
TIP30C	43
TIP31A	38
TIP31B	43
TIP32A	40
TIP32C	55
TIP33A	54
TIP33C	70
TIP34A	63
TIP34C	75
TIP35A	135
TIP35C	165
TIP36A	145
TIP36C	185
TIP41A	50
TIP41B	55
TIP42A	64
TIP42B	82
TIP120	72
TIP121	90
TIP142	125
TIP147	145
TIP2955	60
TIP3055	48
TIS43	30
TIS44	45
TIS45	45
TIS46	45
TIS88	35
TIS90	20
TIS91	24
ZTX107	11
ZTX108	11
ZTX109	11
ZTX300	13
ZTX301	16
ZTX302	20
ZTX303	25
ZTX304	17
ZTX314	24
ZTX326	45
ZTX341	28
ZTX500	15
ZTX501	15
ZTX502	17
ZTX503	15
ZTX504	25
ZTX531	25
ZTX650	25
40311	60
40313	125
40315	55
40316	85
40326	52
40327	62
40347	80
40348	105
40368	43
40361	45
40362	42
40468	60
40408	95
40411	280
40594	98
40595	90
40603	67
40673	68
2N697	40
2N698	40
2N699	30
2N706A	19
2N708	33
2N918	33
2N1131	22
2N1132	24
2N1303	50
2N1304	50
2N1305	35
2N1613	23
2N1670	150
2N1671B	120
2N2160	350
2N2217	43
2N2218A	34
2N2219A	22
2N2220A	23
2N2221A	23
2N2222A	20
2N2303	45
2N2368	21
2N2369A	15
2N2483	28
2N2484	30
2N2646	48
2N2784	55
2N2904	24
2N2905A	22
2N2906	22
2N2907	22
2N2907A	22
2N2926G	10
2N3011	24
2N3053	19
2N3054	55
2N3055	48
2N3108	32
2N3442	140
£N3663	14
2N3702	10
2N3704	10
2N3705	10
2N3706	10
2N3707	10
2N3708	11
2N3709	11
2N3710	10
2N3711	10
2N3771	179
2N3772	195
2N3773	288
2N3819	20
2N3820	45
2N3823	70
2N3866	90
2N3903	20
2N3904	18
2N3905	18
2N3906	17
2N4037	52
2N4058	17
2N4061	17
2N4062	17
2N4859	65
2N4871	50
2N5172	25
2N5179	60
2N5191	70
2N5305	40
2N5457	32
2N5458	32
2N5459	32
2N5485	35
2N5777	45
2N6027	40
2N6109	50
2SD234	50
3N128	112
3N140	112
AC187	26
AC188	26
AF139	40
BC118	18
BC237	10
BC238	10
BC337	12
BCY34	75
BCY35	50
BCY78	19
BD112	95
BD158	60
B0206	110
BD222	65
BDY56	170
BDY60	140
BF184	25
BF185	25
BF245	24
BF337	32
BFX29	26
BFY55	38
BFY56	32
BFY81	99
BSX29	45
BSX78	75
BSY26	40
MJ490	90
MJE170	130
MJE180	130
MPU131	45
TIS59	50
TIS74	47
UC734	50
40324	91
40467A	95
40468A	70
40636	130
2N1302	35
2N1306	40
2N1307	45
2N1308	50
2N2297	45
2N2476	120
2N2497	50
2N3020	33
2N3252	36
2N3302	28
2N3441	140
2N3703	10
2N3713	140
2N3822	130
2N3824	70
2N3879	150
2N4041	40
2N4064	115
2N4220	60
2N4234	36
2N4236	45
2N4264	24
2N4286	15
2N4289	15
2N4314	61
2N4400	20
2N4427	75
2N4898	135
2N4901	160
2N4921	40
2N4922	55
2N5102	125
2N5135	21
2N5136	21
2N5138	20
2N5180	38
2N 5305	20
2N5308	20
2N5879	140
2N6388	126

WELCOME

JACKSONS VARIABLE CAPACITORS

DILICON		0.2 365pF with slow	
100/300pF	**175p**	motion Drive	**395p**
500pF	**225p**	00 208/176	**325p**
6:1 Ball Drive		.. .. with slow	
4511/DAF	**125p**	motion drive	**395p**
Dial Drive 4103		C804-5pF; 10: 15:	
6:1/36:1	**650p**	25: 50pF	**250p**
Drum 54mm	**40p**	100, 150pF	**335p**
0-1-365pF	**275p**	'L' 3x310pF	**695p**
00 2 365pF	**325p**	00-3x25pF	**490p**

RF CHOKES
1μH, 4.7, 10, 22, 33, 47, 100, 200, 470, 750, 1mH, 2.5, 5, 10 **30p each**
43mH, 100 **60p each**

VEROBOARD

	0.1 (copper clad)	0.15 (copper clad)	0.15 (plain)
2½ x 3¼"	**46p**	**39p**	**24p**
2½ x 5"	**55p**	**50p**	**31p**
3¾ x 3¾"	**55p**	**50p**	—
3¾ x 5"	**62p**	**67p**	**43p**
2½ x 17"	**169p**	**135p**	**92p**
3¾ x 17"	**218p**	**180p**	**120p**
4¾ x 17"	**280p**	—	**183p**

Pkt. of **36**pins **20p**. Spot face cutter **105p**. Pin insertion tool **140p**. VQ Boards **129p**. DIP Boards **290p**. Veroblock **324p**.

VERO WIRING PEN
Plus Spool **325p**
Spare spool (wire) **80p** Combs **7p** each

FERRIC CHLORIDE
1lb bag Anhydrous **125p + 35p** P&P

DALO ETCH RESIST PEN + spare tip **75p**

COPPER CLAD BOARDS

Fibre Glass	Single-sided	Double-sided	SRBP 9.5"×8.5"
6" x 6"	**75p**	**90p**	**80p**
6" x 12"	**130p**	**175p**	

DIL PLUGS (Headers)
14 pin **35p;** 16 pin **40p;** 24 pin **85p;** 40 pin **375p**

Soldercon pins: 100 **55p;** 500 **250p.**

DIL SOCKETS (TEXAS)

	Low prof.	Wire Wrap
8pin	**10p**	**25p**
14pin	**12p**	**35p**
16pin	**13p**	**46p**
18pin	**16p**	**52p**
20pin	**22p**	**65p**
22pin	**25p**	**70p**
24pin	**36p**	**78p**
28pin	**39p**	**85p**
36pin	—	**105p**
40pin	**50p**	**109p**

EDGE CONNECTORS:
(Double type

	.1	.156
2x10 way	—	**85p**
2x15 way	—	**99p**
2x18 way	**115p**	**120p**
2x22 way	**130p**	**135p**
2x25 way	**149p**	**160p**
2x30 way	**170p**	—
2x36 way	**194p**	—
2x40 way	**210**	—
2x43 way	**232p**	—

DIODES

BA102	15
AA119	18
AAZ15	15
BY100	24
BY126	12
BY127	12
CR033	157
OA9	75
OA47	12
OA70	12
OA79	15
OA81	15
OA85	14
OA90	7
OA91	7
OA95	8
OA200	9
OA202	8
IN914	4
IN916	5
IN4001/2	5
IN4003	6
IN4004/5	6
IN4006/7	7
IN4148	4
IN5404	17
IS44	20
3A/100V	15
3A/400V	20
3A/600V	27
3A/1000V	30

NOISE
Z5J **180**

VARICAPS

MVAM115	140
BA102	25
BB104	40
BB105B	40
BB106	40

TRIACS

3A200V	49
3A400V	50
8A100V	54
8A400V	64
8A800V	108
12A100V	60
12A400V	70
12A800V	115
16A100V	240
16A400V	105
16A500V	120
25A500V	235
25A800V	295
T2800D	120

BRIDGE RECTIFIERS
(plastic case)

	p
1A/50V	20
1A/100V	22
1A/200V	25
1A/400V	29
1A/600V	34
2A/50V	35
2A/100V	44
2A/200V	46
2A/400V	53
2A/600V	65
4A/100V	72
4A/400V	79
6A/100V	73
6A/200V	78
6A/400V	85
BY164	56
VM18 DIL	50

ZENERS
Range: 2V7 to 39V 400mW **8p each**
Range: 3V3 to 33V. 1.3W **15p each**

SCRs Thyristors

0.6A200V	30
0.8A100V	30
0.8A200V	35
5A100V	32
5A400V	39
5A600V	43
8A300V	48
8A500V	58
8A600V	85
12A100V	42
12A300V	59
12A500V	92
12A800V	120
BT106	150
BT116	150
C106D	38
TIC44	22
TIC45	25
2N4444	140
2N5064	35

DIAC
ST2 **20**

LINEAR ICs

702	75
709 14 pin	38
709C 8 pin	35
710	67
723 14 pin	38
733	99
741 8 pin	17
741 TO5	35
747C 14 pin	70
748C 8 pin	36
753 8 pin	150
810	159
AY-1-0212	580
AY-1-1313A	660
AY-1-1320	315
AY-1-5050	190
AY-1-5051	145
AY-1-6721/6	195
AY-3-1270	840
AY-3-8500	390
AY-3-8910	850
AY-5-1224A	260
AY-5-1230	450
AY-5-1315	560
AY-5-1317A	630
AY-5-3500	510
AY-5-3507	415
AY-5-3600	1090
AY-5-4007D	650
AY-5-8100	735
CA3011	110
CA3012	150
CA3014	157
CA3018	68
CA3019	70
CA3020	186
CA3023	191
CA3028A	80
CA3035	235
CA3036	115
CA3043	275
CA3045	365
CA3046	71
CA3048	214
CA3075	213
CA3080E	65
CA3081	190
CA3085	95
CA3089E	215
CA3090AQ	375
CA3123E	150
CA3130	90
CA3140	48
CA3160	95
ICL7106	795
ICL7107	975
ICL8038CC	335
ICM7205	1150
ICM7215	1050
ICM7216AJ	1950
ICM7216B	1950
ICM7216C	1950
ICM7217A	790
ICM7555	89
LD130	452
LF356	98
LM10	325
LM301AP	23
LM308T	70
LM311	80
LM318S	195
LM324A	45
LM339	70
LM348	90
LM349	125
LM379	375
LM380	80
LM381N	145
LM382	125
LM386	99
LM387	150
LM1458	40
LM3900	60
LM3909N	70
LM3911	125
LM3914	240
LM13600	135
M252AA	625
M253AA	795
MC663	275
MC1204	000
MC1301	79
MC1303	88
MC1304P	260
MC1310P	175
MC1312PQ	195
MC1495	350
MC1496L	92
MC1596	000
MC3302	000
MC3340P	120
MC3360P	128
MC3401	52
MC3403	135
MEM780	205
MFC6040	97
MK50398	635
MM5303	635
MM5307	1275
MM57160	620
NE515	80
NE518	210
NE543K	210
NE544	185
NE555	20
NE556	55
NE560	325
NE561	395
NE5628	410
NE564	425
NE565A	120
NE566	160
NE567V	170
NE570	375
NE571	420
RC4136D	110
SG3402	295
SN76003N	170
SN76013	170
SN76013ND	130
SN76018	148
SN76023	170
SN76023ND	130
SN76033N	195
SN76115N	215
SN76131	110
SN76227N	95
SN76477	200
SN7666D	120
SP8629	295
TAA550	50
TAA960	320
TAA621AX1	228
TAA661A	155
TAA700	353
TAO100	159
TBA120S	70
TBA540Q	220
TBA550Q	330
TBA641-A12	
BX or BX11	250
TBA651	190
TBA800	90
TBA810	95
TBA820	70
TBA920Q	260
TBA990Q	270
TCA270Q	220
TCA965	120
TDA1004	290
TDA1008	310
TDA1022	575
TDA1024	105
TDA2020	320
TL061CP	54
TL062CP	125
TL064CN	159
TL071	45
TL072CP	90
TL074CN	140
TL081CP	42
TL082CP	96
TL083CP	95
TL084CN	120
UAA170	150
UAA180	150
ZN414	80
ZN424E	130
ZN425E	415
ZN1034E	200
ZN1040E	685

TTL 74 (TEXAS)

7400	11
7401	12
7402	12
7403	14
7404	14
7405	18
7406	48
7407	48
7408	22
7409	22
7410	19
7411	25
7412	20
7413	33
7414	52
7416	31
7417	31
7420	19
7421	38
7422	26
7423	32
7425	30
7426	44
7427	32
7428	35
7430	20
7432	28
7433	38
7437	35
7438	30
7440	20
7441	74
7442	71
7443	120
7444	116
7445	116
7446	132
7447	99
7448	99
7450	20
7451	20
7453	20
7454	20
7460	20
7470	41
7472	31
7473	40
7474	34
7475	56
7476	41
7480	55
7481	120
7482	75
7483	94
7484	113
7485	121
7486	33
7489	215
7490	57
7491	85
7492	59
7493	59
7494	95
7495	75
7496	95
7497	180
74100	130
74104	62
74105	62
74107	35
74109	60
74110	54
74111	68
74112	150
74116	198
74118	99
74119	125
74120	105
74121	42
74122	55
74123	95
74125	45
74126	55
74128	74
74132	70
74136	65
74141	85
74142	195
74143	350
74144	350
74145	90
74147	180
74148	145
74150	150
74151	75
74153	75
74154	140
74155	75
74156	80
74157	75
74159	185
74160	99
74161	99
74162	99
74163	99
74164	120
74165	120
74166	155
74167	240
74170	230
74172	420
74173	120
74174	105
74175	82
74176	90
74177	90
74178	149
74180	90
74181	290
74182	88
74184	145
74185	145
74188	299
74190	135
74191	135
74192	135
74193	135
74194	105
74195	198
74196	130
74197	90
74198	195
74221	140
74246	195
74247	195
74248	195
74249	195
74251	120
74265	63
74273	270
74278	220
74279	99
74283	150
74284	385
74285	385
74290	125
74293	125
74297	236
7'298	185
74365	95
74366	95
74367	95
74368	95
74390	185
74393	185
74179	155
74199	198
74490	150

74L

74L00	78
L30	80
L47	395
L75	220
L85	360
L121	195
L123	340

74S

74S00	60
S04	73
S132	350
S138	250
S158	524
S188	210
S189	158
S194	195
S195	795
S241	195
S262	895
S287	325
S288	210
S470	325
S472	1150
S475	825

74LS

LS00	13
LS01	13
LS02	15
LS03	15
LS04	20
LS05	23
LS08	23
LS09	23
LS10	20
LS11	32
LS12	32
LS13	40
LS14	75
LS15	40
LS20	21
LS21	32
LS22	40
LS26	48
LS27	45
LS28	48
LS30	24
LS32	30
LS33	39
LS37	39
LS38	39
LS40	28
LS42	80
LS47	85
LS48	120
LS49	120
LS51	25
LS54	30
LS55	70
LS63	150
LS73	40
LS74	40
LS75	48
LS76	45
LS78	45
LS83	105
LS85	105
LS86	45
LS90	50
LS91	125
LS92	75
LS93	75
LS95	115
LS96	180
LS107	45
LS109	75
LS112	80
LS113	65
LS114	49
LS122	70
LS123	95
LS124	180
LS125	60
LS126	60
LS132	95
LS136	55
LS138	70
LS139	90
LS145	120
LS147	210
LS148	175
LS151	96
LS153	85
LS155	96
LS156	96
LS157	76
LS158	85
LS160	120
LS161	98
LS162	110
LS163	100
LS164	164
LS165	165
LS166	166
LS168	210
LS169	210
LS170	288
LS173	105
LS174	147
LS175	110
LS181	295
LS183	298
LS189	120
LS190	120
LS191	120
LS192	125
LS193	125
LS194	125
LS195	125
LS196	120
LS197	120
LS199	
LS200	345
LS202	345
LS221	120
LS240	225
LS241	225
LS242	232
LS243	232
LS244	225
LS245	270
LS247	135
LS248	135
LS249	135
LS251	130
LS253	130
LS257	115
LS258	120
LS259	160
LS261	450
LS266	75
LS273	180
LS275	320
LS279	88
LS280	250
LS283	190
LS290	130
LS293	130
LS295	215
LS298	215

DIGEST

Sony Screen Machine

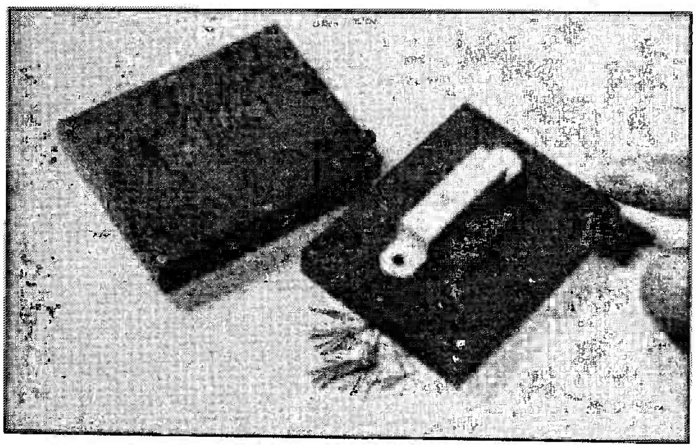
One of the more significant product releases this month was the new Sony C7 video recorder. It has several features which mark it out as the best design yet for home usage. Although Sony themselves placed great emphasis upon the solenoid controls and IR Control System these will bring little more than a yawn to the lips of anyone with the faintest claim to technical knowledge.

Of far greater interest will be the superbly conceived set-up procedure (under MPU control) and the versatile times.

Tuning in most VCRs is both time consuming and patience destroying. The C7, once locked to the set with a panel control, will automatically search the band looking for stations and load any it finds into pre-set locations for easy user access. (It's about time someone did something like this anyway).

Curious too is the lack of eulogy over the picture quality which far outstripped its competitors, being all but indistinguishable from broadcast. Some new features are provided to help use this, however, like a picture search mode which will accelerate the tape, in vision with the sound off, to twenty times normal speed. Finding the exact spot you seek is thus facilitated. Freeze frame and slow-motion are also lurking in the circuits.

The C7 will sell for little more than present machinery and is far more refined in several important areas. Should do well.



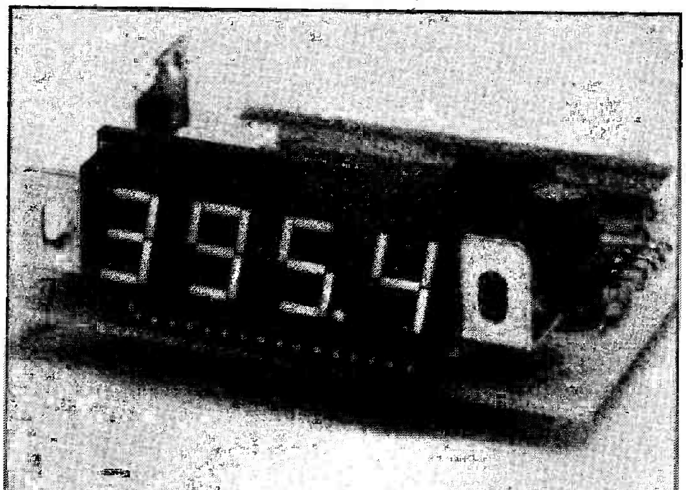
Universal Test Socket

FI have developed a new test socket called the Textool GRID ZIP. It can be either PCB mounted or fixed to front panels using mounting screws. The makers claim an operating life of greater than 25,000 insertions, and one economy feature is the ability to mount more than one device per socket plate, and spare plates can be supplied to increase the utility of the socket.

You can use this test socket with any standard or non-standard device if the leads fit within a 14 x 21 grid (on 0.1" lead centres). The socket consists of a top plate with guide indentations on a 0.1" grid, a camplate to provide the Zero Insertions Pressure clamping operation and a base plate holding the plated beryllium copper contacts. So, once the top plate has been drilled to take the device leads, contacts are placed in the desired locations in the base plate and the cam assembly is dropped onto them. The resulting 'sandwich' is held together by eight screws running through the edges. In use this means that a device is simply dropped onto the pre-drilled holes and the clamping lever is flicked down to clamp the contacts onto the device leads, so no strain is put onto the device and good electrical contact is ensured, this in turn means extended contact life. Average contact resistance is less than 0.005 ohms. In a production situation, incorrect insertions are virtually eliminated as there is only one set of socket holes.

Micro-Data Systems' 3 digit panel meter combines economy with high performance. Accuracy is 0.05% with resolution to 100 uV and the scale allows four digit resolution of quantities up to 4,000, rather than the 2,000 to which other units are limited. A 5 volt supply is required. The naked PCB construction incorporates a red filter, enabling direct panel mounting without the need for a separate bezel. Prices are from £19.95 (one off) down to £14.95 each, if you can find a use for fifty of them.

Further details from Micro-Data Systems, Office Suite 1, Coach Mews, The Broadway, St. Ives, Huntingdon, Cambs PE17 4BN.



Technical Queries

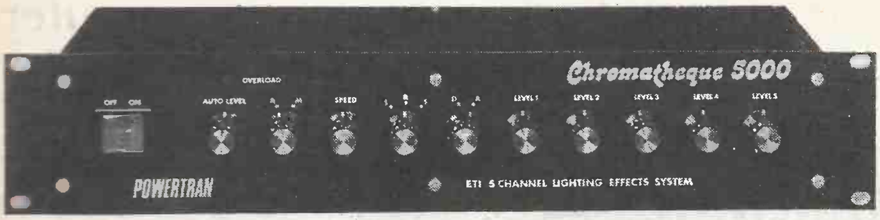
We've had an impassioned plea from our automatic telephone answering machine (our receptionist) about an item which we published some time ago in Digest. Although we have suspended our telephone answering service for ETI technical queries, we are still receiving a number of calls every day from readers asking for technical help. Our receptionist is unable to accept these calls.

Unfortunately we are unable to answer technical questions by telephone. If you are having problems with an ETI project, please write with full details and enclosing a stamped, addressed envelope.

CHROMATHEQUE 5000

POWERTRAN

5 CHANNEL LIGHTING EFFECTS SYSTEM



Panel size 19.0" × 3.5". Depth 7.3"

COMPLETE KIT

ONLY

£49.50 + VAT!

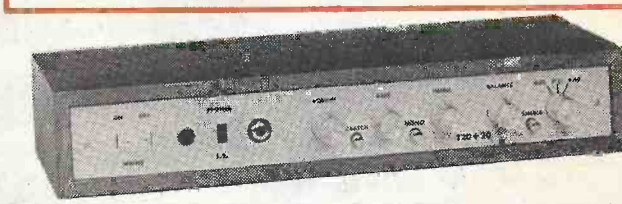
This versatile system featured as a constructional article in ELECTRONICS TODAY INTERNATIONAL has 5 frequency channels with individual level controls on each channel. Control of the lights is comprehensive to say the least. You can run the unit as a straightforward sound-to-light or have it strobe all the lights at a speed dependent upon music level or front panel control or use the internal digital circuitry which produces some superb random and sequencing effects. Each channel handles up to 500W and as the kit is a single board design wiring is minimal and construction very straightforward.

Kit includes fully finished metalwork, fibreglass PCB controls, wire, etc. — Complete right down to the last nut and bolt!

All kits also available as separate packs (eg PCB, component sets, hardware sets etc). Prices in our FREE CATALOGUE.

DE LUXE EASY TO BUILD LINSLEY HOOD 75W STEREO AMPLIFIER £99.30 + VAT

This easy to build version of our world-wide acclaimed 75W amplifier kit based upon circuit boards interconnected with gold plated contacts resulting in minimal wiring and construction delightfully straightforward. The design was published in Hi-Fi News and Record Review and features include rumble filter, variable scratch filter, versatile tone controls and tape monitoring whilst distortion is less than 0.01%.



T20+20 20W STEREO AMPLIFIER £33.10+VAT

This kit, based upon a design published in Practical Wireless, uses a single printed circuit board and offers at very low cost, ease of construction and all the normal facilities found on quality amplifiers. A 30-watt version of this kit (T30+30) is also available for **£38.40** + VAT.

Above 2 kits are supplied with fully finished metalwork, ready assembled high quality teak veneer cabinet, cable, nuts, bolts, etc and full instructions — in fact everything! Matching TUNERS and CASSETTE DECK — see our free catalogue!

BLACK HOLE

THIS MONTH'S FRONT COVER FEATURE!

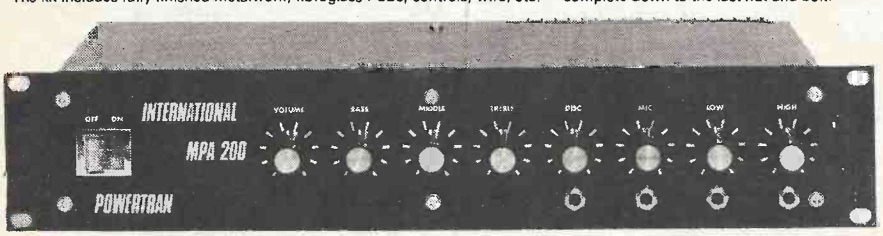
The BLACK HOLE designed by Tim Orr, is a powerful new musical effects device for processing both natural and electronic instruments, offering genuine VIBRATO (pitch modulation) and a CHORUS mode which gives a 'spacey' feel to the sound achieved by delaying the input signal and mixing it back with the original. Notches (HOLES), introduced in the frequency response, move up and down as the time delay is modulated by the chorus sweep generator. An optional double chorus mode allows exciting antiphrase effects to be added. The device is floor standing with foot switch controls, LED effect selection indicators, has variable sensitivity input, has high signal/noise ratio obtained by an audio compander and is mains powered — no batteries to change! Like all our kits everything is provided including a highly superior, rugged steel, beautifully finished enclosure.

COMPLETE KIT ONLY £49.80 + VAT (single delay line system)

De Luxe version (dual delay line system) als available for **£59.80 + VAT**

MPA 200 100 WATT (rms into 8Ω) MIXER/AMPLIFIER

Featured as a constructional article in ETI, the MPA 200is an exceptionally low priced — but professionally finished — general purpose high power amplifier. It features adaptable input mixer which accepts a wider range of sources such as microphone, guitar, etc. There are wide range tone controls and a master volume control. Mechanically the MPA 200 is simplicity itself with minimal wiring needed making construction very straightforward.
The kit includes fully finished metalwork, fibreglass PCBs, controls, wire, etc. — complete down to the last nut and bolt.



Panel size 19.0" × 3.5". Depth 7.3"

COMPLETE KIT ONLY £49.90 + VAT!

MATCHES THE CHROMATHEQUE 5000 PERFECTLY!

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SECURICOR DELIVERY: For this optional service (U.K. mainland only) add £2.50 (VAT inclusive) per kit.
SALES COUNTER: If you prefer to collect kit from the factory, call at Sales Counter. Open 9 a.m.-12 noon, 1-4.30 p.m. Monday-Thursday.

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ion of Ford motor cars and integrated circuit production. The graphs clearly show that production costs are related to the accumulated experience. I would imagine this can be repeated using a host of other products, washing machines for example, which offer a similar picture.

Making Bubbles

The accumulated expertise of chip manufacturers has been most significant in solid state memories with the rapid development of random-access and read only memories, charged-coupled devices and magnetic-bubble memories. Storage capacities of memory devices will continue to increase through 1980. However, an end is in sight to the straight-line growth curve of semiconductor memory densities. Instead of memory capacity doubling every two years this will stretch out to three and four years now that the limits of optical lithographhy are under pressure.

One of the most exciting developments which has been progressing quietly during the past few years is bubble memories. Already announcements are being made of quarter-million-bit bubble memories which could be followed by a megabit device this year and then a 4 megabit memory in the mid 1980's. Bubbles will soon begin to encroach on markets now dominated by the other technologies. With the larger storage densities and the non-volatile memory, this means data can be retrieved even after power loss. Bubble memories occupy less space than either semiconductor memories or floppy discs for the same storage capacity. Access times are in milliseconds which is comparable to other magnetic storage devices but very much slower than semiconductor memories.

At present bubble devices cannot provide portable storage which means a chip cannot be removed and filed away then later plugged into another system. With present costs and performance characteristics, magnetic bubbles seem to pose the biggest threat to storage systems between 300,000 and 3 million bits of data storage. They will threaten the lower end of the tape cassette, floppy disc and fixed-head disc markets. The fabrication and operation of bubble devices was for a long time quite a mystery to me which has prompted me to write about them. It is almost as difficult to accept as the holes theory was when learning about transistors.

Most magnetic bubble memories use a magnetic garnet crystal grown on a non-magnetic substrate. When no magnetic field is applied to the magnetic garnet film, domains in the thin film form serpentine patterns of upward (positive) and downward (negative) magnetization. It is possible to actually see the magnetic patterns using red light and polarising microscope, which greatly simplifies development work. When a magnetic field is applied by sandwiching the chip between two permanent magnets, the magnetic bias expands domains in the bias direction and shrinks those polarised in the opposite direction. At a certain field strength, the serpentine patterns shrink to small cylindrical magnetic domains or 'bubbles'. Typical bubble diameters range from 2 to 30 micrometers determined by the material and the bias.

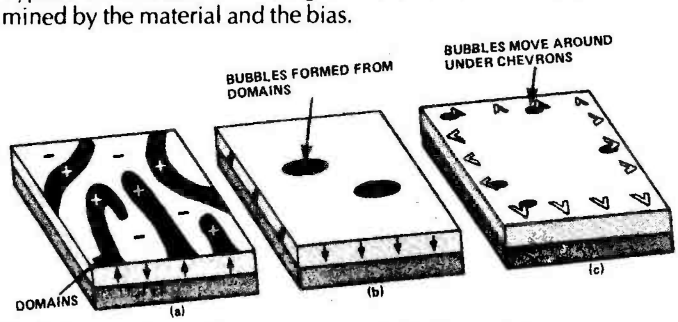
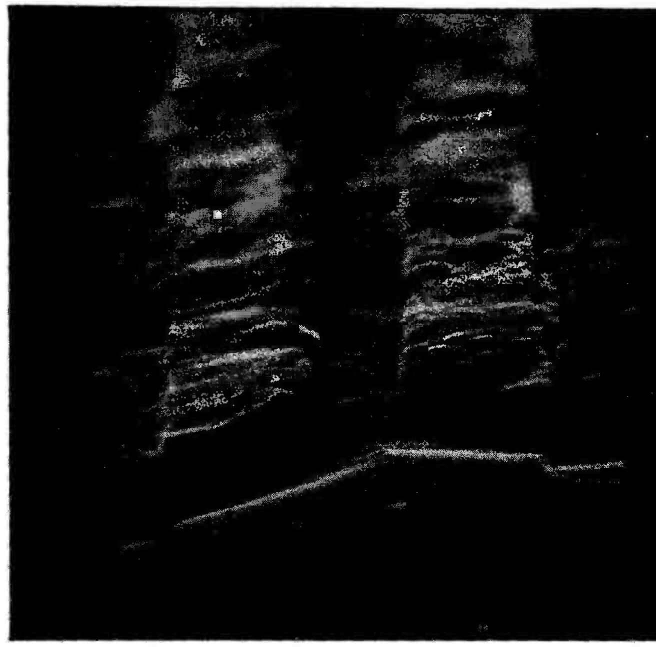


Fig.2(a). serpentine patterns occur naturally in the crystal.
(b) the bubbles form from domains when a bias is applied, from a permanent magnet.
(c) the bubbles move around under the chevrons when a rotating field is applied.



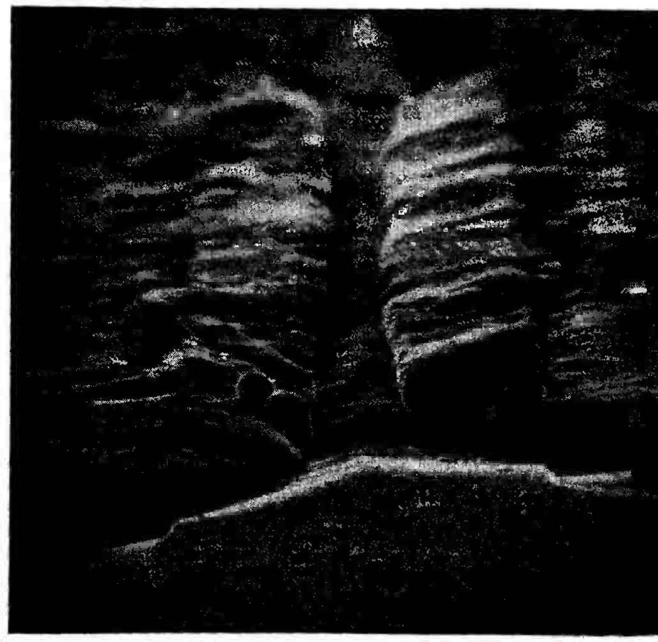


PHOTO 2 (top): the channel following metal deposition.
PHOTO 3 (above): breakdown! The overhang has collapsed.

In memory or logic devices the bubbles can be used to represent data, since the presence of a bubble can signify a binary 1 and the absence of a bubble can signify a binary 0. Bubbles can be generated by altering the bias field with a current pulse through a small conductive loop deposited on the chip. The current pulse produces a magnetic field opposite to that of a bias field thus producing a new bubble. Conversely, bubbles can be annihilated by applying a local field in a direction aiding the bias field. New techiques in magnetic bubble technology will eliminate the bulky field coils and permalloy layer by using a pair of conducting layers instead of magnets to move the bubbles. These and other improvements will further reduce the size, weight and manufacturing cost of bubble memories and will also speed data flow and increase bit densities. **ETI**

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LATEST MODELS. The 1980 models will now be available. Prices and details on application. Be sure you are buying latest model.

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AQ2200 calc with clock alarm stopwatch, calendar display and full month display date calculations, +/−/×/÷ √ % keys M+ M− MRC **£19.45**
AQ1500 8 digit calculator with clock, calendar, lap & 1st, 2nd place 1/10th sec stopwatch **£14.45**
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MQ6 mini-card size calc, watch calendar, stopwatch with case & chain for waistcoat **£19.45**
MQ12 slim card calc with watch, stopwatch, calendar, full month display and alarm **£19.45**
QL10 calc watch calendar date calculations, 2 alarms + countdown alarm & lighter **£39.95**
PW81 slim card calc with watch and calendar, smart case with window **£14.45**
NQ21 hand held calculator with watch, latest model, +/−/×/÷/% memory **£10.45**
ML81 slim calc/watch/calendar/alarm 1 & 2 alarm countdown/stopwatch/time signal on the hour/3 programmed melodies/11 tones on keys, 8 digit calc **£22.45**
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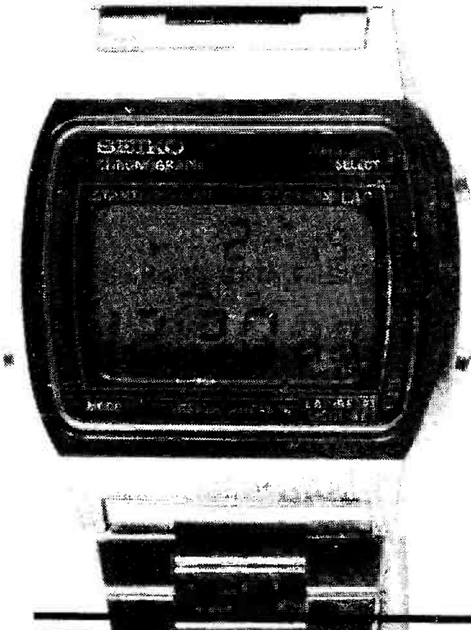

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60 page manual with S-100 interface instructions and several programming examples **£2.25 extra** (No VAT).

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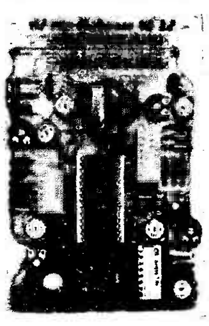

The SE-01 is a complete kit that contains all the parts to build a programmable sound effects generator. Designed around the new **Texas Instruments SN76477** Sound Chip, the board provides banks of MINI DIP switches and pots to program the various combinations of the SLF Oscillator, VCO, Noise, One Shot, and Envelope Controls. A Quad Op Amp IC is used to implement an Adjustable Pulse Generator, Level Comparator and Multiplex Oscillator for even more versatility. The 3¼" x 3" PC Board features a prototype area to allow for user added circuitry. Easily programmed to duplicate **Explosion, Phaser Guns, Steam Trains,** or almost an infinte number of **other sounds.** The unit has a multiple of applications. The low price includes all parts, assembly manual, programming charts, and detailed 76477 chip specifications. It runs on a 9V battery (not included). On board 100MW amp will drive a small speaker directly, or the unit can be connected to your stereo with incredible results! (Speaker not included.)

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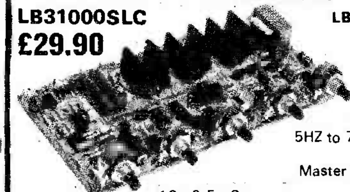

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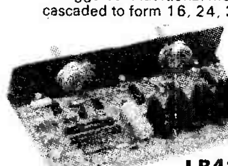
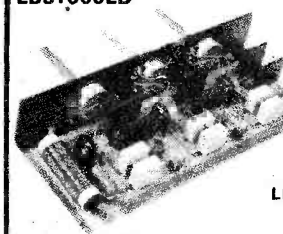


LB41000LS
£17.50
20 x 9.2 x 3.5 cm

LB31000LD



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LB250	LB150	LB100	LB25
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S/N 110 dB	S/N 110 dB	S/N 110dB	S/N 90 dB
THD 0.1%	THD 0.1%	THD 0.1%	THD 0.07%
0.5v SENS	0.5v SENS	0.5v SENS	0.5v SENS
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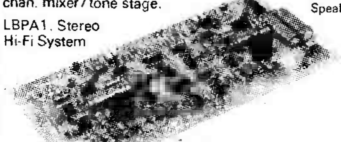

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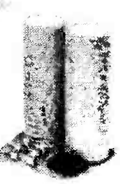

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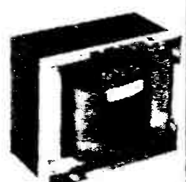

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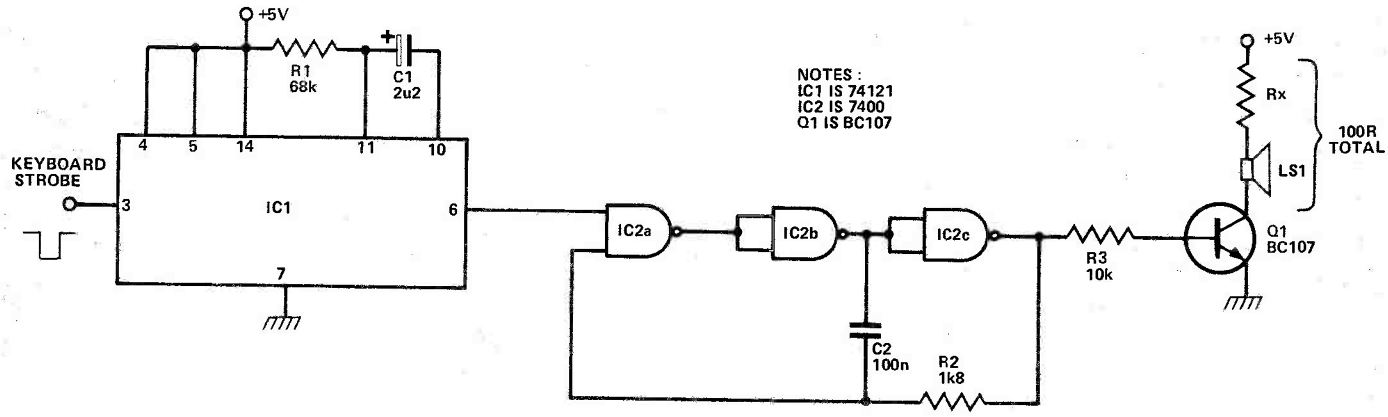


Keyboard Audio Feedback

JA Tarlton, Nottingham.

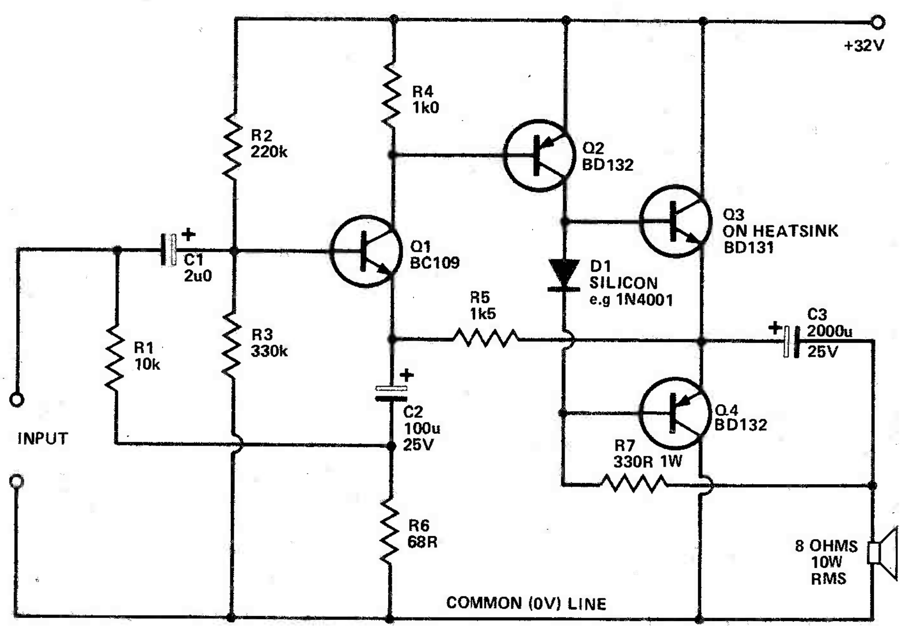
When typing data into a computer it can become a nuisance if the operator has to keep looking up at the VDU screen merely to check if the character typed has been accepted. This often occurs when the keyboard lacks a positive feel.

This circuit provides a positive indication of keyboard operation. It consists of a monostable multivibrator with a duration of approximately 100 mS and a TTL oscillator running at 2 kHz feeding a loudspeaker. In operation the strobe signal from the keyboard triggers the monostable which in turn switches the oscillator on, producing a tone from the loudspeaker.

Simple Ten Watt Amplifier

A Hiley, Woking.

This is an extremely simple and inexpensive general purpose amplifier. The design is conventional, the only point of interest being that the output transistors are underbiased: This means that there is no possibility of thermal runaway - it should, however, introduce large amounts of distortion, but, in fact, due to the high level of negative feedback employed, the distortion is reasonably low. Frequency response is extremely good.



Tech-Tips is an ideas forum and is not aimed at the beginner. We regret we cannot answer queries on these items. ETI is prepared to consider circuits or ideas submitted by readers for this page. All items used will be paid for. Drawings should be as clear as possible and the text should preferably be typed. Circuits must not be subject to copyright. Items for consideration should be sent to ETI TECH–TIPS, Electronics Today International, 145 Charing Cross Road, London WC2H 0EE.

Memory Test-T159

JK Porter, Gravesend.

The game is basically a test of mental agility and determines how many digits the player can successfully retain in his memory, whilst having to do deductive thinking at the same time. Because you can pre-set the level of difficulty, the game is suitable for all ages, and at its upper skill level it is very difficult indeed.

A series of numbers will be shown, each being displayed for about one second. This is an example:

0.7849

The numbers to watch are the first three digits of the mantissa, that is, the 7, 8 & 4. Deduce the number's highest digit, and remeber it. In this case, it is the 8, since you ignore the last digit. If, as in 0.5884, the highest digit occurs twice, only remember it once. Do this for all the numbers flashed at you, (determined by the number you place in Memory 0 at the beginning of the game). So, if you choose to have 6 numbers displayed, you will eventually remember 6 digits. When the program stops, multiply all these digits together. By subtracting the number now in Memory 4, you can see how far you are, and if too high, or too low. (Positive number, too high; negative number, too low).

PROCEDURE

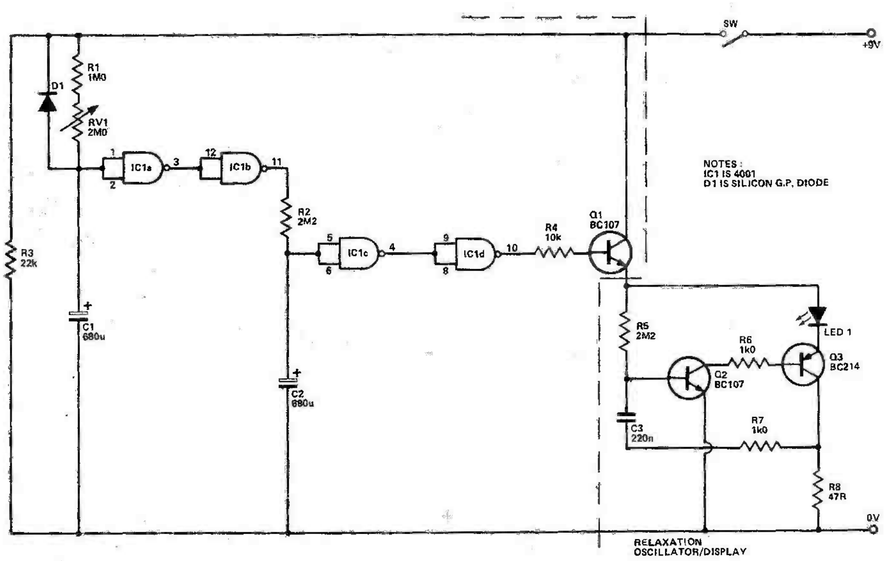
1. LRN. Key in program. LRN. RST.
2. 2nd FIX 4.
3. I STO 4.
4. Quantity of numbers you wish to be shown, e.g. 6 STO 0, You will be shown 6 numbers.
5. Key in all-decimal number, e.g. 0.675432. R/S.
6. Game runs.
7. When program halts, multiply together the requisite digits. Subtract from this the quantity held in Memory 4 to find the result.
8. Continue from 3.

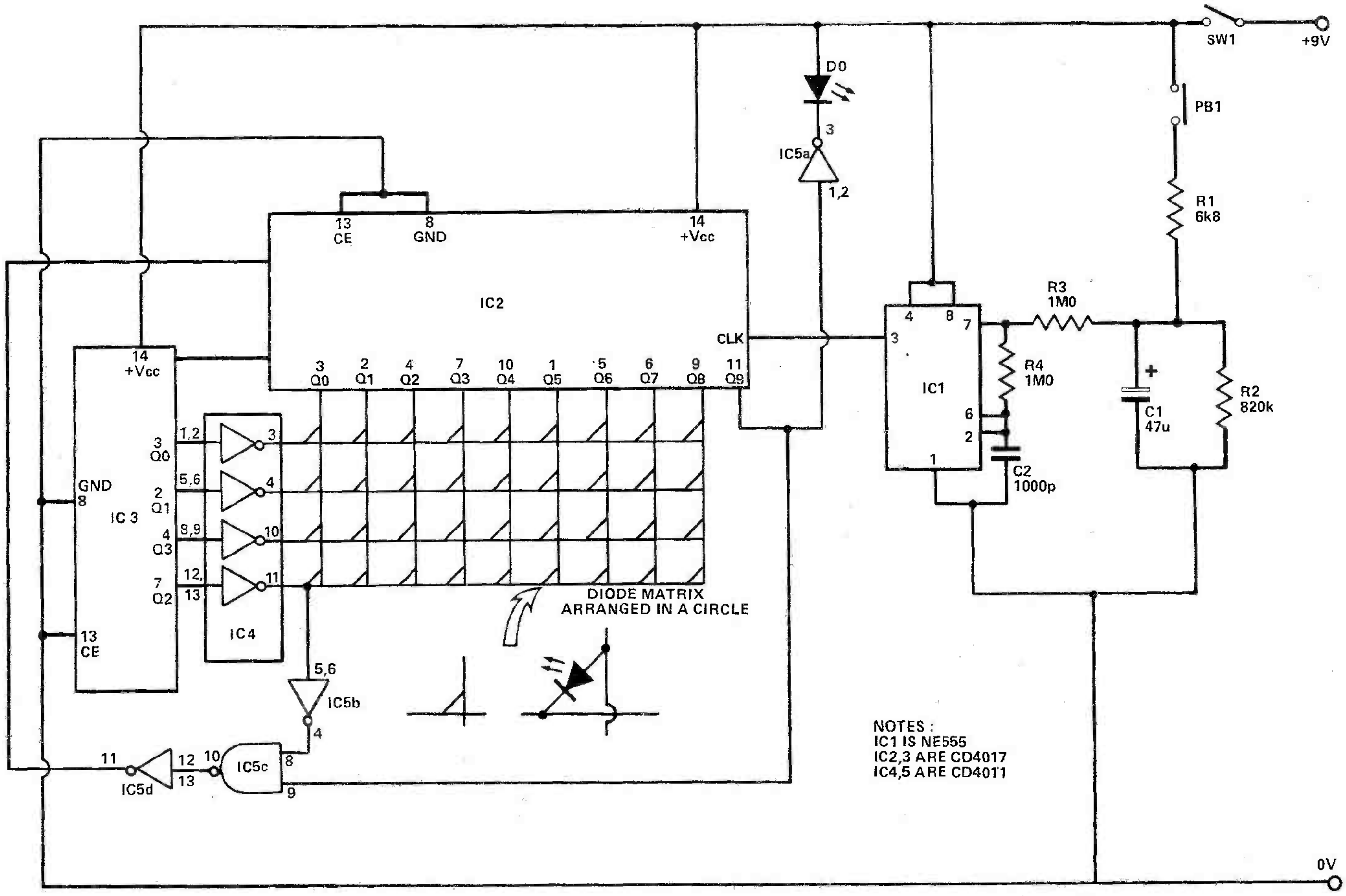
LOC	CODE	KEY
00	34 6	SUM 6
01	33 6	RCL 6
02	35	Yx
03	30	2nd π
04	85	=
05	–35	INV Yx
06	05	5
07	85	=
08	–49	INV 2nd INT
09	36	2nd PAUSE
10	34 6	SUM 6
11	61 0	SBR 0
12	32 1	STO 1
13	61 1	SBR 1
14	32 2	STO 2
15	61 1	SBR 1
16	32 3	STO 3
17	33 1	RCL 1
18	22	x t
19	33 2	RCL 22
20	76	2nd x $\geqslant$ t
21	22	x t
22	33 3	RCL 3
23	76	2nd x $\geqslant$ t
24	51 5	GTO 5
25	33 7	RCL 7
26	39 4	2nd PRD 4
27	51 6	GTO 6
28	86 5	2nd LBL 5
29	39 4	2nd PRD 4
30	86 6	2nd LBL 6
31	56	2nd DSZ
32	71	RST
33	00	0
34	81	R/S
35	71	RST
36	86 0	2nd LBL 0
37	55	X
38	01	1
39	00	0
40	85	=
41	32 5	STO 5
42	49	2nd INT
43	–61	INV SBR
44	86 1	2nd LBL 1
45	33 5	RCL 5
46	–49	INV 2nd INT
47	61 0	SBR 0
48	–61	INV SBR

Cascade Timer

P R G Reynolds, Benfleet.

This device will give timing periods in excess of one hour, using the minimum of external components, together with an inexpensive CMOS integrated circuit. The high input impedance of CMOS circuits is used to provide two cascaded timing networks. Network RV1-C1-R1 gives a variable time delay before sending output 1 low. This output is buffered and inverted, before initiating the timing sequence associated with the second network, R2-C2. Output 2 is again fed to the second buffer before connection to an output display via Q1. A flashing display was chosen in this case for two reasons. First, to conserve current in an already economical circuit. Second, a flashing display is more immediately noticeable. However, there is no reason why an alternative display should not be used.





Electronic Roulette

AC Dickens, Leicester.

The advantage of this design over ten number versions, is that all 37 numbers are catered for, as in a conventional game, and the electronic circuit remains cheap and simple.

Initially, when PB1 is depressed, C1 charges via R1. The voltage on IC1 pin 7 rises, causing IC1 to start generating pulses which rapidly increase in frequency. IC2 & IC3 are decade counters, arranged so that each one of the 36 red LEDs in the matrix is illuminated in turn. The gates of IC5 are arranged so that D_0 (which is green in my circuit) is illuminated after D_{36}, and followed by D_1. Hence an apparent circular motion is generated. After the 'wheel' has been spun, PB1 is released. C1 now discharges via R2 and R3, so that the 'wheel' apparently slows down and then stops at one of the 37 numbers, each of which has an equal probability of occuring. The running time, and speed of 'revolution' can easily be altered by changing the value(s) of appropriate capacitor(s) or resistor(s).

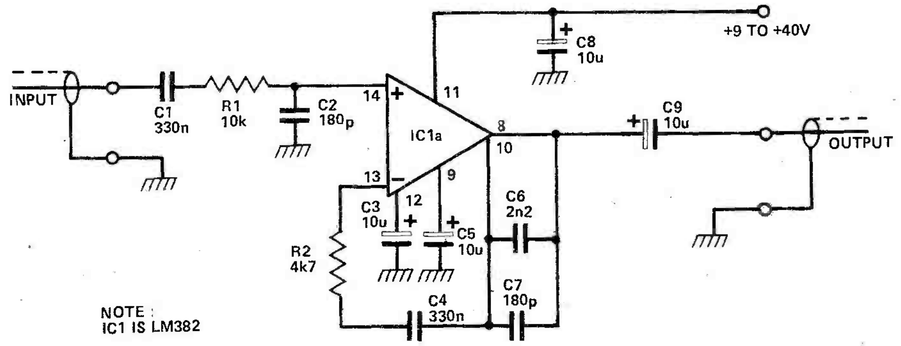
Cassette Tape Preamp

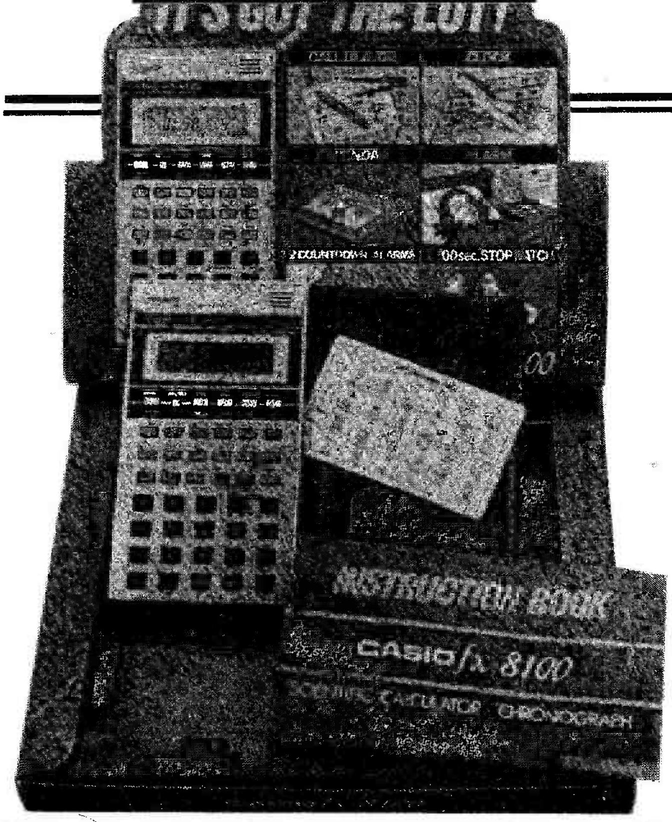
R Willis, Felsted.

Preamp circuits utilising the LM382 low-noise preamp chip have been used in ETI before. However, when using them in conjunction with a cassette player the results can be disappointing as the cassette equalisation was to NAB standards.

This circuit is equalised for the Philips cassette system and will provide a high quality output of about 100 to 200 mV when driven from a stereo tape head.

The circuit will work on supply voltages from +10 V to +40 V, taking about 10 mA and is suitable for industrial, PA, domestic, portable and automatic application. In operation R1-C1 and R3-C11 provide RF immunity. R2-C4 and C15-C16 provide the 120 uS time constant. C3-C5-C12-C14 decouple the internal feedback loop of the IC and C8 decouples the supply line. C1-C8-C10-C17 AC couple the input and output screened wires.





Calculating Casio

This is a slightly butcher than usual scientific calculator/chronograph from Casio measuring 6.6 mmH x 70 mmW x 129 mmD. Its electronic buzzer will give hours of amusement to its proud owner as it can be used with its alarm, two countdown alarms, or hourly time signal, and boy, is it loud! Not only that, but this fine piece of technology has a calendar indicating year, month, date and day with a programmed range from March 1st 1976 to December 31st 1999, if they don't make you obsolete by then! "That's all very well", you cry, "but what does it actuallydo?" Well, 46 scientific functions include: 4 basic calculations, constants for $+/-/\times/\div/x^y/x^{1/y}$, parenthesis calculations up to five levels, accumulation to the memory, fraction calculations, percentage calculations, statistical calculations, obtaining standard deviation sexagesimal to decimal conversion, trigonometric/inverse trigonometric functions, hyperbolic/inverse hyperbolic functions, common and natural logs, exponentiations (antilogarithms, exponentials, powers and roots), squares, square roots, cube roots, reciprocals, factorials, conversion of coordinate system, sign change, register exchange, Pi entry and scientific notation. (Phew).

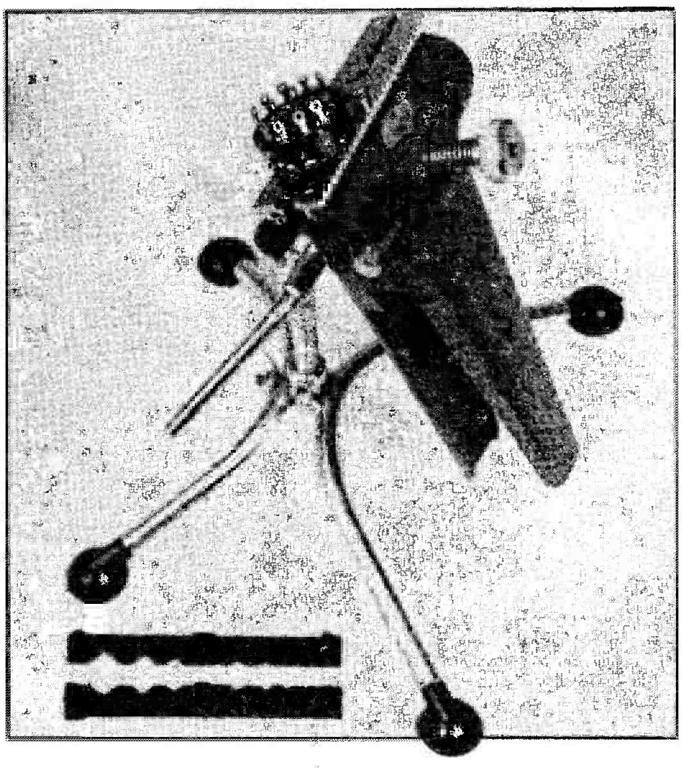
But that's not all — capacity for entry or basic calculations is 8-digit mantissa, or 8-digit mantissa plus 2-digit exponent up to $10^{\pm 99}$. Fraction calculation capacity is maximum 3-digit mantissa for each integer, numerator or denominator and at the same time maximum 6-digit mantissa for the sum of each part. All this from its one little chip: C—MOS—LSI crystal oscillator. Amazing isn't it? But not quite as amazing as the 144-page instruction book that tells you how to make it do all these things. The normal price is £27.95, or £24.95 from Tempus.

Third Hand

Have you ever wished, whilst fiddling with your circuitry, that your hands didn't act like a bunch of sausages? Well, Telpro have produced an aid for the harrassed electronics handyman in the form of the Multi-Purpose Work Holder. One side has a series of holes for gripping objects from 1 mm in diameter (component leads, etc) to 20 mm in diameter. The reverse side is serrated to hold flat objects such as circuit boards. A spring loaded knob allows the clamp pressure to be varied.

The clamp is mounted on a universal joint allowing 360° rotation and 180° tilt from vertical to horizontal and can be locked in any position. The clamp is detachable from its metal stand which has sucker feet, so that an alternative stand for fitting to a bench vice can be used. This is available as an optional extra. Metal and nylon jaws are supplied with the holder as standard.

So gone are the days of squashing things and dropping them just as you're getting the wire onto the pin . . . blast! it slipped out of my fingers.



Stripping News

AB Engineering has produced a new wire stripper and cutter based on their popular AB MK 100 and called the MK 001. It has an improved locking device and features a knurled knob adjustment to control stripping depth, a retaining clip to keep it closed and a curved cutting edge for clean wire cutting. The price is £1.85 and further details of this and the company's large range of tools are available from: AB Engineering Company, Timber Lane, Woburn, Beds. MK17 9PL.

MEMorable Big Brother

MEM are to launch two new programmable logic controllers for controlling automatic machinery. Memaster 500 can handle no less than 512 channels and can store up to 4096 logic instructions. If your system requires more than that, doubling the memory capacity is possible at relatively low cost. If your control requirements are a little more modest the smaller Memaster 80 system may be what you need.

Memaster 500 is rather unusual in that it incorporates a digital input filtering system and a timer and counter unit with direct manual adjustment. The controller fits into a standard rack mounting system. Modular design makes for easy servicing. The controlling program can be tested in slow motion and, if necessary, printed out or burned permanently into UVEPROM (ultraviolet erasable PROM).

You can get further details of this sophisticated new PLC system from MEM Electronics Division, Regency House, 101 Hagley Road, Birmingham B16 8LA.

ETIPRINTS

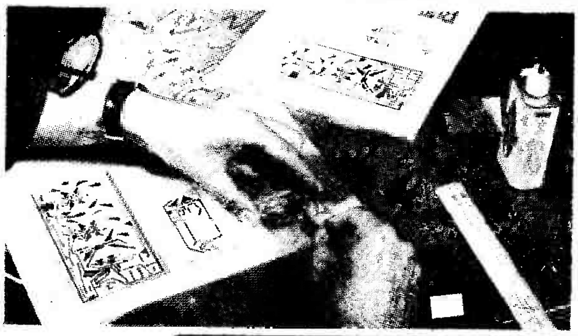
ETIPRINTS are a fast new aid for producing high quality printed circuit boards. Each ETIPRINTS sheet contains a set of etch resistant rub down transfers of the printed circuit board designs for several of our projects. ETIPRINTS are made from our original artwork ensuring a neat and accurate board. We thought ETIPRINTS were such a good idea that we have patented the system (patent numbers 1445171 and 1445172).

PARTS LIST

Shown below is the listing for the last year's ETIPRINTS. Earlier sheets are available, ring Tim Salmon for details.

033	LED Audio Display (2 boards) (topside pattern) Bench Amp NICD Charger	Aug 79
034	Cable Tester Reaction Tester Speech Compressor Preamp Power Supply Rectifier & De-Thump Board Power Amp (2) (price £1.60)	Nov 79
035	Oven Leakage Detector Pinball Wizard	Nov 79
036A	3 x Display Board Relay Activator Points Controller	Nov 79
036B	Data Distributor (double sided)	Nov 79
036C	Train Speed Controller Track Cleaner & Electronic Pot (double sided)	Nov 79
036D	Power Switch Selector (double sided)	Nov 79
037A	Encoder (double sided)	Dec 79
037B	Decoder (top side)	Dec 79
037C	Decoder (bottom side)	Dec 79
038A	Long Period Timer Rain Alarm Touch Switch Flash Trigger Pseudo Random Noise Gen	Dec 79
038B	Hum Filter Dice Logic Probe	Dec 79
038C	Function Generator	Dec 79
039	Buffer Moving Coil Preamp Process Controller	Jan 80
039A	Hum Filter Logic Probe	Dec 79
039B	Long Period Timer Rain Alarm Touch Switch Flash Trigger Pseudo Random Noise Gen	Dec 79
039C	Function Generator	Dec 79
049A	ETI 80 — VCO and VCLFO	Feb 80
040B	ETI 80 — PSU Tuning Fork Filter Coin Toss	Feb 80
041A	ETI Audiophile ETI VCA Signal Trace ETI HC Electromyogram	Mar 80
041B	VCM Heater Controller	Mar 80
042A	300W Amp Module	Apr 80

HOW IT WORKS



Lay down the ETIPRINT and rub over with a soft pencil until the pattern is transferred to the board. Peel off the backing sheet carefully making sure that the resist has transferred. If you've been a bit careless there's even a 'repair kit' on the sheet to correct any breaks!

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95p INC P & P

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CAPACITORS

Electrolytic Axial Leads — Order Code: Cap 015 + μF + V d.c.
−10% to +50% Tol.

μF \ V d.c.	16	25	40	63
1.0				9
1.5				9
2.2				9
3.3				9
4.7				9
6.8			9	10
10		8		10
15	8		9	11
22		8		13
33	8		9	
47		8	11	13
68	9			
100		9	13	
150	9	10		31
220	13		26	36
330			30	40
470		23	32	47
680	21	30	39	54
1000	25	30	59	
1500	35	39		
2200	42			

Electrolytic Radial Leads — Order Code: Cap 034 + μF + Volts
−10% to +50% Tol.

μF \ V d.c.	6.3	10	16	25	35	40	50	63
.47								7
.68								7
1.0								7
1.5								7
2.2								7
3.3								7
4.7						7		8
6.8				7			8	9
10			7			8		9
15			7	8			9	11
22		7	8			9	11	
33			8	9		11		
47		8	9		11			
68			9	11				
100		9						
150		11						
220	11							

Miniature Low Value — Order Code
Polystyrene, Axial, ±1% Tol., >63V DC Wkg. — Cap 424
Ceramic Plate, Radial, Low K, 100V DC Wkg — Cap 632
Ceramic Plate, Radial, Med K, 100V DC Wkg. — Cap 630
Ceramic Plate, Radial, High K, 63V DC Wkg. — Cap 629
+ Value

pF	424	632	pF	424	632	630	nF	424	629
1			100	18	7		10	27	8
1.2			120	18	9		12	29	
1.5			150	18	9		15	29	
1.8		6	180	18	9		18	31	
2.2		6	220	18	9		22	31	9
2.7		6	270	20	9		27	42	
3.3		6	330	20	9		33	45	
3.9		6	390	20		6	39	50	
4.7		6	470	20		6			
5.6		6	560	20		6			
6.8		6	680	20		6			
8.2		6	820	20		6			
10		6	1000	20		6			
12		6	1200	20		6			
15		6	1500	20		7			
18		6	1800	20		7			
22		6	2200	20		7			
27		6	2700	20		7			
33		6	3300	20		7			
39		6	3900	20		7			
47		6	4700	25		8			
56		7	5600	25					
68		7	6800	25					
82		7	8200	25					

Polyester Radial Leads — Order Code
Dipped Type, C280/352 Style — Cap 352
Moulded Type, 10.2mm Pitch — Cap 360
+ Value

μF	352	360	μF	352	360
.001		7	.1	7	9
.0015		7	.15	8	10
.0022	6	7	.22	9	11
.0033	6	7	.33	11	
.0047	6	7	.47	14	
.0068	6	7	.68	17	
.01	6	8	1.0	21	
.015	6	8	1.5	30	
.022	6	8	2.2	35	
.033	6	8			
.047	6	8			
.068	7	8			

Trimmers — Order Code
250V D.C. Wkg. Film Dielectric, Miniature

1.4 – 4.1pF	20	Cap 808 A
2 – 8pF	20	Cap 808 B
2 – 20pF	22	Cap 808 C
5.5 – 59.5pF	31	Cap 808 D

Electrolytic Can Type — Order Code: Cap HR + μF + Volts
High Ripple, IEC Grade 1, Low E.S.R.
Supplied complete with Vertical Fixing Clip.

10000μF	16V	Ripple 5.8A @ 85°C	8.1A @ 50°C	238
22000μF	16V	9.8A	13.7A	370
4700μF	25V	4.6A	6.4A	215
10000μF	25V	8.0A	11.2A	282
22000μF	25V	12.8A	17.9A	469
4700μF	40V	5.6A	7.8A	248
10000μF	40V	9.2A	12.8A	393
4700μF	70V	7.5A	10.5A	403

Tantalum Bead — Order Code: Cap PR + μF + Volts
20% Tol.

μF \ V d.c.	10	16	25	35
0.1				11
0.22				11
0.47				11
1				11
2.2		11		13
4.7		12	16	18
10	13	16	18	22
22		18		
47	22			

INTEGRATED CIRCUITS

4000 Buffered C-MOS — High Speed

HEF4000	22	HEF4044	1·05	HEF4512	138
HEF4001	22	HEF4046	1·33	HEF4514	313
HEF4002	22	HEF4047	109	HEF4515	374
HEF4006	1·19	HEF4049	57	HEF4516	127
HEF4007	22	HEF4050	57	HEF4517	478
HEF4008	1·00	HEF4051	87	HEF4518	118
HEF4011	22	HEF4052	90	HEF4519	69
HEF4012	22	HEF4053	90	HEF4520	118
HEF4013	57	HEF4066	62	HEF4521	235
HEF4014	1·05	HEF4067	475	HEF4528	124
HEF4015	1·00	HEF4068	22	HEF4532	150
HEF4016	57	HEF4069	22	HEF4534	638
HEF4017	1·00	HEF4070	22	HEF4539	138
HEF4018	1·00	HEF4071	23	HEF4543	194
HEF4019	58	HEF4072	23	HEF4555	98
HEF4020	1·12	HEF4073	23	HEF4556	98
HEF4021	1·07	HEF4075	23	HEF4557	458
HEF4022	1·03	HEF4076	130	HEF4585	122
HEF4023	22	HEF4077	22	HEF4724	214
HEF4024	78	HEF4078	23	HEF40097	11[illegible]
HEF4025	22	HEF4081	23	HEF40098	92
HEF4026	2·44	HEF4082	23	HEF40106	78
HEF4027	57	HEF4085	80	HEF40160	149
HEF4028	89	HEF4086	80	HEF40161	149
HEF4029	113	HEF4093	63	HEF40162	149
HEF4030	58	HEF4094	219	HEF40163	149
HEF4031	2·50	HEF4104	208	HEF40174	149
HEF4035	138	HEF4502	114	HEF40175	149
HEF4040	107	HEF4505	714	HEF40192	149
HEF4041	94	HEF4508	2·30	HEF40193	175
HEF4042	83	HEF4510	135	HEF40194	149
HEF4043	100	HEF4511	157	HEF40195	149

7400 T.T.L.

N7400N	13	N7444N	92	N74122N	40	N74193N	91
N7401N	14	N7445N	85	N74123N	77	N74194N	73
N7402N	14	N7446AN	85	N74125N	37	N74195N	57
N7403N	14	N7447AN	71	N74126N	37	N74198N	135
N7404N	16	N7448AN	92	N74128N	38	N74199N	122
N7405N	16	N7450N	14	N74132N	38	N74221N	77
N7406N	32	N7451N	14	N74145N	57	N74279N	61
N7407N	32	N7453N	14	N74147N	98	N74298N	77
N7408N	16	N7454N	14	N74148N	86	N74365N	59
N7409N	16	N7460N	14	N74150N	91	N74366N	59
N7410N	14	N7470N	28	N74151N	46	N74367N	59
N7411N	16	N7472N	19	N74153N	43	N74368N	59
N7412N	14	N7473N	28	N74154N	91		
N7413N	23	N7474N	24	N74155N	46		
N7414N	31	N7475N	34	N74156N	46		
N7416N	21	N7476N	30	N74157N	43		
N7417N	21	N7480N	32	N74158N	43		
N7420N	14	N7483N	63	N74160N	63		
N7421N	16	N7485N	80	N74161N	63		
N7425N	19	N7486N	25	N74162N	63		
N7426N	20	N7490N	40	N74163N	63		
N7427N	20	N7491AN	57	N74164N	86		
N7428N	23	N7492N	40	N74165N	86		
N7430N	14	N7493N	40	N74166N	86		
N7432N	20	N7494N	57	N74170N	122		
N7433N	23	N7495AN	46	N74173N	77		
N7437N	21	N7496N	57	N74174N	77		
N7438N	21	N74100N	92	N74175N	55		
N7439N	30	N74107N	26	N74180N	57		
N7440N	14	N74109N	45	N74181N	205		
N7442N	51	N74116N	92	N74182N	57		
N7443N	92	N74121N	28	N74192N	91		

74LS

N74LS00N	19	N74LS28N	35	N74LS138N	99	N74LS253N	117		
N74LS01N	19	N74LS30N	19	N74LS139N	99	N74LS257N	117		
N74LS02N	19	N74LS32N	27	N74LS153N	88	N74LS258N	117		
N74LS03N	19	N74LS33N	35	N74LS154N	138	N74LS260N	29		
N74LS04N	27	N74LS37N	35	N74LS155N	93	N74LS261N	321		
N74LS05N	27	N74LS38N	35	N74LS156N	93	N74LS266N	64		
N74LS08N	27	N74LS40N	27	N74LS157N	93	N74LS273N	143		
N74LS09N	27	N74LS42N	60	N74LS158N	97	N74LS283N	117		
N74LS10N	19	N74LS51N	27	N74LS160N	129	N74LS290N	117		
N74LS11N	26	N74LS54N	27	N74LS161N	117	N74LS293N	119		
N74LS12N	26	N74LS55N	27	N74LS162N	144	N74LS298N	149		
N74LS13N	48	N74LS73N	35	N74LS163N	117	N74LS365N	121		
N74LS14N	74	N74LS75N	44	N74LS164N	119	N74LS366N	121		
N74LS15N	26	N74LS76N	46	N74LS170N	220	N74LS367N	121		
N74LS20N	19	N74LS78N	39	N74LS173N	132	N74LS368N	121		
N74LS21N	26	N74LS83AN	106	N74LS174N	141	N74LS373N	173		
N74LS22N	26	N74LS85N	104	N74LS175N	119	N74LS374N	173		
		N74LS86N	39	N74LS181N	306	N74LS375N	117		
		N74LS90N	59	N74LS190N	117	N74LS378N	155		
		N74LS92N	76	N74LS191N	117	N74LS386N	56		
		N74LS93N	76	N74LS192N	119	N74LS390N	196		
		N74LS95BN	82	N74LS193N	119	N74LS393N	196		
		N74LS96N	126	N74LS194N	161	N74LS395N	207		
		N74LS107N	41	N74LS195AN	119	N74LS490N	143		
		N74LS109N	45	N74LS196N	132	N74LS670N	239		
		N74LS112N	45	N74LS197N	132				
		N74LS113N	45	N74LS240N	206				
		N74LS114N	45	N74LS241N	206				
		N74LS125N	53	N74LS242N	206				
		N74LS126N	53	N74LS243N	206				
		N74LS132N	78	N74LS244N	206				
		N74LS136N	49	N74LS251N	117				

LINEAR

CA3046	84
CA3080E	77
CA3130E	99
CA3140E	48
CA3189E	293
LM301AN	34
LM339N	78
LM380N	104
LM381AN	198
LM3900N	75
MC3403P	156
NE531	131
NE536T	259
NE555N	28
NE556N	66
NE566N	171
NE570N	485
NE571N	505
RC4136	146
TBA120S	88
TDA1022	713
TDA1034B	239
TL081CP	84
TL084CN	156
UA741CN	20
UA741CT	47
UA748CN	39

Voltage Regulators

LM309DA(K)	119
UA723CN	42
UA7805CU	78
UA7812CU	78
UA7815CU	78
UA7912CU	97
UA7915CU	97
UA78L05CS	38
UA78L12CS	38
UA78L15CS	38

Plessey I/C's

SL440	331
SL445	182
SL610	245
SL612	245
SL620	369
SL621	369
SL622	910
SL624	342
SL630	232
SL640	409
SL680	245
SL1610	177
SL1611	177
SL1612	177
SL1621	239
SL1626	267
SL1630	177
SL1640	206
SL1641	206
SL6640	27[illegible]
SP8629	475

Zener Diodes

400mW C4V7-C33 BZY88/BZX79 + Voltage — 9

CASES — Boss Industrial Mouldings

Small Desk Console — Boss Industrial Mouldings
Slope Front Console, Recessed Top.
ABS Base, C/W Brass Bushes, In Orange
1mm Aluminium Top Panel Finished Grey

		Order Code
W161, D96, H39 (57)	214	Case BIM1005 OR
W215, D130, H47 (73)	308	Case BIM1006 OR

Plastic Boxes — Boss Industrial Mouldings
Moulded Box and Close Fitting Flanged Lid
ABS Box, C/W Brass Bushes, and Lid In Orange

		Order Code
L112 W62 D31	99	Case BIM2003 OR
L150 W80 D50	131	Case BIM2005 OR
L190 W110 D60	223	Case BIM2006 OR

Plastic Boxes with Metal Lids
Recessed Top Box
ABS Base, C/W Brass Bushes, In Orange
1mm Aluminium Top Panel Finished Grey

		Order Code
L85 W56 D29	112	Case BIM4003 OR
L111 W71 D42	150	Case BIM4004 OR
L161 W96 D53	208	Case BIM4005 OR

Diecast Boxes
Diecast Box and Flanged Lid
Aluminium Box and Lid in Natural Finish

		Order Code
L113 W63 D31	124	Case BIM5003 NA
L152 W82 D50	215	Case BIM5005 NA
L192 W113 D61	334	Case BIM5006 NA

Small Desk Consoles
Slope Front Console, Recessed Top.
ABS Base, C/W Brass Bushes, In Orange
1mm Aluminium Top Panel Finished Grey
Ventilation Slots In Base

		Order Code
W105 D143 H32 (56)	236	Case BIM6005 OR
W170 D143 H32 (56)	312	Case BIM6006 OR
W170 D214 H32 (87)	431	Case BIM6007 OR

OPTO ELECTRONICS — Order Code

Light Emitting Diodes, Individual

.125" (3mm)	Red	16	CQY54
	Green	18	CQY95
	Yellow	20	CQY97
Panel Mounting Clip to suit		3	LED3 Clip
.2" (5mm)	Red	16	CQY24A
	Green	18	CQY94
	Yellow	20	CQY96
Panel Mounting Clip to suit		5	LED5 Clip

Photoresistors

ORP12	95	ORP12
ORP61	95	ORP61

Phototransistors

OCP71	220	OCP71
BPX25	195	BPX25
BPX29	195	BPX29

Photocoupler

FCD820	165	FCD820

HARDWARE — Order Code

D.I.L. Sockets

8 Pin Low Profile Socket Tin	12	DIL SKT 8
14 Pin Low Profile Socket Tin	14	DIL SKT 14
16 Pin Low Profile Socket Tin	16	DIL SKT 16

Heatsinks

Individual Type for 1 x T05 50°C/W	12	Sink 5F
Individual Type for 1 x T066 10.5°C/W	28	Sink TV2
Individual Type for 1 x T03 7.2 C/W	26	Sink TV3
Individual Type for 1 x T0126 17°C/W	26	Sink TV4
Individual Type for 1 x T0220 17 C/W	26	Sink TV5

P.C.B. Components

Dalo Pen, Blue Ink, Slow Drying	98	Pen 33PC

SWITCHES — Order Code

Miniature Toggle — Honeywell

SPDT		67	SW 8A1011
SPDT	C/Off	81	SW 8A1021
SPDT	Double Bias To Centre	90	SW 8A1041
SPDT	Single Bias To Centre	90	SW 8A1051
SPDT	Bias	84	SW 8A1061
DPDT		99	SW 8A2011
DPDT	C/Off	111	SW 8A2021
DPDT	Double Bias To Centre	123	SW 8A2041
DPDT	Single Bias To Centre	123	SW 8A2051
DPDT	Bias	116	SW 8A2061

Miniature Push — C & K

SP	Push To Make, Momentary	62	SW 8531
SP	Push To Break, Momentary	62	SW 8533

MAINS TRANSFORMERS — Order Code

Secondaries may be connected in series or parallel to give wide voltage range
Primaries 0-220, 240V

6VA - Clamp Type Construction 235 each
Approx. 18% Regulation. F.C. 54, H36, W35

0-4.5V, 0-4.5V Secondaries	Trans 6VA	45
0-6V, 0-6V		60
0-12V, 0-12V		120
0-15V, 0-15V		150
0-20V, 0-20V		200

20VA - Clamp Type Construction 360 each
Approx. 16% Regulation F.C. 70, H48, W46

0-4.5V, 0-4.5V Secondaries	Trans 20VA	45
0-6V, 0-6V		60
0-12V, 0-12V		120
0-15V, 0-15V		150
0-17.5V, 0-17.5V		175
0-20V, 0-20V		200

SEMICONDUCTORS

IN914	5	BC182L	12
IN4001	5	BC184	11
IN4002	5	BC184L	12
IN4004	7	BC212	[illegible]
IN4007	9	BC212L	12
IN4148	4	BC214	[illegible]
IN5402	15	BC214L	12
2N2218A	31	BC547	[illegible]
2N2369	21	BC548	[illegible]
2N2646	46	BC549	12
2N2926G	13	BC557	15
2N3053	19	BC558	[illegible]
2N3054	55	BCY70	15
2N3055	55	BCY71	[illegible]
2N3055	—	BD131	39
Full ISB Test	95	BD132	39
2N3442	155	BD139	39
2N3702	9	BD140	39
2N3704	9	BFR90	[illegible]
2N3706	10	BFX85	29
2N3773	297	BFY50	[illegible]
2N3819	22	BFY51	[illegible]
2N3820	39	BFY52	[illegible]
2N3904	9	BLX65	[illegible]
2N5457	39	BLY93A	[illegible]
2N5459	35	BRY39	[illegible]
40673	88	BSX20	[illegible]
AC188	24	[illegible]	[illegible]
AD161	42	[illegible]	[illegible]
AD162	42	[illegible]	[illegible]
BAW95D	1200	[illegible]	[illegible]
BC107	14	[illegible]	[illegible]
BC108	14	[illegible]	[illegible]
BC108C	18	[illegible]	[illegible]
BC109	14	[illegible]	[illegible]
BC109B	19	[illegible]	[illegible]
BC109C	20	[illegible]	[illegible]
BC148	10	[illegible]	[illegible]
BC158	10	[illegible]	[illegible]
BC177	17	[illegible]	[illegible]
BC179	20		
BC182	11		

RESISTORS — Order Code

Carbon Film, Fixed

0.25W, E24 Values 1R0-10M, 5% Tol.	2 each	100/100 (Mult 10/Value)	Res RD¼
0.5W, E12 Values 1R0-4M7, 10% Tol.	3 each	150/100 (Mult 10/Value)	Res RD½
			+ Value

Metal Film, Fixed

0.5W, E24 Values, 5R1-1M, 2% Tol.	8 each	400/100 (Mult 10/Value)	Res MR30
2.5W, E12 Values, 10R-27K, 5% Tol.	16 each	800/100 (Mult 10/Value)	Res PR52
			+ Value

Metal Glaze, Fixed

0.5W, E24 Values, 1M-33M, 5% Tol.	16 each	800/100 (Mult 10/Value)	Res VR37
			+ Value

VERO ELECTRONICS PRODUCTS

2.5" x 5" .1" pitch Veroboard	71	200-21069J
3.75" x 5" .1" pitch Veroboard	79	200-21072D
2.5" x 1" .1" pitch Veroboard (5)	85/Pack	200-21076C
3.75" x 5" .1" pitch Plain Board	68	200-21078H
5.82" x 2.9" .1" pitch V-Q DIP Board	135	200-21084E
Spot Face Cutter	107	203-21013A
Pin Insertion Tool for .040 type pin	147	203-21015F
DS Pins .040 (100)	44/Pack	200-21087G
SS Pins .040 (100)	44/Pack	200-21017B
Verowire Kit (1-pen, 2-wire, 25-comb)	454/Kit	200-21341D
Verowire Combs (25)	109/Pack	200-21339F
Verowire Wire (2)	109/Pack	200-21340G

Skeleton Presets, Miniature — Order Code

0.1W, E3 Values, 100R-1M, Lin. Vertical Mounting	[illegible]	[illegible]
0.1W, E3 Values, 100R-1M, Lin. Horizontal Mounting	[illegible]	[illegible]
		+ Value

Skeleton Presets, Standard

0.3W, E3 Values, 100R-4M7, Lin. Vertical Mounting	[illegible]	[illegible]
0.3W, E3 Values, 100R-4M7, Lin. Horizontal Mounting	[illegible]	[illegible]
		+ Value

Potentiometer, Rotary

0.5W, E3 Values, 1K-2M2 Lin.	39	[illegible]
0.25W, E3 Values, 4K7-2M2 Log.	39	[illegible]
		+ Value

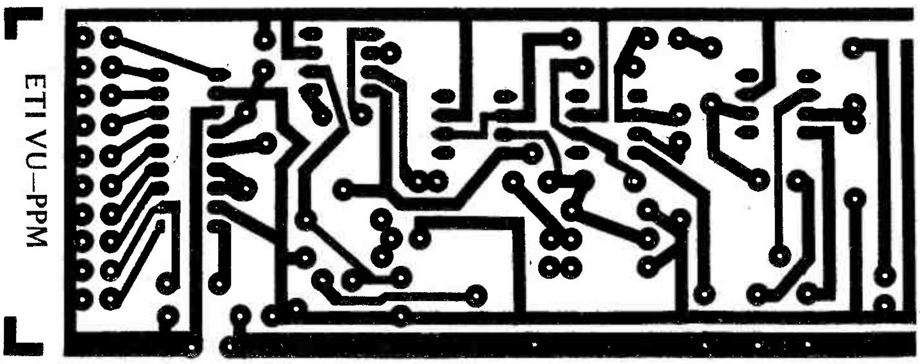
Potentiometer, Slider

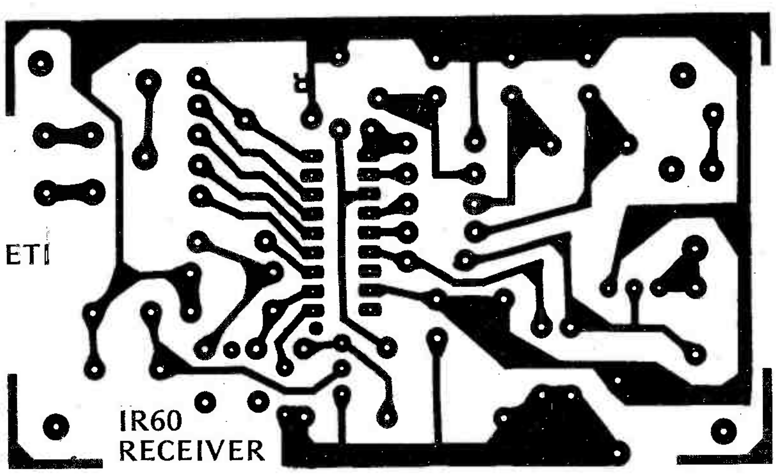
0.5W, E3 Values, 2K2-470K Lin.	45	[illegible]
0.25W, E3 Values, 1K0 - 1M0 Log	45	[illegible]
		+ Value

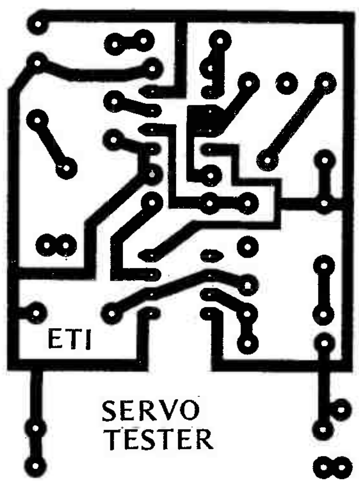
PCB FOIL PATTERNS

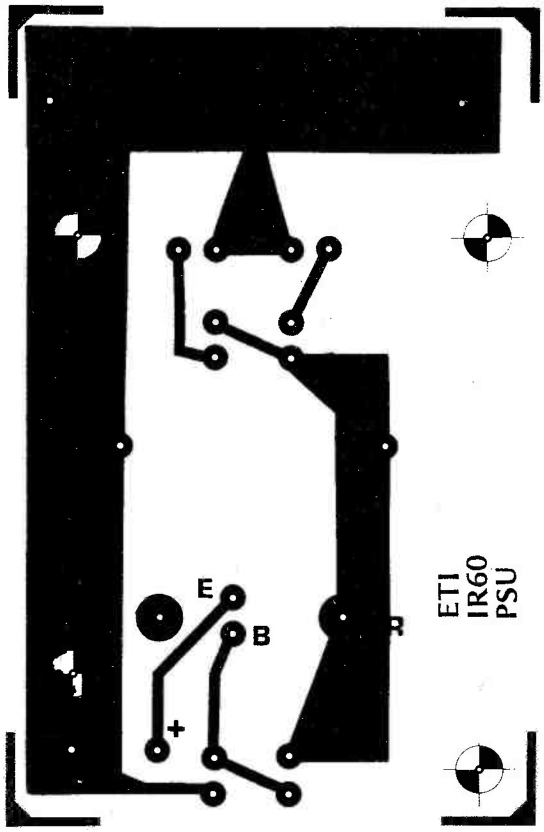
Shown below are the foil patterns for the months projects. The Black Hole PCB is shown overleaf. The Infra-Red remote control project will be concluded next issue — at which time details of the transmitter circuit and PCB will be given.

Companies producing boards of ETI projects should note that both the Chorus Machine and Voltage Controlled Filter PCBs are copyrighted to Powertran and Digisound respectively — and may not thus be reproduced other than by individuals for their own usage in a one-off basis.








ETI
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PSU
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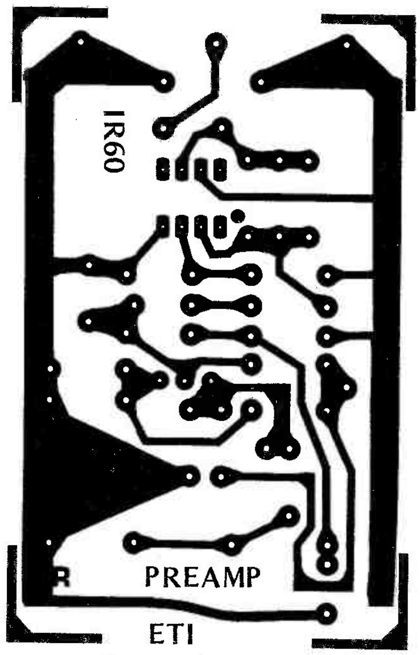
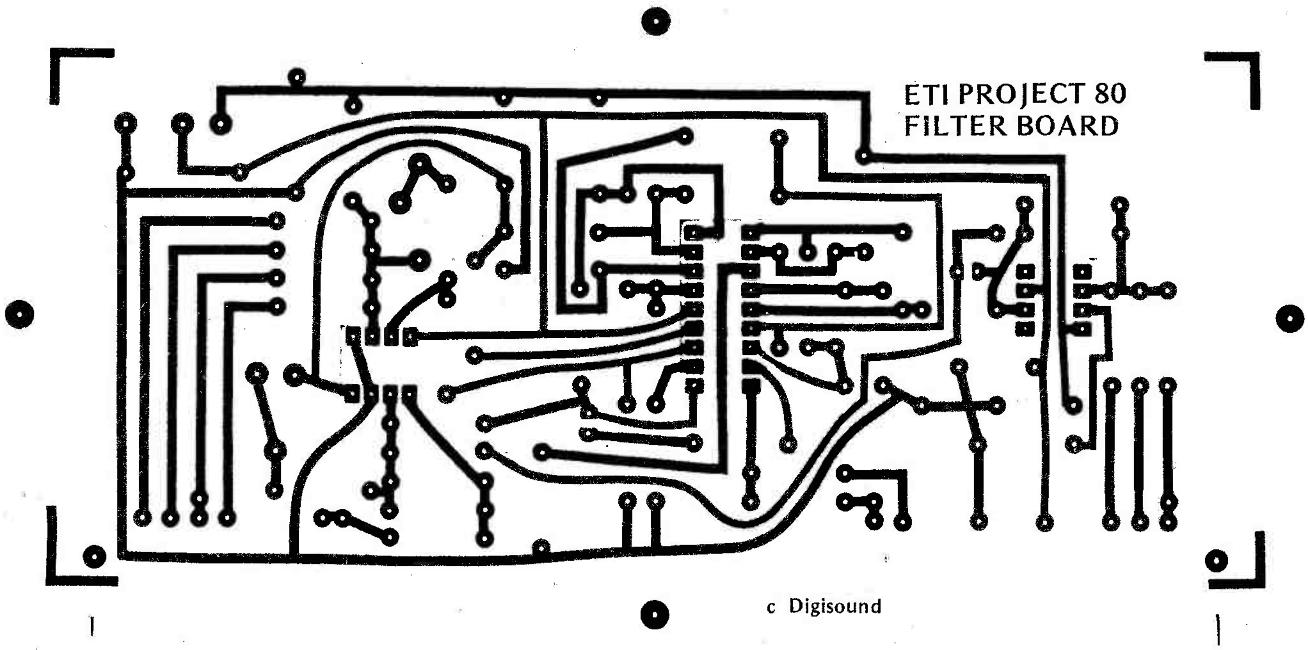
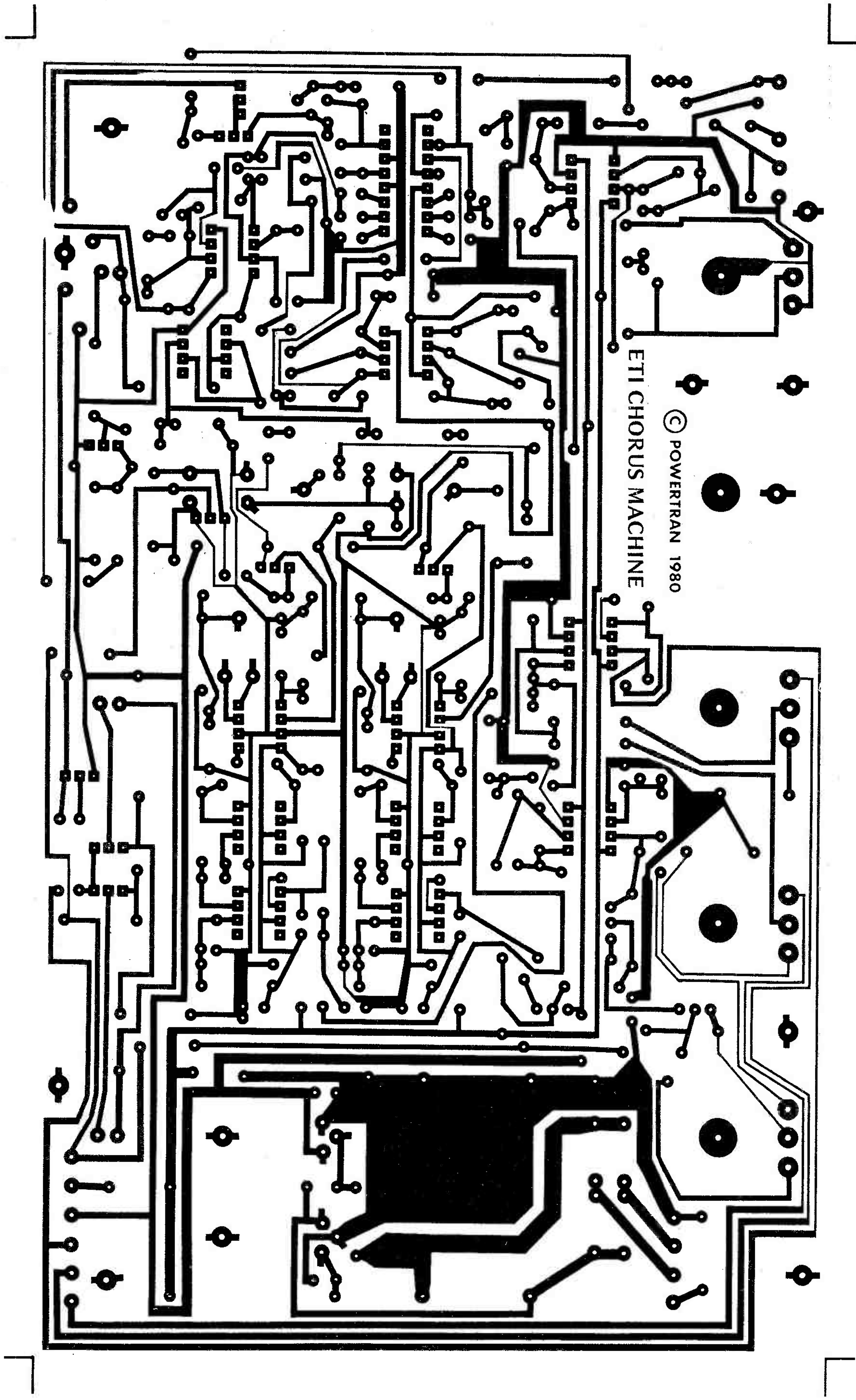

IR60
R
PREAMP
ETI


ETI PROJECT 80
FILTER BOARD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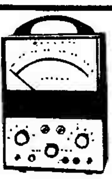

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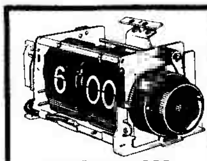

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BC148	**7p**	BC213	**8p**	BCY70	**12p**	BD139	**34p**	2N2907	**19p**
BC149	**7p**	ZTX214	**8p**	BCY71	**12p**	BD140	**34p**	2N3054	**49p**
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555	**19p**	LM3900	**48p**	7805 5V Regulator TO3	**100p**	IN4001	**4p**
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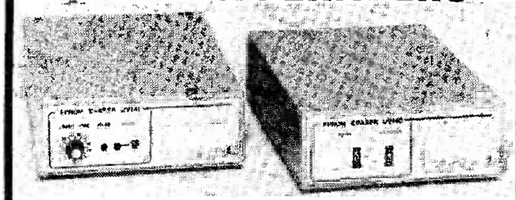
UV EPROM ERASERS



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COMPUTER BOARDS

The following is an extract from our leaflet ref. 'MP4', which is available free on request (a 9" x 6" SAE helps, but is not essential). See Microprocessor section to the right for board prices.

For many people the wide choice of micro-processors now available presents a difficult choice. To understand any particular microprocessor in depth a development system is almost essential, however in the past to understand more than one several separate development systems have had to be purchased.

The reason that separate systems, one for each processor, have been necessary is due to the fact that individual microprocessors have their own individual features: in one case to access memory a separate read strobe and write strobe is required, in another a 'read/write' line is used in combination with a combined strobe called 'valid memory address and phi-2'. With some processors, the same address bus can be used for both memory and 'input/output ports', under the control of a 'memory request' or an 'input/output request' control line.

Naturally, if a development system takes advantage of any of the particular unique features of any particular microprocessor, this makes it more difficult to graft some other unrelated microprocessor onto the same bus at a later date.

A Universal Micro System provides a basic bus structure on which any one micro-processor can be connected. The system uses a CPU (Central Processor Unit) card which is separate from the rest of the system, and this allows the same memory and interfaces to be retained when a different MPU is used.

The basic system bus consists of data and address buses together with read and write strobes. By locating the data input (Keyboard) and output (VDU) in the memory space then such chips as the 8080/Z80 family, which normally use input/output ports, can now be used without any fundamental change to the bus (and as a bonus, users of these MPU's have all the ports entirely free for their own purposes).

The range of p.c.b.'s includes boards to implement a memory-mapped VDU, cassette interface, keyboard interface, PROM programmer, and a number of RAM and ROM cards. All the cards are of International Size 114 x 203 mm (4½" x 8") except for the larger power PSU A power supply card. This latter card is sized so that it can be bolted to the side of a standard 4" chassis module which is then compatible with the other cards. The cards have a standard 43-way edge connector, with one position used for polarisation.

We do not propose to defend the (relatively) small number of bus connexions (42), against such standards as the 'S100' 100-position bus. The S-100 bus, as it originated in America, is bigger and better. It i… …ore expensive. In the same way, a Ford 'Granada' is bigger and … Ford 'Cortina', but it doesn't mean a Cortina isn't good va… …ows — it may even be better value!

The International Size … …st '3U' 19" rack systems. These … and a variety of modules a… …ustomising their own… …'s the firm 'R.S. … …culty.) … …t to compete … …he purchaser … …d) assembly … …e computer … …s virtually ide… The… …ent: You choo… …s will be used. … …se's, or indee… …es not permit… …ere to offer gu… your needs, i… As menti… the design o… …ble arrangeme… …e obsolete ov… have been pr… pattern which… Often these ca… decoding. An e… …uit regulator, or ga… …est' and 'Input/Output R… …oes not already have this facility.

Of course we know … …o would faint clean away at the thought of cutt… …s, adding extra integrated circuits and bits of wire in th… …above, but it is not for these people that this sort of system ha… …esigned. We would like to think of this system as basis on which you can build your own personal design, perhaps as an alternative to the use of 'Veroboard' or etching your own pcb's.

(Further sections give an outline of each card in turn. Although we have in mind all sorts of exotic future developments (e.g. high resolution graphics, floppy disc controllers, dynamic high-density RAM cards, programmable VDU formats, colour displays, Light pens, sound generators etc.) we prefer to keep quiet about them until they actually exist. All of the cards described actually exist, and at the time of writing (September 1979) most are in stock. (We plan it so they are all in stock, but people will insist on buying them, without caring what havoc they wreak in our stock control!))

NEW! 'ISBUS-1.1'

Low-cost commercial quality computer back board, 13" x 4 3/8" approx, for the International Standard (114x203mm) cards. Although intended for the 86-way double sided connector, it can be used with the 43-way connector specified for the computer boards we advertise. (Pin 37 is used for polarisation.) Takes up to 13 cards on 1" centres, and provides for 4 power rails, 58 parallel address/data etc. bus lines and 3 'daisy chains'. Epoxy glass, tinned, price £11.50. More details in our free leaflet 'ISB-1/1'.

CMOS

These cut prices for Amateur Users and Export. Note: industrial users — quantity prices available. Mostly Motorola, RCA

4000	15p	4042	75p	4089	£1.50	4419	£2.68	4532	£1.27
4001	17p	4043	94p	4093	63p	4422	£5.00	4534	£5.13
4002	17p	4044	90p	4094	£1.90	4431	TBA	4536	£3.69
4006	£1.05	4045	£1.45	4095	£1.05	4433	£11.32	4537L	£13.23
4007	18p	4046	£1.28	4096	£1.05	4435	£7.93	4538	£1.25
4008	87p	4047	87p	4097	£3.72	4450	£2.67	4539	91p
4009	50p	4048	58p	4098	£1.10	4451	£2.67	4541	£1.14
4010	50p	4049	48p	4099	£1.45	4452	TBA	4543	£1.59
4011	18p	4050	48p	40061	N/S	4461	£2.18	4549	£3.69
4012	18p	4051	72p	40100	£2.50	4462	£2.42	4552	£10.55
4013	42p	4052	72p	40101	£1.61	4490FP	£6.54	4553	£3.87
4014	86p	4053	72p	40102	£2.12	4490VP	£3.48	4554	£1.19
4015	89p	4054	£1.10	40103	£2.12	4500	£6.95	4555	78p
4016	45p	4055	£1.28	40104	£1.09	4501	17p	4556	78p
4017	89p	4056	£1.34	40105	£1.06	4502	91p	4557	£3.86
4018	89p	4057	£25.70	40106	61p	4503	69p	4558	£1.14
4019	48p	4059	£4.80	40107	68p	4505	£5.71	4559	£3.69
4020	99p	4060	£1.15	40108	£5.36	4506	51p	4560	£1.84
4021	91p	4061	£15.67	40109	£1.02	4507	55p	4561	65p
4022	86p	4062T	£10.00	40181	£3.39	4508	£2.48	4562	£5.33
4023	20p	4063	£1.09	40182	£1.40	4510	99p	4566	£1.59
4024	66p	4064	N/S	40192	£1.40	4511	£1.38	4568	£2.38
4025	19p	4065	N/S	40193	£1.40	4512	81p	4569	£2.57
4026	£1.80	4066	57p	40194	£1.18	4514	£2.65	4572	25p
4027	45p	4067	£3.80	40257	£1.48	4515	£2.99	4580	£5.74
4028	81p	4068	22p	4160	£1.08	4516	£1.08	4581	£2.62
4029	99p	4069	20p	4161	£1.08	4517	£3.82	4582	98p
4030	58p	4070	23p	4162	£1.08	4518	£1.02	4583	76p
4031	£2.05	4071	21p	4163	£1.08	4519	51p	4584	43p
4032	£1.00	4072	21p	4174	£1.08	4520	£1.08	4585	£1.01
4033	£1.45	4073	21p	4175	99p	4521	£1.88	4595	£1.20
4034	£1.96	4075	23p	4194	£1.08	4522	£1.08	4597	£2.32
4035	£1.11	4076	85p	4408	£6.59	4524	N/S	4598	£2.65
4036	£2.45	4077	23p	4409	£6.59	4526	£1.08	4599	£6.95
4037	£1.00	4078	21p	4410	£5.73	4527	£1.52	4700	£1.75
4038	£1.08	4081	20p	4411	£9.58	4528	99p		
4039	£2.45	4082	21p	4412VP	£9.43	4529	£1.14		
4040	£1.05	4085	74p	4415V	£7.50	4530	85p		
4041	80p	4086	73p	4415F	N/S	4531	£1.45		

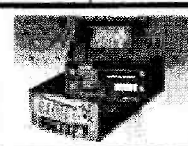
74C

74C00	24p	74C83	£1.29	74C164	£1.04	74C905	£7.26	74C926	£4.84
74C02	24p	74C85	£1.29	74C165	£1.04	74C906	54p	74C927	£4.84
74C04	24p	74C86	64p	74C173	90p	74C907	54p	74C928	£4.84
74C08	24p	74C89	£4.38	74C174	£1.51	74C908	96p	74C929	£11.93
74C10	24p	74C90	85p	74C175	90p	74C909	£1.63	74C948	TBA
74C14	£1.41	74C93	85p	74C192	£1.10	74C910	£6.78	80C95	54p
74C20	24p	74C95	£1.04	74C193	£1.10	74C911	£7.13	80C96	61p
74C30	24p	74C107	£1.22	74C195	£1.04	74C912	£7.13	80C97	54p
74C32	24p	74C150	£4.12	74C200	£6.76	74C914	£1.41	80C98	61p
74C42	92p	74C151	£2.46	74C221	£1.36	74C915	£1.10	82C19	£4.13
74C48	£1.38	74C154	£3.67	74C373	£1.73	74C918	£1.06	88C29	£1.93
74C73	54p	74C157	£2.20	74C374	£1.73	74C921	£11.83	88C30	£1.93
74C74	56p	74C160	£1.10	74C901	54p	74C922	£3.66		
74C76	54p	74C161	£1.10	74C902	54p	74C923	£3.73		
		74C162	£1.10	74C903	54p	74C924	TBA		
		74C163	£1.10	74C904	54p	74C925	£4.84		

MODULATORS

UM1111: E36 UHF Ch.36 Vision Modulator £2.50
UM1231 UHF Ch.36 Vision Modulator wide handwidth (for computers etc.) £4.70
UM1263 FM Sound Sub-carrier Modulator £2.50

SWITCH MODE PSUs



AC 5221S 5V/10A	£69.90
AC 9221S 5V/5A, 12V/1A, −12V/1A, −5V/0.1A	£86.80
AC 5421S 5V/20A	£99.20
AC 9421S 5V/10A, 12V/2A, −12V/2A, −5V/0.1A	£126.50

MICROPROCESSORS

COMPUTER BOARDS
114 x 203 mm fibreglass, with gold plated edge connector.

Buffered SC/MP CPU	£7.95
SC/MP Protoboard	£7.95
Z80 CPU card	£7.50
VDU 'A' } set	£7.50
VDU 'B' } of	£7.50
VDU 'G' } three	£7.95
EPROM Programmer (2708s)	£7.95
4k PROM board (5204s)	£5.95
8k PROM board (2708s)	£7.95
2k RAM board (2102s) 1k-2k	£7.95
8k RAM board (2114s) 1k-8k	£7.95
TAPE Interface	£7.50
Keyboard Interface	£7.50
PSU 5v. +12v. −12v board	£7.50
PSU 5v. −12v board	£4.95

Further details on request

Z80

Z80 CPU (2½MHz)	£9.90
Z80-CTC (2½MHz)	£5.95
Z80-P10 (2½MHz)	£6.60

(Add £1 for the 4MHz version of any of the above 3 chips.)

SC/MP II RAM I/O

SC/MP II (4MHz)	£8.82
INS 8154 RAM I/O	£8.18

6800

6800 MPU	£6.55
6802 MPU	£9.95
6810 (128 × 8 RAM)	£2.97
68A10 (128 × 8 RAM)	£3.75
6820, 6821 PIA	£3.96
6850 ACIA	£3.08
MC6880	£2.64

6502

6502	£12.00
6520 PIA	£6.22

CMOS

COSMAC CDP 1802CE	£9.85
COSMAC CDP 1802E	£10.85
CDP 1864	£7.25

STATICS (Mostly 450nS)

2101—256 x 4	£2.25
2102—1K x 1	£1.20
2111—256 x 4	£1.95
2112—256 x 4	£2.25
2114/4045—1K x 4	£4.39
2114L—1K x 4	£5.50
4118—1K x 8	£20.99

DYNAMICS

MK 4116 16K 250nS	£6.95
MK 4816 2K x 8	£30.52

UV ERASABLES

2708 1K x 8	£6.75
2716/2516 2K x 8 single 5v	£19.95
.2532 4K x 8 (5v)	£47.00
PROMWASHING each Prom	50p (+30p +VAT)

UV PROM ERASER

UV140	£61.20
UV141	£77.70

INTERFACE

81LS95/6/7/8	£1.25
75491 LED driver	50p
75492	92p
ZN425	£3.95
8T26	£2.64

MOSTEK VDU BOARD

VAB-2	£125.00

CRT Controller: Uarts

Thompson CSF SF.196364E	£11.50
AY-5-1013 UART TR 1602	£4.00
AY-5-1013A	£4.70
AY-3-1014A	£5.60
AY-3-1015	£5.60

CHAR. GEN. KEYBOARD ENCODER

MCM 66760	£9.75
MK 5302	£15.29
RO-3-2513 (5v Uppercase)	£6.95
DM 8678 CAB/BWF	£14.27
AY-5-2376	£9.75

FIRMWARE

2K Tiny Basic for Z80 (2 x 2708)	£25
4K NIBL in 4 x 2708	£55
NIBL-MM In 4 x 2708	£55
ETIBUG 1+2 in 2708	£19.95
KITBUG (1 x 2708)	£14.95
ELBUG (2 x 2708)	£34.90
KITBUG MM (1 x 2708)	£19.95
SC/MP Utilities (1 x 2708)	£19.00

VOLTAGE REGULATORS

7805	75p
7905	£1.08
7812	97p
7912	£1.08
LM 323K	£5.61

QUARTZ

32.768KHz (Watch)	£3.23
60 KHz	£9.95
100.0 KHz	£3.62
200.0 KHz	£3.92
204.8 KHz	£3.92
262.144 KHz	£3.92
307.2 KHz	£3.92
312.5 KHz	£3.92
455.0 KHz	£4.95
1.000 MHz	£3.62
1.008 MHz	£3.92
1.280 MHz	£3.92
1.8432 MHz	£3.62
2.000 MHz	£3.62
2.097152 MHz	£3.23
2.4576 MHz	£3.62
2.500 MHz	£3.92
2.56250 MHz	£3.62
3.000 MHz	£3.62
3.2768 MHz	£3.23
3.579545 MHz	£1.95
3.93216 MHz	£3.92
4.000 MHz	£2.90
4.032 MHz	£3.23
4.096 MHz	£3.23
4.194304 MHz	£3.23
4.433619 MHz	£1.25
4.608 MHz	£3.23
4.800 MHz	£3.23
4.915 MHz	£3.23
5.000 MHz	£3.23
5.0688 MHz	£3.23
5.120 MHz	£3.23
5.185 MHz	£3.23
6.000 MHz	£3.23
6.144 MHz	£3.23
6.400 MHz	£3.23
6.55360 MHz	£3.23
7.000 MHz	£3.23
7.168 MHz	£3.23
7.680 MHz	£3.23
7.86432 MHz	£3.23
8.000 MHz	£3.23
8.388608 MHz	£3.23
8.867237 MHz	£3.23
9.375 MHz	£3.92
9.800 MHz	£3.92
10.000 MHz	£3.23
10.245 MHz	£3.23
10.700 MHz	£3.23
10.92 MHz	£3.92
11.000 MHz	£3.92
12.000 MHz	£3.92
14.0 MHz	£3.92
14.31818 MHz	£3.23
16.000 MHz	£3.92
18.000 MHz	£3.23
18.432 MHz	£3.23
20.000 MHz	£3.62
20.1134 MHz	£3.23
27.0 MHz	£3.92
27.648 MHz	£3.92
38.6666 MHz	£3.23
48.000 MHz	£3.23
100.000 MHz	£3.23
116.000 MHz	£3.23

VEROBOARD
0.1" Pitch with copper strips

2½" × 1" (pack of 5)	74p
2½" × 3¾"	53p
2½" × 5"	62p
2½" × 17"	£1.86
3¾" × 3¾"	62p
3¾" × 5"	69p
3¾" × 17"	£2.40
4.7" × 17.9"	£3.14

0.1" Plainboard (no strips)

3¾" × 2½"	38p
3¾" × 5"	59p
3¾" × 17.0"	£1.56
Terminal pins	£1.50/500
V-Q DIP board	£1.17
DIP breadboard	£2.91
Spot face cutter	93p
Pin insertion tool	£1.28

SOLDERCON PINS
100 50p 1000 £3.95

DIL SOCKETS
8/14/16 pin 10p/12p/13p
18/20/22 pin 18p/20p/25p
24/28/40 pin 30p/40p/50p
24 pin Textool lever type zero insertion force £8.50

TIMER ICs
NE555/556 29p/49p

OP-AMPS (All Mini dips)

CA 3130E	84p
CA 3140E	35p
UA 741 (Texas)	22p

4 DIGIT LED DISPLAY
Multiplexed, common cathode, prime quality.
NSB 3881 (0.3") £4.25

LED DISPLAYS

DL-704E	85p
DL-727E/728E	£2.00
DL-747E/750E	£1.80
FND 500/560	£1.20

LIQUID CRYSTAL DISPLAY
4×0.5" Digits 40 pin DIL £9.95

CLOCK CHIPS

AY-5-1224A	£2.60
MK 50253	£5.50
MK 50366	£6.50

SIX DECADE COUNTERS

MK 50395/6/7	£8.75
MK 50398/9	£6.20

DATA

Note: In this section all data books are subject to 0% VAT. For postage see 'Terms' at top of page.

113 page Electronic Projects Index 72-77 (North Tyneside Libraries)	£1.50
c650 page COSMOS Databook (RCA)	£4.95
c31 page 'A Guide to SC/MP Programming' by Dr. Drury (Kemitron)	£3.75
c20 page 'A Guide to Kitbug' (Kemitron)	75p
c24 page NIBL Reference Guide (National)	£3.45
Data for 4116 (Mostek)	50p
c6 page data for Mk 4118	25p
16-page data for IMS 8154 (ISP-8A/650) (National)	50p
20-page data for SC/MP II (National)	50p
c100 page CDP 1802 MPU User Manual (RCA)	£4.50
c45 page Fixed Point Binary Arithmetic Routines for COSMAC	£4.50
c31 page Floating Point Arithmetic Routines for COSMAC (listings excluded)	£4.50
c43 page COSMAC MPU Product Guide (RCA)	75p
c15 page CDP 1802 Instruction Summary	25p
c70 page Understanding CMOS (RCA)	£1.50
1 page COSMOS Pocket Selection Guide (RCA)	25p
c21 page COSMOS Digital Integrated Circuits (RCA)	75p

REVISED Z80 DATA PACK £14.95
The contents of this data pack have changed. It now includes data in bound volumes, and also covers some other microprocessors as well. Regrettably the books cannot be supplied separately, as we are forced to buy the packs complete. Contents:
c275-page Z80 Programming Manual
c525-page Microcomputer Component Data Book
c25-page Z80 Micro Reference Manual (pocket size)
c130-page Microcomputer Systems Data Book

c50-page Finite State Fantasies (Cartoons putting programming on human level) (Matrix Press)	£2.[illegible]
c175 page Home Computers: Beginners Glossary and Guide by Miller and Sippl (Dilithium)	£4.95

74LS

74LS00	14p	74LS27	28p	74LS76	40p	74LS125	60p	74LS163	£1.18	74LS240	£2.36	74LS283	£1.92	74LS375	£1.68
74LS01	14p	74LS28	48p	74LS78	40p	74LS126	60p	74LS164	£1.14	74LS241	£2.32	74LS290	£1.28	74LS377	£2.12
74LS02	16p	74LS30	22p	74LS83	£1.15	74LS132	95p	74LS165	75p	74LS242	£2.32	74LS293	£1.28	74LS378	£1.84
74LS03	16p	74LS32	27p	74LS85	£1.18	74LS136	55p	74LS166	£2.26	74LS243	£2.32	74LS295	£1.85	74LS379	£2.15
74LS04	16p	74LS33	39p	74LS86	43p	74LS138	85p	74LS170	£2.88	74LS244	£1.70	74LS298	£1.68	74LS384	86p
74LS05	20p	74LS37	39p	74LS90	60p	74LS139	85p	74LS173	£1.05	74LS245	£2.70	74LS324	£2.40	74LS386	86p
74LS08	22p	74LS38	39p	74LS91	£1.04	74LS145	£1.08	74LS174	£1.06	74LS247	£1.90	74LS325	£2.90	74LS390	£2.30
74LS09	22p	74LS40	28p	74LS92	89p	74LS147	£1.70	74LS175	£1.10	74LS248	£1.90	74LS326	£2.94	74LS393	£2.30
74LS10	20p	74LS42	98p	74LS93	89p	74LS148	£1.73	74LS181	£3.98	74LS249	£1.90	74LS327	£2.86	74LS395	£2.18
74LS11	22p	74LS47	90p	74LS95	£1.16	74LS151	96p	74LS183	£2.98	74LS251	£1.34	74LS347	£1.48	74LS396	£2.15
74LS12	23p	74LS48	£1.20	74LS96	£1.16	74LS153	76p	74LS190	£1.40	74LS253	£1.42	74LS348	£1.86	74LS398	£2.76
74LS13	38p	74LS49	£1.20	74LS107	44p	74LS154	£1.70	74LS191	£1.40	74LS257	£1.10	74LS352	£2.28	74LS399	£2.30
74LS14	75p	74LS51	24p	74LS109	55p	74LS155	96p	74LS192	£1.30	74LS258	£1.46	74LS353	£2.28	74LS445	£1.58
74LS15	30p	74LS54	28p	74LS112	55p	74LS156	96p	74LS193	£1.30	74LS259	£1.60	74LS365	65p	74LS447	£1.44
74LS20	20p	74LS55	30p	74LS113	50p	74LS157	76p	74LS194	£1.66	74LS261	£4.50	74LS366	65p	74LS490	£1.80
74LS21	22p	74LS63	£1.50	74LS114	50p	74LS158	96p	74LS195	£1.36	74LS266	52p	74LS367	65p	74LS668	£1.82
74LS26	48p	74LS73	46p	74LS122	70p	74LS160	£1.28	74LS196	£1.00	74LS273	£2.44	74LS368	66p	74LS669	£1.82
		74LS74	41p	74LS123	70p	74LS161	98p	74LS197	£1.40	74LS275	£2.50	74LS373	£1.80	74LS670	£2.48
		74LS75	48p	74LS124	£1.80	74LS162	£1.38	74LS221	96p	74LS279	66p	74LS374	£1.95		

TTLs by TEXAS

7400	11p
74S00	60p
7401	12p
7402	12p
7403	14p
7404	14p
74S04	90p
7405	18p
7406	32p
7407	32p
7408	17p
7409	19p
7410	15p
7411	24p
7412	20p
7413	30p
7414	50p
74C14	90p
7416	27p
7417	27p
7420	17p
7421	40p
7422	22p
7423	34p
7425	30p
7426	40p
7427	34p
7428	36p
7430	17p
7432	30p
7433	40p
7437	35p
7438	35p
7440	17p
7441	70p
7442A	60p
7443	112p
7444	112p
7445	100p
7446A	93p
7447A	50p
7448	80p
7450	17p
7451	17p
7453	17p
7454	17p
7460	17p
7470	36p
7472	30p
7473	34p
7474	30p
7475	30p
7476	35p
7480	50p
7481	100p
7482	84p
7483A	90p
7484	100p
7485	110p
7486	34p
7489	175p
7490A	30p
7491	80p
7492A	46p
7493A	30p
7494	84p
7495A	70p
7496	65p
7497	180p
74100	130p
74104	65p
74105	65p
74107	34p
74109	55p
74110	55p
74111	70p
74116	200p
74118	130p
74119	210p
74120	110p
74121	28p
74122	48p
74123	48p
74125	55p
74126	60p
74128	75p
74132	75p
74135	50p
74136	75p
74137	50p
74141	50p
74142	200p
74145	90p
74147	190p
74148	150p
74150	100p
74151A	70p
74153	70p
74154	100p
74155	90p
74156	90p
74157	70p
74159	190p
74160	100p
74161	100p
74162	100p
74163	100p
74164	120p
74165	130p
74166	120p
74167	200p
74170	240p
74172	450p
74173	120p
74174	90p
74175	85p
74176	90p
74177	90p
74178	160p
74180	93p
74181	160p
74182	90p
74184A	150p
74185	150p
74186	500p
74188	325p
74190	90p
74191	90p
74192	90p
74193	90p
74194	90p
74195	95p
74196	95p
74197	80p
74198	150p
74199	150p
74200	£10
74221	160p
74251	140p
74259	250p
74278	290p
74279	110p
74283	160p
74290	150p
74293	150p
74298	200p
74365	100p
74366	100p
74367	100p
74368	100p
74390	200p
743o3	200p
74490	225p

74LS SERIES

74LS00	14p
74LS02	16p
74LS03	18p
74LS04	16p
74LS05	25p
74LS08	22p
74LS10	20p
74LS11	40p
74LS13	40p
74LS14	72p
74LS15	45p
74LS20	20p
74LS21	40p
74LS27	38p
74LS30	20p
74LS32	27p
74LS42	70p
74LS47	90p
74LS51	24p
74LS55	30p
74LS73	60p
74LS74	36p
74LS75	40p
74LS76	45p
74LS83	110p
74LS85	100p
74LS86	40p
74LS90	40p
74LS92	70p
74LS93	60p
74LS96	110p
74LS107	45p
74LS109	80p
74LS112	100p
74LS113	90p
74LS114	45p
74LS122	80p
74LS123	70p
74LS124	180p
74LS125	60p
74LS126	60p
74LS132	95p
74LS133	30p
74LS136	55p
74LS138	75p
74LS139	75p
74LS145	120p
74LS147	220p
74LS148	175p
74LS151	100p
74LS153	60p
74LS154	200p
74LS155	90p
74LS156	90p
74LS157	60p
74LS158	90p
74LS160	130p
74LS161	100p
74LS162	140p
74LS163	100p
74LS164	120p
74LS165	160p
74LS166	180p
74LS173	110p
74LS174	110p
74LS175	110p
74LS181	320p
74LS190	100p
74LS191	100p
74LS192	100p
74LS193	100p
74LS195	140p
74LS196	120p
74LS197	120p
74LS221	140p
74LS240	175p
74LS241	175p
74LS242	170p
74LS243	170p
74LS244	195p
74LS245	250p
74LS247	140p
74LS248	140p
74LS249	140p
74LS251	140p
74LS253	140p
74LS257	120p
74LS258	160p
74LS259	160p
74LS266	100p
74LS273	195p
74LS279	90p
74LS298	249p
74LS324	200p
74LS348	200p
74LS365	100p
74LS367	100p
74LS368	100p
74LS373	180p
74LS374	195p
74LS378	200p
74LS390	160p
74LS393	160p
74LS445	140p
74LS668	100p
74LS669	100p
74LS670	400p

4000 SERIES

4000	15p
4001	25p
4002	20p
4006	95p
4007	25p
4008	80p
4009	40p
4010	50p
4011	25p
4012	25p
4013	50p
4014	84p
4015	84p
4016	45p
4017	80p
4018	80p
4019	45p
4020	100p
4021	110p
4022	100p
4023	27p
4024	50p
4025	20p
4026	130p
4027	50p
4028	84p
4029	100p
4030	55p
4031	200p
4033	180p
4034	200p
4035	110p
4036	295p
4037	115p
4038	120p
4039	295p
4040	100p
4041	80p
4042	80p
4043	90p
4044	90p
4046	110p
4047	100p
4048	55p
4049	40p
4050	48p
4051	80p
4052	80p
4053	80p
4054	150p
4055	125p
4056	135p
4059	600p
4060	115p
4063	120p
4066	55p
4067	450p
4068	27p
4069	20p
4070	30p
4071	25p
4072	25p
4073	25p
4075	25p
4076	107p
4081	27p
4082	25p
4086	72p
4089	138p
4093	80p
4094	250p
4095	95p
4096	95p
4097	340p
4098	120p
4099	200p
40100	220p
40101	132p
40102	180p
40103	180p
40104	99p
40105	99p
40106	90p
40107	60p
40108	470p
40109	100p
40110	300p
40114	250p
4411	1100p
4502	120p
4503	70p
4507	55p
4508	290p
4510	99p
4511	150p
4512	80p
4514	265p
4515	300p
4516	110p
4518	100p
4520	100p
4521	250p
4526	108p
4527	150p
4528	120p
4532	200p
4538	120p
4543	180p
4553	450p
4556	72p
4560	250p
4569	250p
4572	40p
4583	90p
4584	90p
4724	250p
40097	90p
14411	1100p
14412	1100p
14433	1100p
14500	700p
14599	290p
CD22100	350p
CD22101	700p
CD22102	700p

INTERFACE ICs

DM8123	175p
DS8835	250p
DS8836	150p
MC1488	100p
MC1489	100p
25S10	350p
75107	160p
75150	175p
75154	175p
75182	230p
75322	300p
75324	375p
75325	375p
75361	300p
75363	400p
T5365	350p
75451	72p
75491/2	96p
8T26	250p
8T28	300p
8T95	200p
8T97	200p
81LS95	140p
81LS96	140p
81LS97	140p
81LS98	140p
9601	110p
9602	220p

93 SERIES

9301	160p
9302	175p
9308	316p
9310	275p
9311	275p
9312	160p
9314	165p
9316	225p
9321	225p
9322	150p
9334	360p
9368	200p
9370	200p
9374	200p

VEROBOARDS

(copper clad)	0.1	0.15
2.5×3.75"	48p	43p
2.5×5"	57p	51p
3.75×3.75"	57p	—
3.75×5"	64p	64p
3.75×17"	222p	194p
4.75×17.9"	290p	—
Pkt of 100 pins		50p
Spot face cutter		86p
Pin insertion tool		118p
Vero Wiring Pen + 2 wire spools + combs		370p
Combs		7p

LINEAR I.Cs

AY1-0212	600p
AY1-1313	668p
AY1-1320	320p
AY1-5050	140p
AY3-1270	840p
AY5-1224A	240p
AY5-1315	600p
AY5-1317A	775p
CA3019	80p
CA3046	70p
CA3048	225p
CA3080E	72p
CA3086	48p
CA3089E	225p
CA3090AQ	375p
CA3130E	90p
CA3140E	50p
CA3160E	100p
CA3161E	140p
CA3162E	450p
CA3189E	400p
DAC1408-8	200p
FX209	750p
ICL7106	850p
ICL8038	340p
LF356P	95p
LM10C	425p
LM301A	30p
LM311	120p
LM318	200p
LM319	225p
LM324	50p
LM339	75p
LM348	95p
LM377	175p
LM380	75p
LM381AN	160p
LM709	36p
LM710	50p
LM725	350p
LM733	100p
LM741	18p
LM747	70p
LM748	35p
LM2917	250p
LM3900	70p
LM3909	70p
LM3911	130p
LM3914	250p
LM4136	120p
MC1310P	150p
MC1458	48p
MC1495L	350p
MC1496	100p
MC3340P	120p
MC3360P	120p
MK50398	750p
MM57160	620p
NE531	150p
NE555	22p
NE556	70p
NE561B	425p
NE562B	425p
NE565	130p
NE566	155p
NE567	175p
NE571	425p
RC4151	400p
SAD1024A	1250p
SFF96364	1100p
SN76003N	175p
SN76013N	140p
SN76013ND	120p
SN76023N	140p
SN76023ND	120p
SN76477	200p
SP8515	750p
TAA621	275p
TBA641B11	225p
TBA651	200p
TBA800	90p
TBA810	100p
TBA820	90p
TCA940	175p
TDA1004	300p
TDA1008	320p
TDA1010	225p
TDA1022	600p
TDA1024	120p
TDA1034B	250p
TDA1170	250p
TDA2002V	325p
TDA2020	320p
TL071	50p
TL072	95p
TL074	150p
TL081	45p
TL082	95p
TL084	130p
TL170	50p
UAA170	200p
UDN6118	320p
UDN6184	320p
ULN2003	100p
XR2206	350p
XR2207	400p
XR2211	600p
XR2216	675p
XR2240	400p
ZN414	90p
ZN419C	225p
ZN424E	135p
ZN425E	400p
ZN1034E	200p
95H90	800p

VOLTAGE REGULATORS

Fixed Plastic TO-220

1A	+ve		—ve	
5V	7805	60p	7905	70p
12V	7812	60p	7912	70p
15V	7815	60p	7915	70p
18V	7818	60p	7918	70p
24V	7824	60p	7924	70p

100mA	TO-92			
5V	78L05	30p	79L05	70p
12V	78L12	30p	79L12	70p
15V	78L15	30p	79L15	70p

OTHER REGULATORS

LM309K	135p
LM317T	200p
LM323K	550p
LM723	37p
78HGKC	600p
78HO5KC	600p
78MGT2C	135p
78P05	900p
79BIGKC	700p

OPTO-ELECTRONICS

2N5777	45p
OCP71	130p
ORP12	90p
ORP60	90p
ORP61	90p
TIL78	70p

OPTO-ISOLATORS

ILD74	130p
MCT26	100p
MCS2400	190p
TIL111	90p
TIL112	90p
TIL116	90p

LEDS

0.125"		0.2"	
TIL32	75p	TIL220 Red	16p
TIL209 Red	13p	TIL222 Gr	18p
TIL211 Gr	20p	TIL228 Red	22p
TIL212 Ye	25p	MV5491 TS	120p
TIL216 Red	18p	Clips	3p

DISPLAYS

3015F	200p
DL704	140p
DL707 Red	140p
707 Gr	140p
DL747 Red	225p
747 Gr	225p
FND357	120p
FND500	120p
FND507	120p
MAN3640	175p
MAN4640	200p
NSB5881	570p
TIL311	600p
TIL312/3	110p
TIL321/2	130p
TIL330	140p
7750/60	200p

DRIVERS

9638	200p
9370	200p
UDN6118	320p
UDN6184	320p

BREADBOARDS

EXP350 3.6" x 2.1" (Up to 3 x 14 pin ICs)	£3.15
EXP650 3.6" x 2.4" (Up to 1 x 40 pin IC)	£3.60
EXP300 6" x).1" (Uto 6 x 14 pin ICs)	£5.75
EXP600 6" x 2.4" (Up to 1 x 40 pin DCs)	£6.30

IC TEST CLIPS

14 pin	£2.60	24 pin	£4.90
16 pin	£2.75	40 pin	£7.90

TRANSISTORS

AC126	25p
AC127/8	20p
AC176	25p
AC187/8	25p
AF116	50p
AD149	70p
AD161/2	45p
AU107	200p
BC107/8	11p
BC109	11p
BC117	20p
BC147/8	9p
BC149	10p
BC157/8	10p
BC159	11p
BC169C	12p
BC172	12p
BC177/8	17p
BC179	18p
BC182/3	10p
BC184	11p
BC187	30p
BC212/3	11p
BC214	12p
BC237	15p
BC327	16p
BC337	16p
BC338	16p
BC461	36p
BC477/8	30p
BC516/7	50p
BC547B	16p
BC548C	9p
BC549C	18p
BC557B	16p
BC559C	18p
BCY70	18p
BCY71/2	22p
BD131/2	50p
BD135/6	54p
BD139	56p
BD140	60p
BD189	60p
BD232	95p
BD233	75p
BD235	85p
BD241	70p
BD242	70p
BDX53B	150p
BDY56	200p
BF200	32p
BF244B	35p
BF256B	70p
BF257/8	32p
BF259	36p
BFR39	25p
BFR40	25p
BFR41	25p
BFR79	25p
BFR80	25p
BFR81	25p
BFX29	30p
BFX30	34p
BFX84/5	40p
BFX86/7	30p
BFX88	30p
BFW10	90p
BFY50	30p
BFY51/2	30p
BFY56	33p
BFY90	90p
BRY39	45p
BSX19/20	20p
BU104	225p
BU105	190p
BU108	250p
BU109	225p
BU205	200p
BU208	200p
BU406	145p
E300	50p
E308	50p
E310	50p
MJ2501	225p
MJ2955	90p
MJ3001	225p
MJE340	50p
MJE2955	100p
MJE3055	70p
MPF102	45p
MPF103/4	40p
MPF105/6	40p
MPS6531	50p
MPS6534	50p
MPSA06	30p
MPSA12	50p
MPSA13	50p
MPSA20	50p
MPSA42	50p
MPSA43	50p
MPSA56	32p
MPSA70	50p
MPSU06	63p
MPSU07	90p
MPSU45	90p
MPSU65	78p
OC28	130p
OC35	130p
TIP29A	40p
TIP29C	55p
TIP30A	48p
TIP30C	60p
TIP31A	58p
TIP31C	62p
TIP32A	68p
TIP32C	82p
TIP33A	90p
TIP33C	114p
TIP34A	115p
TIP34C	160p
TIP35A	225p
TIP35C	290p
TIP36A	270p
TIP36C	340p
TIP41A	65p
TIP41C	78p
TIP42A	70p
TIP42C	82p
TIP54	160p
TIP120	120p
TIP122	130p
TIP142	160p
TIP147	160p
TIP2955	78p
TIP4055	70p
TIS43	34p
TIS93	30p
ZTX108	12p
ZTX300	13p
ZTX500	15p
ZTX502	18p
ZTX504	30p
2N457A	250p
2N696	35p
2N697	25p
2N698	45p
2N708A	20p
2N918	45p
2N930	18p
2N1131/2	20p
2N1613	25p
2N1711	25p
2N2102	70p
2N2160	350p
2N2219A	30p
2N2222A	30p
2N2369A	16p
2N2484	30p
2N2646	45p
2N2904/5	25p
2N2906A	24p
2N2907A	30p
2N2926	9p
2N3053	30p
2N3054	65p
2N3055	48p
2N3442	140p
2N3553	240p
2N3565	30p
ZN3584	250p
2N3643/4	48p
2N3702/3	12p
2N3704/5	12p
2N3706/7	14p
2N3708/9	12p
2N3773	300p
2N3819	25p
2N3820	50p
2N3823	70p
2N3866	90p
2N3902	700p
2N3903/4	18p
2N3905/6	20p
2N4037	65p
2N4058/9	12p
2N4060	12p
2N4061/2	18p
2N4123/4	27p
2N4125/6	27p
2N4401/3	27p
2N4427	90p
2N4871	60p
2N5087	27p
2N5089	27p
2N5172	27p
2N5179	90p
2N5191	83p
2N5194	90p
2N5245	40p
2N5296	55p
2N5401	50p
2N5457/8	40p
2N5459	40p
2N5460	60p
2N5485	44p
2N5875	250p
2N6027	48p
2N6041	180p
2N6044	180p
2N6107	65p
2N6247	190p
2N6254	130p
2N6290	65p
2N6292	65p
2SC1172	150p
3N128	120p
3N140	100p
3N141	110p
3N201	110p
3N204	100p
40290	250p
40360	40p
40361/2	45p
40364	120p
40408	70p
40409	85p
40410	85p
40411	300p
40594	97p
40595	105p
40673	75p
40841	90p
40871/2	90p

DIODES

BY127	12p
BYX36-300	20p
OA47	9p
OA81	15p
OA85	15p
OA90	9p
OA91	9p
OA95	9p
OA200	9p
OA202	10p
1N914	4p
1N916	7p
1N4148	4p
1N4001/2	5p
1N4003/4	6p
1N4005	6p
1N4006/7	7p
1N5401/3	14p
1N5404/7	19p
JS920	9p

HEAT SINKS

For TO220 Voltage Regs. and Transistors	22p
For TO5	12p

BRIDGE RECTIFIERS

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

ZENERS

2.7V-33V

400mW	9p
1W	15p

TRIACS PLASTIC

3A 400V	60p
3A 500V	65p
6A 400V	70p
6A 500V	88p
8A 400V	75p
8A 500V	95p
12A 400V	85p
12A 500V	105p
16A 400V	110p
16A 500V	130p
T2800D	130p

THYRISTORS

1A 50V	40p
1A 400V	65p
3A 400V	90p
8A 600V	140p
12A 400V	160p
16A 100V	160p
16A 400V	180p
16A 600V	220p
BT106	110p
C106D	45p
MCR101	35p
2N3525	120p
2N4444	140p
2N5060	34p
2N5064	40p

LOUD-SPEAKERS

Size		
2½"	64R	70p
2½"	8R	70p
2"	8R	80p
1½"	8R	80p

MEMORIES

2102-2L	120p
2107B	500p
2111-2	225p
2112-2	300p
2114	525p
2114-2L	600p
4027	375p
4044	900p
4116	600p
5101	510p
6810	350p
74S201	325p
82S16	325p

ROM/PROMs

71301	700p
74S188	225p
74S287	350p
74S387	350p
74S470	650p
74S471	650p
74S571	650p
82S137	750p
93427	400p
93436	650p
93446	650p
93448	900p

CPUs

1600	1200p
2650A	2000p
6502	1000p
6800	900p
6802	1250p
6809	2500p
8080A	550p
8085A	1400p
1NS8060	1000p
Z80	1100p
Z80A	1250p

EPROMS

1702A	500p
2516	2100p
2708	800p
2716	2100p

SUPPORT DEVICES

3242	800p
3245	400p
6532	1100p
6820	500p
6821	500p
6845	2500p
6850	500p
8205	320p
8212	225p
8216	225p
8224	400p
8228	525p
8251	700p
8253	1200p
8255	550p
8257	1100p
8259	1400p
Z80P10	650p
Z80AP10	800p
Z80CTC	650p
MC14411	1100p
MC14412	1100p

UART

AY-3-1015P	500p
AY-5-1013P	400p
IM6402	500p
TMS6011NC	400p

CHARACTER GENERATORS

3257ADC	990p
MCM6576	1000p
RO-3-2513 U.C.	600p
RO-3-2513 L.C.	650p
SN74S262AN	900p

KEYBOARD ENCODER

AY-5-2376	900p

TRANSFORMERS

(prim 220/240V)

6-0-6	100mA	88p
9-0-9	75mA	92p
12-0-12	100mA	95p
0-120	12500mA	280p
0-25V (5VA)		250p
9-0-9 1A		270p*
12V 2A		350p*
0-12-15 20-24-30 1A		340p*
15-0-15 1A		265p*

(Please add 50p p&p charge to all marked * above our normal p&p charge).

RESISTORS High Stab 5% E12 Carbon Film

¼W 10R-1M one value	7p/5pcs
½W 10R-10M one value	5p/3pcs

Miniature Presets Hor/Vert 100R-1M	12p
Carbon Track Pots 5K-1M Log or Lin	
Single	30p
Single with Switch	60p
Dual	72p
SLIDER POTS 60mm Track LIN 5K, 10K, 50K, 100K	60p
LOG 10K	60p

LOW PROFILE DIL SOCKETS BY TEXAS

8 pin	10p	18 pin	22p	24 pin	30p
14 pin	11p	20 pin	25p	28 pin	38p
16 pin	12p	22 pin	28p	40 pin	48p

WIRE WRAP SOCKETS BY TEXAS

8 pin	30p	18 pin	70p	24 pin	90p
14 pin	40p	20 pin	75p	28 pin	110p
16 pin	55p	22 pin	80p	40 pin	140p

SUBMINIATURE SWITCHES

Toggle	
SPST	60p
SPDT	65p
DPDT	70p
DPDT (centre off)	85p
Push to make	15p
break	25p
Push latching SPCO	60p
SLIDE DPDT	18p
ROCKER SPST	28p
WAFER	
1P/12W	45p
3P/4W	45p
4P/3W	45p
2P/6W	45p

CRYSTALS

100KHz	300p
1MHz	370p
1.008MHz	370p
3.2768MHz	350p
3.579545MHz	200p
4MHz	350p
8.867237MHz	400p
10.7MHz	350p
18MHz	300p
26.690MHz	210p
27.145MHz	210p

ANTEX SOLDERING IRONS

C-15W	400p
CX-17W	415p
CCN-15W	415p
X25	415p
SPARE BITS	
C/CX/CCN	46p
X25	50p
SPARE ELEMENTS	
C/CX/X25	180p
CCN	200p
ADCOLA IRONS	
K1000	550p
K2000	550p

VEROBOARDS

DIP Breadboard 4.15 × 6.15 (Suitable for 20 × 14 pin or 16 × 16 pin DIL ICs)	300p
DIP Breadboard as above with tracks for 31 way connector	375p
V-Q Boards for ICs (No track cutting)	115p

CONNECTOR PLUGS

31 way Plug	110p
31 way Socket	110p
S-100 Busboard	1200p

EDGEBOARD CONNECTORS 0.156" PITCH

2 x 10 way	85p	2 x 22 way	135p
2 x 15 way	100p	2 x 25 way	160p
2 x 18 way	120p		

COUNTERS

74C925	475p
74C928	600p
ICM7216B	2000p
ICM7217A	850p
ZN1040E	700p

TTL & ECL

MC4024	325p
MC4044	325p
10116	70p
10231	350p

SPECIAL OFFERS (subject to stocks)

555	£18/100	7805	£5/10
741	£16/100	7812	£5/10
2114L-3	£4.50	7905	£6/10
2708	£6.75	7912	£6/10
2716 (plus 5V only)	£21.00	2114L 450ns complete)	
4116 (200 ns)	£40/8	P&P + VAT Extra	£28/8

PROTOBOARD (R) SOLDERLESS BREAD-BOARDS

Socket Strips/Bus Strips/Binding Posts mounted on sturdy base plate.

PB6	6 x 14 DIL ICs	£9.20
PB100	10 x 14 DIL ICs	£11.80
PB102	12 x 14 DIL ICs	£22.95
PB103	24 x 14 DIL ICs	£34.45
PB104	32 x 14 DIL ICs	£45.95

(The above boards are suitable for all DIL ICs.)

16 KEY KEYPAD (Reed Switches)	£4.00
UHF Modulators	£3.75
Reed Switches (12VA)	£0.25
LOGIC PROBE	£18.00
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4K STATIC RAM BOARD FOR ELF II	£69.44
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With countdown alarm. Hours, minutes, seconds, alpha day and date on upper display; and day, date, month, alarm and hourly chimes. Countdown alarm (upper display). Stopwatch from 1/100 sec to 12 hours; net, lap, and 1st & 2nd place times. Stainless steel. Glass.

Only £57.50

TS7 Alarm Chronograph

100M Water Resistant. Suitable for swimming, water skiing etc. Hours, minutes, seconds, day, date and month. Programmable weekly alarm. Interval alarm timer up to 16 hours. Hourly chimes. Stopwatch, 1/100 second to 20 minutes, then seconds to 12 hours. Upper display — lap times. Lower display — Total time.

Only £74.95

TS5 World Time/Alarm

Two Alarms, local and world time (dual tones). Hourly chimes. Normally displays hours, minutes, seconds, day; or optionally hours, minutes, day, date, month. World time mode displays an atlas with each of the 19 time zones highlighted when selected. Date and summer time functions.

Stainless £79.95
Gold Pl £99.95

H127 Analogue/Digital

Independent analoque display. Digital hours, minutes, seconds, day; and day, date, month, 1/100 second stopwatch to 20 minutes, then seconds to 12 hours; net lap and 1st & 2nd place. Single counter to 9,999 or dual counter to 99.

(£95) **£69.95**

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CQ-82 Clock, 4 alarms (one with snooze), calculator **£13.95**
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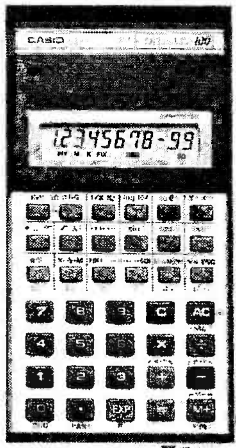
Granstand Adam. 4 games, one as "Simon says", was £22.50 **£16.95**
Grandstand 4-in-1, Was £22.50 **£16.95**



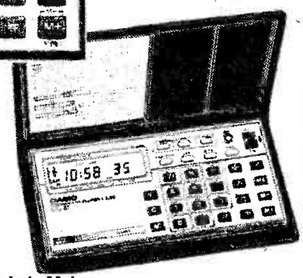
FX-100 SCIENTIFIC

LCD, 10 digits, 44 scientific functions, 6 levels ( ), standard deviations, co-ordinates conversions, sexagesimal conversions, fractions, cube roots, FIX, SCI, NORM, ENG, RND and RAN (random number). 7,500 hours battery 3/4 x 3 x 5⅞ inches.

£15.95 (£17.95)

MELODY 81

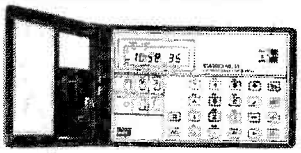
(ML-81)
(RRP £24.95)
£22.95
More musical than the Melody 80

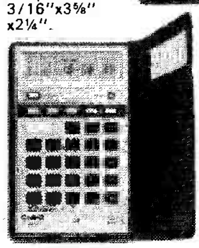


ML-81. 11 Note Melody Maker
Clock, 200 year auto calendar. Two musical alarms, countdown timer and hourly chimes. 1/10 second stopwatch measuring net, lap, and 1st & 2nd place times to 24 hours. Calculator with full memory, %, square roots. 1 year battery life from two RW42 batteries. 5/16"x4½"x2¼".

ML-71

(24.95)
£22.95
As ML-81 but 1 alarm, No √ 3/16"x3⅝" x2¼".





AQ-2200

£19.95(£21.95)
Permanent display of full month calendar. Clock, alarm, hourly chimes. Stopwatch from 1/10 second to 12 hours; net, lap, 1st & 2nd place times. Calculator with full memory, %, √. 1 year batteries. 9/32x2⅝x4½".

MQ-12

(RRP £21.95)
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Card version of AQ2200. No √ 3/16"x3⅝"x2⅜".

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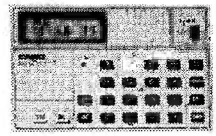

CASIO PW-81

6 digit clock, 24-hour alarm, hourly chimes. 8 digit calculator, with full memory, % 3/16x3⅝x2¼".

£14.95 (£17.95)

83QS-41B ALARM CHRONOGRAPH

Stainless steel encased, mineral glass, water resistant, 3-YEAR BATTERY. Hours, minutes, seconds, date, am/pm; or hours, minutes, alpha day, date, am/pm. 24-hour alarm, hourly chimes. Stopwatch measures net, lap and 1st and 2nd place from 1/10 second to 12 hours. (£29.95)

£24.95

(Similar to illustration)

F-80 Alarm Chronograph

Black resin case, mineral glass. Water resistant. 3 YEAR BATTERY. Hours, minutes, seconds, date, am/pm; or hours, minutes, alpha day, date am/pm. 24 hour alarm, hourly chimes. Stopwatch from 1/10 second to 12 hours; net, lap and 1st and 2nd place. Nightlight.

£19.95 (£24.95)

95QS-36B Chronograph

Stainless steel, mineral glass. Water resistant. 5 YEAR BATTERY. Hours, minutes, seconds am/pm and day (12 or 24 hours). Dual time (12 or 24 hour). Day, date, month and year calendar. Stopwatch from 1/100 sec to 7 hours; net, lap and 1st & 2nd place times.

(£24.95) **£19.95**

111QS-34B

Superbly finished chrome plated case, mineral glass. Water resistant. Comprehensive display, hours, minutes, seconds, am/pm, day and date. Button for nightlight.

£14.95 (£17.95)
F-8C Black resin cased version. **£19.95**

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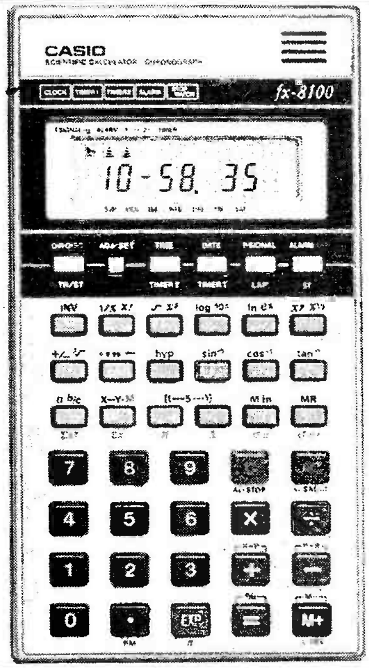
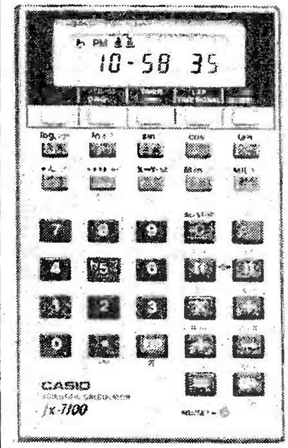


You always wanted a calculator that does everything except make tea —

HERE IT IS!

CASIO FX-8100 (left) 46 scientific functions, clock, calendar, alarm, countdown alarm, interval alarm timer, hourly chimes, 1/100sec stopwatch. ONE YEAR BATTERY LIFE approx. (continuous use). LC Display; 8 digit mantissa plus 2 digit exponent. 5 level parentheses, full access memory. Trigs, logs, hyperbolics, standard deviations, co-ordinate conversions, sexagesimal to decimal conversions, fractions, percentages, cube roots, sign change, register exchange, Pi entry etc. CLOCK displays hours, minutes, seconds, am/pm and day. CALENDAR pre-programmed to 1999; day, date, month and year. 24-hour ALARM, hourly chimes. Countdown ALARM TIMER, interval (repeater) alarm timer or 1/100 second STOPWATCH measuring net, lap and first and second place times to 10 hours. 6.6 × 70 × 129mm (¼ × 2.¾ × 5.⅛ inches). Leatherette wallet. RRP £27.95.

All this for ONLY £24.95!



Casio FX-7100

RRP £27.95
ONLY £24.95

FX-7100 (above). Card version of the FX-8100. ONE YEAR BATTERY LIFE, 8 digit display and 39 scientific functions (does not have hyperbolics, fractions or calendar function). With clock, alarm, and hourly chimes. Interval alarm timer or 1/100 sec stopwatch. Wallet. 3/16 × 2⅛ × 3⅝ inches.

CASIO ★★★★★ Star Buys ★★★★★ SEIKO

CASIO 81QS-35B ALARM CHRONOGRAPH

ONLY £29.95

RRP £34.95

Stainless steel, mineral glass, water resistant. 5-YEAR BATTERY.
Hours, minutes, seconds and day. Day, date, month and year calendar pre-programmed to 2029. 12- or 24-hour display. **24-hour alarm, hourly chimes, stopwatch** from 1/100 second to 7 hours, measuring net, lap and first and second place times. Backlight for night time viewing.

CASIO C-80 CALCULATOR WATCH

ONLY £24.95

RRP £29.95

Black resin, mineral glass, water resistant. FINGER-TOUCH KEYBOARD.
Hours, minutes, seconds, am/pm and day. Day, date and month auto calendar pre-programmed to 2009. Professional 24-hour **stopwatch** measuring net, lap and first and second place times to 1/100 second. **Dual time**, 24-hour. 8 digit calculator. Backlight for night-time viewing. 44.9 × 35.8 × 10.2mm.

SEIKO TS2 ALARM CHRONOGRAPH

ONLY £47.50

Stainless steel encased, Glass, splash resistant. 2-YEAR BATTERY.
Comprehensive display of hours, minutes, seconds, day, date and month. **24-hour alarm and hourly chimes. Stopwatch** from 1/100 second to 20 minutes, then seconds to 20 hours. Upper display — lap times, lower display — total time. 8mm thick — 8.8mm including front buttons.

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SN74141N IC **50p ea**

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DISPLAYS by Hewlett-Packard. Seven segment OL707 (5082-7750) **95p.** Common anode half inch red display brand new in maker's cartons 6 for **£5.** 50 for **70p ea.** 500 for **60p ea.**

TV SOUND. High quality sound through your hi-fi. Simply plug into your aerial socket, **£6.50,** as reviewed Popular Hi-Fi.

BURROUGHS 8 DIGIT Panaplex calculator display 7 segment 0.25" digits. Neon type with red bevel socket and date. **£1.95 ea.** 10 for **£17.**

HONEYWELL PROXIMITY DETECTOR integral amplifier 8V DC **£3.50 ea,** 10 for **£30.**

MULLARD TBA800. IC audio amplifier **95p ea,** 10 for **£8,** 100 for **£70,** 500 for **£300.**

RCA CA3089. FM IF **£1.50,** 10 for **£12.**

RCA CA3090AQ. FM decoder **£2.50,** 10 for **£20,** 100 for **£175.**

BU 205 TEXAS, £1.50 ea, 10 for **£12,** 100 for **£100** per 1,000 **85p ea.**

2N3055 80V version TO3 power 10 for **£3.50.** 100 for **£28,** 500 for **£125.**

BU208 TO3 Texas TV power transistors **£1.75 ea,** 10 for **£15,** 100 for **£120,** 1,000 for **£1 ea.**

MC1310P-SN76115N FM stereo decoder **£1.20 ea,** 10 for **£1 ea,** 100 for **85p ea.**

MULLARD AD161-AD162 Matched pairs 1 pair **80p,** 10 pairs **£8,** 100 pairs **£50.** Cartons of 600 pairs **£250** EX-STOCK

RADIATION DETECTORS Quartz Fibre Dosimeters. Pen type with clip with lens and scale 0-5R. Originally over £5 **OUR PRICE 95p EACH.** 10 for **£8.** 100 for **£70.** **ORP12** light dependent resistance Mini Type. 2 for **£1.** 10 for **£4.50.** 100 for **£40.**

TV TUNERS by Mullard UHF 38 mcs size 3¾x2¾x1¼ **£2.50 ea.** 10 for **£20.** 100 for **£175.** 500 for **£750.** 1,000 for **£1,250.**

MULLARD TUNER MODULES with data LP1171 combined AM/FM IF strip **£3.50.** LP 1179 FM front end with AM tuning gang, used with LP1171 **£3.50.** LP1171 and 79 pair **£5.75,** 10 pairs for **£50,** 100 pairs for **£400.**

CA3085 RCA POSITIVE VARIABLE REG. 5volt 100m amp variable 1.8-24V **55p ea.** 10 for **£5.** 100 for **£35.** 1,000 for **£300.**

MULLARD LP1157 AM tuner modules with circuit **£2.50 ea,** 10 for **£20,** 100 for **£175.**

LUSTRAPHONE RIBBON MIKE £1.50, + pre amp on chassis 3×2×1in 10 for **£12.50.**

TAA661B (14 pin DIL) IC TV sound and FM amplifier-detector by ATES on p. circuit board with other parts. Complete with data & connections **60p.** 10 for **£5.** 100 for **40p ea.** 500 for **35p ea.**

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RSP63½ track	**£2.25**	**£20.00**	**£175.00**
XES11 Erase	**£1.25**	**£11.00**	**£100.00**

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12V	100m/a	1½×1½×1½	**£0.95**
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12V	2 amps	2¾×2¾×2½	**£2.50**

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RCA CD4029AE 16 pin DIL presettage up down counter **85p each, 25** for **£15,** 100 for **£50,** 1,000 for **£355** (in anti static tubes of 25).

UHF TV TUNER (preamp) with BF180 **55p each.** Built on PC board 2×2in (sold without data) 10 for **£4.50,** 100 for **£35,** 1,000 for **£250.**

HELICAL 10 TURN POTS BY M.P.C. 2.5 watts 5% tolerance, type MM105. British made. 47 ohms/100/220/470 1k/2.2k/4.7k/47k. All at our price **£1.95 ea.** Manufacturers list price £3.80. Quantities:

Per 10	**£1.50 ea.**
Per 100	**£1.25 ea.**
Per 1,000	**£1.00 ea.**

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47 ohms	2.2k	Per 10	**50p ea.**
220	4.7k	Per 100	**45p ea.**
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1k	47k		

RELAYS min open type. 6/9v change over **85p.** P.10 **75p ea.** P.100 **65p.** P.1,000 50p ea. Min. 9/12v **2p** cover 200 ohm **£1.20.**

TBA625 ATES voltage regulators **55p ea,** 5 volts 100m/amps (TO99) per 10 **£4.50,** per 100 **£39,**

16 PIN low profile DIL sockets **12p,** 10 for **£1,** 100 for **£8,** 1,000 for **6p ea.**

THYRISTORS Motorola 2N5061 0.8 amp 60 volt **19p,** 10 for **15p ea,** 100 for **13p ea,** 1,000 for **11p ea,** 10,000 for **10p ea**

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Aryx 50	**£12.08 net**	Antex x 25	**£4.83 net**
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Antex C	**£4.83 net**	500 gm reel solder	**£6.61 net**

EXAMPLE TWO — PRINTED CIRCUIT MATERIALS

PCB's 300 x 150 mm		Etch Resist Pen	**£1.14**
SRBP S/S **£1.38**	D/S **£1.73**	**Breadboards**	
F/Glass S/S **£1.96**	D/S **£2.13**	Bimboard 1 2£9.23	
Positive resist 75cc	**£1.67**	Eurobreadboard	**£6.56 net**
Ferric Chloride 500 g	**£3.45**	T-DeC	**£5.18**

EXAMPLE THREE — SWITCHES

Chrome toggle		13A time switch adaptors	
Std. SPDT **65p**	DPDT **89p**	Smiths TS100	**£14.43 net**
Min. SPDT **66p**	DPDT **92p**	Wavechange, Lorlin, 1P12W, 2P6W, 3P4W, 4P3W	**46p each**

EXAMPLE FOUR — CAPACITORS BY SIEMENS

Polyester 7.5mm PCM
1, 1.5, 2.2, 3.3, 4.7μF, 10, 15, 22, 33, 42μF **8p** each, .1μ **12p,** .15μ **15p,** .22μ **18p,** .33μ **21p,** .47μ **27p,** .68μ **34p,** 10mm PCM 1μ **37p.**
Electrolytic, axial, (μ F/V)
1/40 **24p,** 1/100 **15p,** 2.2/25 **24p,** 2.2/63 **15p,** 4.7/16 **24p,** 4.7/40 **15p,** 10/25 **15p,** 10/40 **18p,** 22/25 **18p,** 22/40 **18p,** 22/63 **19p,** 47/10 **18p,** 47/25 **18p,** 47/40 **16p,** 47/63 **20p,** up to 1000/16V **36p,** then 1000/25V **49p** to 47/16 **65p.**
Also full supporting ranges of other ceramic, plastic and electrolytic caps.

EXAMPLE FIVE — POTENTIOMETERS BY RADIOHM

Single gang lin or log	**34p**	*(Twin types stereo matched)*	
Twin gang lin or log	**93p**	Slider knobs	**10p** each.
Mono slider lin or log	**83p**	Presets lin, horiz, or vert @	**10p**
Twin slider lin or log	**136p**		

EXAMPLE SIX — RESISTORS

$\frac{1}{3}$, $\frac{1}{2}$, $\frac{3}{4}$W **2.3p** 1W **6p**
Wirewound from **21p**

AND AS FOR SEMI CONDUCTORS . . .

1N914	**6p**	40673	**99p**	MU481	**£1.70**	T1P41A	**69p**
1N4007	**9p**	AC128	**36p**	MJ491	**£1.88**	T1P41C	**74p**
1N4148	**5p**	AC176	**67p**	MJ2955	**97p**	T1P42A	**69p**
1N5402	**19p**	AD136	**£4.25**	MJE2955	**£1.13**	T1P42C	**74p**
2N1599	**£1.01**	AD149	**£1.01**	MJE3055	**£1.00**	T1P2955	**69p**
2N2369A	**24p**	AD161	**40p**	MPSA12	**42p**	T1P3055	**69p**
2N3055	**81p**	AD162	**52p**	MPSA63	**44p**	T1S43	**40p**
2N3702-11	**11p**	AF127	**43p**	OA47	**14p**	W02	**35p**
2N4443	**£1.78**	AL102	**£1.84**	OA90	**8p**	2Tx107,9	**14p**
2N4444	**£2.28**	BA379	**29p**	OA91	**8p**	2Tx300	**14p**
2N4991	**98p**	BB103	**43p**	OA202	**16p**	62Tx500	**16p**
2N5457-9	**45p**	BB104	**70p**	OC29	**£1.23**		
40HF40	**£2.25**	BB105	**37p**	OC36	**£1.18**		
40361	**49p**	C106D1	**52p**	T2800D	**£1.20**		
40362	**49p**	E1110	**92p**	T1P31A	**52p**		
40636	**£1.69**	E1210	**97p**	T1P32A	**52p**		

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BC140	28p	OC29	89p
BC141	30p	OC43	50p
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BC179	12p	2N2369	14p
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BC182L	9p	2N2904	15p
BC183	9p	2N904A	15p
BC183L	9p	2N2905	15p
BC184L	9p	2N2906	15p
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				74LS174	99p
				7486	25p
				7491	63p
				7492	35p
				7493	28p
				7494	63p
				7495	63p
		7470	30p	74100	110p
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		7474	20p	74121	25p
7400	9p	7475	27p	74122	36p
7401	9p	7480	40p	74123	44p
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7404	10p	74LS01	11p	74157	60p
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7410	12p	74LS20	18p	74192	80p
7412	17p	74LS30	18p	74193	80p
7413	25p	74LS32	24p	74194	80p
7414	45p	74LS42	89p	74LS175	99p
7416	25p	74LS51	24p	74LS190	110p
7417	25p	74LS55	28p	74LS192	115p
7420	14p	74LS74	39p	74LS194	115p
7427	28p	74LS75	46p	74LS195	115p
7430	14p	74LS76	39p	74LS196	95p
7432	22p	74LS85	99p	74LS197	125p
7438	26p	74LS90	36p	74LS257	99p
7442	48p	74LS93	79p	74LS260	99p
7447	50p	74LS114	49p	74LS273	199p
7450	15p	74LS122	65p	74LS367	59p
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4009	36p	4412	86p
4010	38p	4445	174p
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4016	42p	4514	229p
4017	79p	4515	229p
4018	79p	4516	109p
4019	45p	4520	99p
4020	89p	4522	129p
4021	89p	4526	125p
4022	79p	4531	125p
4023	19p	4555	92p
4024	49p	4556	69p
4025	17p	4581	269p
4026	159p	4582	115p
4027	39p	4584	59p
4028	79p	4585	99p
4029	89p		
4030	49p		
4034	169p		
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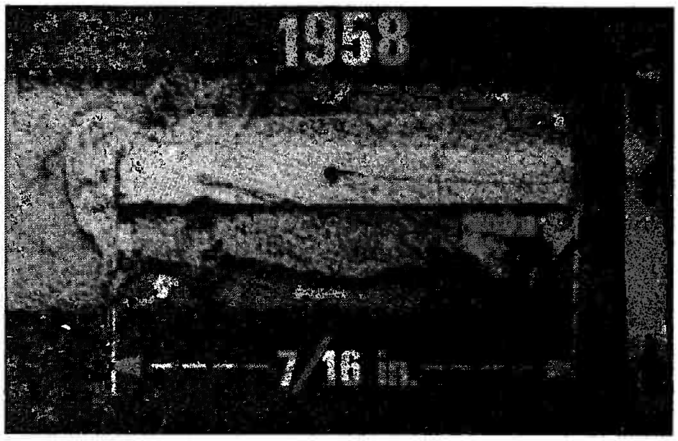
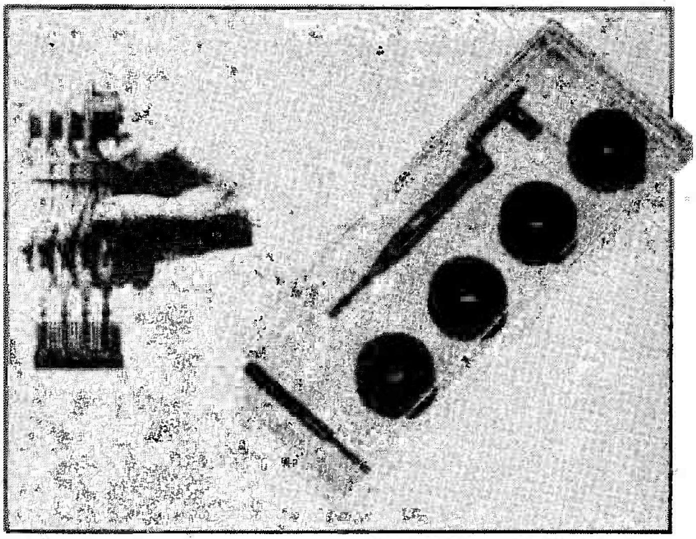
April Fool

Did you spot our deliberate mistakes (well, that's our story) last month? You may have found the contents page listing a shade inaccurate after the circuit supplement. As the supplement is extra to the magazine, its pages are numbered separately. So, to find the Touch Dimmer, for instance, take 16 (the size of the supplement) from 87 and there it is on page 71.

We've already had numerous letters and phone calls about the disembodied program listing which appears on the last Tech Tip page. So, you want to know what it is? Have a look at Tech Tips this month.



It had to happen. The integrated circuit is so old that it has earned its place in a museum. Doesn't it make you feel old? The world's first IC, invented by Jack Kilby of Texas Instruments in 1958, is one of three exhibits on loan from TI in Dallas for the 'Challenge of the Chip' exhibition at the Science Museum. The other two are the first silicon transistor and the first single chip microcomputer.



Wrap Up

This low cost wire wrapping kit caught our eye. We reckoned it was inexpensive enough for any hobbyist or small scale producer to consider buying.

It wraps 30 AWG wire onto standard 0.0025in square posts without stripping or slitting the insulation. It can 'daisy chain' continuously through several points or can be used in the point-to-point mode; it also has a built-in wire cut-off device for terminating the final connection of each chain.

The JWK–6 kit contains the 'Just Wrap' wrapping tool, the JUW–1 unwrapping tool and four 50ft wire refill cartridges, one each of red, white, blue and yellow insulation for colour coding. All packaged in a sturdy clear plastic box. The 'Just Wrap' kit is available at £18.65 excluding VAT and delivery from: OK Machine & Tool (UK) Ltd, Dutton Lane, Eastleigh, Hants SO5 4AA.

AD. INDEX

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This machine is ideal to the computing student or Maths student, ideal to teach your children arithmetic, and is also great fun to use.

Because of the enormous volume of users of this kit we are able to offer a **new reduced price** of **£199** + VAT

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INTERFACE

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T.V. The Iv peak to peak video signal can drive a monitor directly and is also fed to the on-board modulator to drive the domestic T.V.

I.O. On-board UART (Int.6402) which provides serial handling for the on-board cassette interface or the RS232/20mA teletype interface.

The cassette interface is Kansas City standard at either 300 or 1200 baud. This is a link option on the NASCOM-2.

The RS232 and 20mA loop connector will interface directly into any standard teletype.

The input and output sides of the UART are independently switchable between any of the options — i.e. it is possible to house input on the cassette and output on the printer.

PIO There is also a totally uncommitted Parallel I/O (MK3881) giving 16, programmable, I/O lines. These are addressable as 2 x 8 bit ports with complete handshake controls.

Documentation Full construction article is provided for those who buy a kit and an extensive software manual is provided for the monitor and Basic.

Basic The Nascom 2 contains a full 8K Microsoft Basic in one ROM chip with additional features like DEEK, DOKE, SET, RESET for simple programming.

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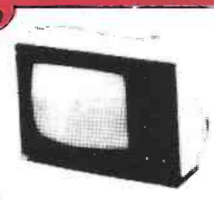
video 100



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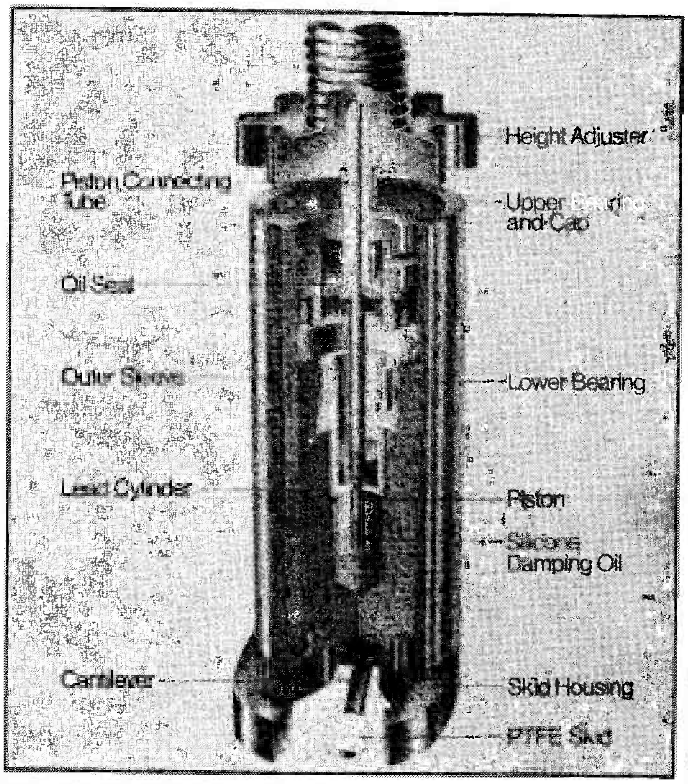
You may have seen this gadget demonstrated on telly a while ago. The Zerostat Z-track tone arm/cartridge damper has an effective mass of only ½ gm. It manages to improve tracking ability, reduce mechanical and accoustic feedback, attenuate unwanted subsonic signals (protecting the amplifier from overloading and the speakers from excessive cone movement) and minimise the effects of record warps.

The Z-track damper fits on to most head shells. It contains a tiny, silicone fluid-damped piston and rides on a low-friction PTFE skid wide enough to ride on the record surface without tracking. Life expenctancy is of the order of 1,000 12" sides. Badly warped records magically become playable and mildly warped records sound as if they were perfectly flat.

The Z-track is adjustable for most tone arm/cartridge combinations. Cost? — £9.95, about the price of two LPs. For further information contact Zerostat Components Ltd, St Ives, Cambs PE17 4LF.



Creditel

You'll soon be able to make phone calls by credit card. The Post Office has just ordered a quarter of a million plastic telephone credit cards for the likes of you and I.

Charges for using the card will be included on your phone bill. As anyone can use a card to make a call (just give the operator the card number), it's vital to keep it in one of those important little places where no-one else can get at it.

The Post Office has arranged with some foreign couuntries that credit card calls may be made back to the UK from abroad. You still have to pay in the end, though.

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The devices feature a Darlington connected PNP input stage which allows the input common-mode voltage to include ground. Current drain (independent of the supply voltage rail) is low (400 uA) and offset voltage is only ±2 mV for the military version. Use of a split power supply is also possible.

Applications include simple analogue to digital converters, MOS clock timers and high voltage digital logic gates. The uA193 series comparators are direct replacements for the LM193 family. Further information, application notes, etc are available from Fairchild Camera & Instrument (UK) Ltd, 230 High Street, Potters Bar, Herts EN6 5BU.

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£69.95 All Inc.

Don't count on this

ever appearing cheaper anywhere else. We don't think it will somehow. Yet again ETI brings you the best of modern technology at ridiculous prices. Following up our extremely successful offer on Seiko's first calculator watch last year we thought that since they'd improved the timepiece, we'd improve the offer!

The watch is no larger than a normal un-calculator un-alarm job but boasts enough facilities to make Big Ben jealous! And with the price as small as the watch we don't see how you can live without one!

To ETI Calculator Watch Offer, Modmags Sales Office,
145 Charing Cross Road, London WC2H 0EE.

I enclose cheque/PO nos. .... to value .... for ....
Seiko Alarm-Calculators.

Name ....

Address ....

....

BI-PAK SEMICONDUCTORS

TRANSISTORS

Type	Price
AC107	£0.25
AC113	£0.23
AC115	£0.23
AC117	£0.35
AC117K	£0.39
AC121	£0.23
AC122	£0.16
AC125	£0.21
AC126	£0.21
AC127	£0.21
AC128	£0.18
AC128K	£0.30
AC132	£0.23
AC134	£0.23
AC137	£0.23
AC141	£0.25
AC141K	£0.35
AC142	£0.42
AC142K	£0.35
AC151	£0.23
AC153	£0.25
AC153K	£0.35
AC154	£0.23
AC155	£0.23
AC156	£0.23
AC157	£0.29
AC165	£0.23
AC166	£0.23
AC167	£0.23
AC168	£0.29
AC169	£0.23
AC171	£0.29
AC176	£0.21
AC176K	£0.30
AC178	£0.29
AC179	£0.29
AC180	£0.23
AC180K	£0.32
AC181	£0.23
AC181K	£0.32
AC187	£0.21
AC187K	£0.32
AC188	£0.21
AC188K	£0.32
ACY17	£0.40
ACY18	£0.40
ACY19	£0.40
ACY20	£0.40
ACY21	£0.40
ACY22	£0.40
ACY27	£0.40
ACY28	£0.37
ACY29	£0.56
ACY30	£0.40
ACY31	£0.40
AD130	£0.81
AD140	£0.69
AD142	£0.98
AD143	£0.86
AD149	£0.69
AD161	£0.40
AD162	£0.40
AD161/2	£0.81
AF124	£0.35
AF125	£0.35
AF126	£0.35
AF127	£0.37
AF139	£0.40
AF178	£0.69
AF179	£0.69
AF180	£0.69
AF181	£0.67
AF186	£0.58
AF239	£0.44
AL102	£1.38
AL103	£1.36
ASY26	£0.44
ASY27	£0.46
ASY28	£0.44
ASY29	£0.44
ASY50	£0.35
ASY51	£0.35
ASY52	£0.35
ASY54	£0.35
ASY55	£0.35
ASY56	£0.35
ASY57	£0.35
ASY58	£0.35
ASY73	£0.35
AU104	£1.61
AU110	£1.61
AU113	£1.61
BC107	£0.09
BC107A	£0.09
BC107B	£0.10
BC107C	£0.12
BC108	£0.09
BC108A	£0.09
BC108B	£0.10
BC108C	£0.12
BC109	£0.09
BC109A	£0.09
BC109B	£0.10
BC109C	£0.12
BC113	£0.18
BC114	£0.18
BC115	£0.22
BC116	£0.22
BC116A	£0.22
BC117	£0.23
BC118	£0.16
BC119	£0.29
BC120	£0.46
BC125	£0.20
BC126	£0.25
BC132	£0.21

Type	Price
BC134	£0.21
BC135	£0.17
BC136	£0.21
BC137	£0.21
BC139	£0.37
BC140	£0.35
BC141	£0.32
BC142	£0.25
BC143	£0.25
BC145	£0.53
BC147	£0.08
BC148	£0.08
BC149	£0.08
BC150	£0.23
BC151	£0.25
BC152	£0.25
BC153	£0.29
BC154	£0.22
BC157	£0.12
BC158	£0.12
BC159	£0.12
BC160	£0.30
BC161	£0.44
BC167	£0.14
BC168	£0.14
BC169	£0.10
BC169C	£0.12
BC170	£0.10
BC171	£0.10
BC172	£0.10
BC173	£0.10
BC174	£0.17
BC175	£0.40
BC177	£0.18
BC178	£0.18
BC179	£0.18
BC180	£0.29
BC181	£0.10
BC182	£1.25
BC182L	£0.10
BC183	£0.10
BC183L	£0.10
BC184	£0.10
BC184L	£0.10
BC186	£0.25
BC187	£0.25
BC207	£0.13
BC208	£0.13
BC209	£0.14
BC212	£0.10
BC212L	£0.10
BC213	£0.10
BC213L	£0.10
BC214	£0.10
BC214K	£0.10
BC225	£0.30
BC226	£0.41
BC227	£0.18
BC238	£0.18
BC251	£0.17
BC251A	£0.18
BC301	£0.32
BC302	£0.33
BC303	£0.32
BC304	£0.44
BC327	£0.18
BC328	£0.17
BC337	£0.17
BC338	£0.17
BC440	£0.35
BC441	£0.35
BC460	£0.44
BC461	£0.44
BC477	£0.23
BC478	£0.23
BC479	£0.23
BC547	£0.12
BC548	£0.12
BC549	£0.12
BC550	£0.16
BC556	£0.16
BC557	£0.15
BC558	£0.14
BCY30	£0.63
BCY31	£0.63
BCY32	£0.69
BCY33	£0.63
BCY34	£0.69
BCY70	£0.17
BCY71	£0.17
BCY72	£0.17
BCZ10	£0.69
BCZ11	£0.69
BCZ12	£0.69
BD115	£0.58
BD116	£0.92
BD121	£0.75
BD123	£0.75
BD124	£0.81
BD131	£0.40
BD132	£0.40
BD131/132mp	£0.92
BD133	£0.46
BD135	£0.44
BD136	£0.40
BD137	£0.40
BD138	£0.41
BD139	£0.41
BD140	£0.41
BD139/140mp	£0.92
BD155	£0.92
BD175	£0.69
BD176	£0.69
BD177	£0.78

Type	Price
BD178	£0.78
BD179	£0.86
BD180	£0.86
BD181	£0.98
BD182	£1.04
BD183	£1.09
BD184	£1.27
BD185	£0.78
BD186	£0.78
BD187	£0.86
BD188	£0.86
BD189	£0.90
BD190	£0.90
BD195	£1.04
BD196	£1.04
BD197	£1.09
BD198	£1.09
BD199	£1.14
BD200	£1.14
BD201	£0.92
BD202	£0.92
BD201/202mp	£1.96
BD203	£0.92
BD204	£0.92
BD203/204mp	£1.96
BD205	£0.92
BD206	£0.92
BD207	£0.92
BD208	£0.00
BD222	£0.00
BD225	£0.54
BD232	£0.63
BD233	£0.55
BD234	£0.63
BD235	£0.63
BD236	£0.67
BD237	£0.63
BD238	£0.69
BD239A	£0.58
BD240A	£0.58
BDX32	£2.53
BDY11	£1.50
BDY17	£2.07
BDY20	£0.92
BDX77	£1.04
BF115	£0.25
BF117	£0.58
BF118	£0.86
BF119	£0.86
BF121	£0.58
BF123	£0.58
BF125	£0.58
BF127	£0.68
BF152	£0.29
BF153	£0.29
BF154	£0.25
BF155	£0.40
BF156	£0.32
BF157	£0.32
BF158	£0.32
BF159	£0.32
BF160	£0.35
BF162	£0.35
BF163	£0.35
BF164	£0.55
BF165	£0.55
BF167	£0.23
BF173	£0.23
BF176	£0.44
BF177	£0.30
BF178	£0.30
BF179	£0.35
BF180	£0.35
BF181	£0.35
BF182	£0.35
BF183	£0.35
BF184	£0.23
BF185	£0.23
BF186	£0.30
BF187	£0.30
BF188	£0.46
BF194	£0.12
BF195	£0.12
BF196	£0.12
BF197	£0.12
BF198	£0.16
BF199	£0.16
BF200	£0.35
BF202	£1.04
BF222	£1.04
BF224	£0.20
BF240	£0.20
BF241	£0.20
BF244	£0.35
BF257	£0.29
BF258	£0.29
BF259	£0.29
BF262	£0.69
BF263	£0.69
BF270	£0.41
BF271	£0.36
BF272	£0.92
BF273	£0.41
BF274	£0.44
BF324	£0.40
BF336	£0.35
BF337	£0.41
BF338	£0.44
BF457	£0.43
BF458	£0.43
BF459	£0.43
BF596	£0.32
BFR39	£0.28
BFR40	£0.29

Type	Price
BFR79	£0.32
BFR80	£0.32
BFX29	£0.25
BFX30	£0.35
BFX84	£0.25
BFX85	£0.28
BFX86	£0.29
BFX87	£0.25
BFX88	£0.25
BFX90	£0.43
BFY50	£0.20
BFY51	£0.20
BFY52	£0.20
BFY53	£0.20
BIP19	£0.44
BIP20	£0.44
BIP19/20	£0.92
BSX25	£1.67
BSX19	£0.21
BSX20	£0.21
BSY25	£0.18
BSY26	£0.18
BSY27	£0.18
BSY28	£0.18
BSY29	£0.18
BSY38	£0.22
BSY39	£0.22
BSY40	£0.33
BSY41	£0.33
BSY51	£0.29
BSY95	£0.15
BSY95A	£0.15
BRY39	£0.52
BU105	£1.84
BU105/02	£2.24
BU204	£1.81
BU205	£1.81
BU208	£2.19
BU208/02	£2.59
MJE2955	£1.04
MJE3055	£0.69
MJE3440	£0.60
MP8113	£0.60
MPF102	£0.32
MPF104	£0.40
MPF105	£0.40
MPSA05	£0.23
MPSA06	£0.23
MPSA55	£0.23
MPSA56	£0.23
ND120	£0.21
OC20	£2.13
OC22	£1.73
OC23	£1.73
OC24	£1.55
OC25	£1.15
OC26	£1.15
OC28	£0.92
OC29	£1.09
OC35	£1.04
OC36	£1.04
OC41	£0.23
OC42	£0.25
OC44	£0.28
OC45	£0.23
OC70	£0.28
OC71	£0.17
OC72	£0.28
OC74	£0.30
OC75	£0.35
OC76	£0.40
OC77	£0.68
OC81	£0.25
OC81DD	£0.28
OC82	£0.28
OC82D	£0.35
OC83	£0.30
OC84	£0.44
OC139	£0.92
OC140	£0.92
OC169	£0.40
OC170	£0.40
OC171	£0.40
OC200	£0.44
OC201	£1.09
OC202	£1.38
OC203	£0.98
OC204	£1.04
OC205	£1.32
TIC44	£0.33
TIC45	£0.40
TIP29A	£0.46
TIP29B	£0.48
TIP29C	£0.51
TIP30A	£0.46
TIP30B	£0.48
TIP30C	£0.51
TIP31A	£0.46
TIP31B	£0.48
TIP31C	£0.51
TIP32A	£0.46
TIP32B	£0.48
TIP32C	£0.51
TIP41A	£0.51
TIP41B	£0.53
TIP41C	£0.55
TIP42A	£0.51
TIP42B	£0.53
TIP42C	£0.55
TIP2955	£0.69
TIP3055	£0.53
TIS43	£0.25
TIS90	£0.21
UT46	£0.23
ZTX107	£0.12
ZTX108	£0.12

Type	Price
ZTX109	£0.12
ZTX300	£0.14
ZTX301	£0.14
ZTX302	£0.18
ZTX303	£0.18
ZTX304	£0.23
ZTX330	£0.17
ZTX500	£0.15
ZTX501	£0.14
ZTX502	£0.18
ZTX503	£0.14
ZTX504	£0.29
ZTX531	£0.29
ZTX550	£0.18
2N388	£0.41
2N388A	£0.64
2N404	£0.23
2N524	£0.46
2N527	£0.58
2N598	£0.46
2N599	£0.53
2N696	£0.15
2N697	£0.14
2N698	£0.14
2N699	£0.37
2N706	£0.12
2N706A	£0.14
2N707	£0.55
2N708	£0.16
2N711	£0.35
2N717	£0.35
2N718	£0.29
2N718A	£0.58
2N726	£0.33
2N727	£0.33
2N743	£0.23
2N744	£0.23
2N914	£0.17
2N918	£0.35
2N929	£0.23
2N930	£0.21
2N946	£0.46
2N1131	£0.21
2N1132	£0.21
2N1302	£0.17
2N1303	£0.21
2N1304	£0.21
2N1305	£0.21
2N1306	£0.29
2N1307	£0.29
2N1308	£0.35
2N1309	£0.35
2N1699	£0.40
2N1613	£0.23
2N1711	£0.23
2N1889	£0.52
2N1890	£0.52
2N1893	£0.35
2N2147	£0.86
2N2148	£0.81
2N2160	£0.00
2N2192	£0.44
2N2193	£0.44
2N2194	£0.44
2N2217	£0.25
2N2218	£0.25
2N2218A	£0.23
2N2219	£0.23
2N2219A	£0.28
2N2220	£0.23
2N2221	£0.23
2N2221A	£0.25
2N2222	£0.23
2N2222A	£0.23
2N2368	£0.21
2N2369	£0.16
2N2369A	£0.16
2N2411	£0.29
2N2412	£0.29
2N2646	£0.54
2N2711	£0.25
2N2712	£0.25
2N2714	£0.25
2N2904	£0.21
2N2904A	£0.24
2N2905	£0.21
2N2905A	£0.23
2N2906	£0.18
2N2906A	£0.22
2N2907	£0.23
2N2907A	£0.25
2N2923	£0.17
2N2924	£0.17
2N2925	£0.17
2N2926G	£0.10
2N2926Y	£0.09
2N2926O	£0.09
2N2926R	£0.09
2N2926B	£0.09
2N3010	£0.75
2N3011	£0.17
2N3053	£0.20
2N3054	£0.46
2N3055	£0.46
2N3391	£0.23
2N3391A	£0.25
2N3392	£0.23
2N3393	£0.23
2N3394	£0.23
2N3395	£0.25
2N3402	£0.24
2N3403	£0.24
2N3404	£0.33
2N3405	£0.48
2N3414	£0.18
2N3415	£0.18

Type	Price
2N3416	£0.33
2N3417	£0.33
2N3614	£1.15
2N3615	£1.21
2N3616	£1.21
2N3646	£0.10
2N3702	£0.09
2N3703	£0.09
2N3704	£0.08
2N3705	£0.08
2N3706	£0.09
2N3707	£0.09
2N3708	£0.08
2N3708A	£0.08
2N3709	£0.08
2N3710	£0.08
2N3711	£0.08
2N3772	£1.84
2N3773	£2.53
2N3819	£0.21
2N3820	£0.40
2N3821	£0.69
2N3823	£0.69
2N3903	£0.12
2N3904	£0.12
2N3905	£0.12
2N3906	£0.12
2N4058	£0.14
2N4059	£0.16
2N4060	£0.16
2N4061	£0.14
2N4062	£0.14
2N4921	£0.63
2N4923	£0.75
2N5135	£0.12
2N5136	£0.12
2N5138	£0.12
2N5172	£0.16
2N5194	£0.64
2N5245	£0.46
2N5294	£0.39
2N5296	£0.41
2N5457	£0.37
2N5458	£0.37
2N5459	£0.40
2N5551	£0.41
2N6027	£0.39
2N6121	£0.81
2N6122	£0.81
2S301	£0.58
2S302	£0.49
2S302A	£0.49
2S303	£0.64
2S403	£0.82
2S305	£0.92
2S306	£0.92
2S307	£0.92
2S321	£0.66
2S322	£0.49
2S322A	£0.49
2S323	£0.66
2S324	£0.82
2S325	£0.00
2S326	£0.82
2S327	£0.82
40311	£0.42
40313	£1.09
40316	£1.09
40317	£0.46
40326	£0.46
40327	£0.52
40346	£0.52
40347	£0.75
40348	£0.92
40360	£0.41
40362	£0.44
40406	£0.52
40407	£0.40
40408	£0.60
40409	£0.86
40410	£0.86
40411	£0.00
40430	£1.09
40476	£1.84
40494	£0.81
40495	£0.92
40512	£1.55
40594	£1.04
40636	£1.27

VOLTAGE REGULATORS

UA7805	£0.75
UA7812	£0.75
UA7815	£0.75
UA7818	£0.75
UA7824	£0.75
UA7905	£0.85
UA7912	£0.85
UA7915	£0.85
UA7918	£0.85
UA7924	£0.85
72723	£0.52
UA723	£0.52
LM309K	£1.72

74 SERIES TTL ICs

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
7400	£0.10	7427	£0.28	7473	£0.29	74110	£0.41	74166	£0.90
7401	£0.13	7428	£0.30	7474	£0.29	74111	£0.67	74174	£0.75
7402	£0.13	7430	£0.15	7475	£0.33	74118	£0.92	74175	£0.71
7403	£0.13	7432	£0.25	7476	£0.29	74119	£1.36	74176	£0.67
7404	£0.13	7433	£0.35	7480	£0.51	74121	£0.28	74177	£0.67
7405	£0.13	7437	£0.24	7481	£0.98	74122	£0.45	74180	£1.73
7406	£0.25	7438	£0.24	7482	£0.78	74123	£0.46	74181	£0.67
7407	£0.25	7440	£0.14	7483	£0.67	74136	£0.60	74182	£0.81
7408	£0.15	7441	£0.58	7484	£1.01	74141	£0.63	74184	£0.81
7409	£0.15	7442	£0.46	7485	£0.78	74145	£0.63	74190	£0.78
7410	£0.13	7443	£0.81	7486	£0.25	74150	£0.78	74191	£0.71
7411	£0.20	7444	£0.81	7489	£1.96	74151	£0.55	74192	£0.69
7412	£0.17	7445	£0.75	7490	£0.37	74153	£0.55	74193	£0.67
7413	£0.28	7446	£0.69	7491	£0.74	74154	£0.94	74194	£0.71
7414	£0.58	7447	£0.55	7492	£0.40	74155	£0.58	74195	£0.69
7416	£0.26	7448	£0.64	7493	£0.35	74156	£0.58	74196	£1.21
7417	£0.26	7450	£0.13	7494	£0.86	74157	£0.58	74197	£1.21
7420	£0.13	7451	£0.13	7495	£0.58	74160	£0.67	74198	£2.13
7421	£0.23	7453	£0.13	7496	£0.58	74161	£0.71	74199	£2.13
7422	£0.18	7454	£0.13	74100	£0.98	74162	£0.71		
7423	£0.24	7460	£0.13	74104	£0.45	74163	£0.71		
7425	£0.22	7470	£0.29	74105	£0.44	74164	£0.78		
7426	£0.26	7472	£0.23	74107	£0.28	74165	£0.78		

CMOS ICs

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
CD4000	£0.16	CD4015	£0.94	CD4026	£1.38	CD4043	£1.01	CD4070	£0.20
CD4001	£0.23	CD4016	£0.49	CD4027	£0.58	CD4044	£0.94	CD4071	£0.20
CD4002	£0.16	CD4017	£0.94	CD4028	£0.78	CD4045	£1.61	CD4072	£0.20
CD4006	£1.06	CD4018	£0.98	CD4029	£0.98	CD4046	£1.50	CD4081	£0.20
CD4007	£0.20	CD4019	£0.48	CD4030	£0.55	CD4047	£1.00	CD4082	£0.25
CD4008	£1.06	CD4020	£1.04	CD4031	£2.30	CD4049	£0.86	CD4510	£1.27
CD4009	£0.52	CD4021	£0.94	CD4035	£1.38	CD4050	£0.55	CD4511	£1.44
CD4010	£0.55	CD4022	£0.94	CD4037	£1.09	CD4054	£1.27	CD4516	£1.15
CD4011	£0.23	CD4023	£0.22	CD4040	£1.01	CD4055	£1.15	CD4518	£1.15
CD4012	£0.22	CD4024	£0.75	CD4041	£0.87	CD4056	£1.55		
CD4013	£0.48	CD4025	£0.22	CD4042	£0.83	CD4069	£0.20		

LINEAR ICs

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
CA3011	£1.12	LM301	£0.33	NE556	£0.69	UA747C	£0.69	TBA810	£1.13
CA3014	£1.55	LM304	£1.84	NE565	£1.38	72747	£0.69	TBA820	£0.81
CA3018	£0.75	LM308	£1.15	NE566	£1.73	UA748	£0.40	TBA9200	£2.98
CA3020	£1.86	LM309	£1.73	NE567	£1.96	72748	£0.40	TCA270S	£2.30
CA3028	£0.92	LM380	£0.98	UA702C	£0.53	748P	£0.40	TBA800	£0.92
CA3036	£1.01	LM381	£1.67	72702	£0.53	SN76013N		ZN414	£1.15
CA3036	£1.15	LM3900	£0.67	UA703	£0.29		£2.01	TBA120	£0.80
CA3042	£1.73	MC1303L	£0.98	UA709	£0.29	SN76023	£2.01	TBA641A	£1.84
CA3043	£2.13	MC1304	£2.19	72709	£0.53	SN76110	£1.73	TBA6413	£2.53
CA3046	£0.81	MC1310	£1.09	709P	£0.29	SN76115	£2.19		
CA3052	£1.74	TBA120	£0.60	UA710C	£0.46	SN76660	£0.86		
CA3054	£1.27	MC1312	£2.19	72710	£0.35	SL414A	£2.24		
CA3075	£1.73	MC1350	£1.38	UA711C	£0.37	TAA550B	£0.49		
CA3081	£1.73	MC1352	£1.61	72711	£0.37	TAA621A	£2.30		
CA3089	£2.30	MC1469	£3.39	UA723C	£0.52	TAA621B	£2.88		
CA3090	£4.14	MC1496	£1.04	72723	£0.52	TAA661	£1.73		
CA3123	£2.19	NE536	£3.06	UA741C	£0.26	TAD100	£1.50		
CA3130	£1.07	NE550	£1.09	72741	£0.28	TBA540	£2.42		
CA3140	£0.81	NE555	£0.23	741P	£0.23	TBA810S	£0.86		

DIODES

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AA110	£0.09	BAX13	£0.08	BY164	£0.59	OA10	£0.40	SD10	£0.07
AA120	£0.09	BAX16	£0.09	BY176	£0.86	OA47	£0.09	SD19	£0.07
AA129	£0.09	BY100	£0.25	BY206	£0.35	OA70	£0.09	IN34	£0.08
AAY30	£0.10	BY101	£0.25	BYZ10	£0.52	OA79	£0.12	IN34A	£0.08
AAZ13	£0.17	BY106	£0.25	BYZ11	£0.52	OA81	£0.12	IN914	£0.07
BA100	£0.16	BY114	£0.25	BYZ12	£0.46	OA85	£0.12	IN916	£0.07
BA102	£0.37	BY124	£0.25	BYZ13	£0.46	OA90	£0.12	IN4148	£0.07
BA148	£0.17	BY126	£0.17	BYZ16	£0.47	OA91	£0.12	IS44	£0.06
BA154	£0.14	BY127	£0.18	BYZ17	£0.41	OA95	£0.12	IS920	£0.07
BA155	£0.16	BY128	£0.18	BYZ18	£0.41	OA182	£0.15		
BA173	£0.17	BY130	£0.20	BYZ19	£0.41	OA200	£0.09		
BB104	£0.46	BY133	£0.24	OA5	£0.69	OA202	£0.09		

TRIACS

2 amp Volts	T05 Case No.	Price
100	TR12a/100	£0.36
200	TR12a/200	£0.59
400	TR12a/400	£0.82

10 amp Volts		Price
100	TR110a/100	£0.89
200	TR110a/200	£1.06
400	TR110a/400	£1.29

6 amp Volts		
100	TR16a/100	£0.59
200	TR16a/200	£0.70
400	TR16a/400	£0.89

10 amp Volts		
400	TR110a/400p	£1.29

Diacs

BR100 £0.23 D32 £0.23

BRIDGE RECTIFIERS

SILICON 1 amp

Type	No.	Price
50v RMS	BR1 50	£0.23
100v RMS	BR1 100	£0.25
200v RMS	BR1 400	£0.29
400v RMS	BR1 400	£0.41

SILICON 2 amp

Type	No.	Price
50v RMS	BR2 50	£0.52
100v RMS	BR2 100	£0.55
200V RMS	BR2 200	£0.60
400v RMS	BR2 400	£0.67
1000v RMS	BR2 1000	£0.78

SILICON 10 amp

Type	No.	Price
50v RMS	BR10 50	£1.73
200v RMS	BR10 200	£1.96

SILICON 25 amp

Type	No.	Price
50v RMS	BR25 50	£2.19
200v RMS	BR25 200	£2.53

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BP26	Radio Antenna Book Long Distance Reception & Transmission	0.85
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BP160	Coil Design & Construction Manual	0.75
BP202	Handbook of Integrated Circuits Equivs & Substitutes	1.00
BP211	First Book of Diode Characteristics & Equivalents & Substitutes	1.25
BP213	Electronic Circuits for Model Railways	1.00
BP215	Shortwave Circuits & Gear for Experimenters & Radio Hams	0.85
BP217	Solid State Power Supply Handbook	0.85
BP221	28 Tested Transistor Projects	1.25
BP224	50 CMOS IC Projects	0.95
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BP227	Beginners Guide to Building Electronic Projects	1.25
RCC	Resistor Colour Code Disc	0.20

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Right-angle mounting brackets. Ideal for mounting, PCB, panels et cetera into boxes and cases.
18SWG — Mild steel — short face has slotted hole 6.5cm x 3.7cm long face has 3.7cm diam. hole

O/NO:1726	Height 15cm, length 15cm, width 10cm	£0.06
O/NO:1727	Height 25cm, length 15cm, width 10cm	£0.07

SWITCHES

Description	No.	Price
DPDT miniature slide	1973	£0.16
DPDT standard slide	1974	£0.17
Toggle switch SPST 1½ amp 250V ac	1975	£0.38
Toggle switch DPDT 1 amp 250V ac	1976	£0.48
Rotary on-off mains switch	1977	£0.58
Push switch — Push to make	1978	£0.16
Push switch — Push to break	1979	£0.21

ROCKER SWITCH

A range of rocker switches SPST — moulded in high insulation material available in a choice of colours ideal for small apparatus

Colour	No.	Price
RED	1980	£0.35
BLACK	1981	£0.35
WHITE	1982	£0.35
BLUE	1983	£0.35
YELLOW	1984	£0.35
LUMINOUS	1985	£0.35

Description	No.	Price
Miniature SPST toggle 2 amp 250V ac	1958	£0.81
Miniature SPST toggle 2 amp 250V ac	1959	£0.86
Miniature DPDT toggle 2 amp 250V ac	1960	£0.91
Miniature DPDT toggle centre off 2 amp 250V ac	1961	£1.07
Push-button SPST 2 amp 250V ac	1962	£1.04
Push-button SPST 2 amp 250V ac	1963	£1.09
Push-button DPDT 2 amp 250V ac	1964	£1.34

MIDGET WAFER SWITCHES

Single bank wafer type — suitable for switching at 250V ac 100mA or 150V dc in non-reactive loads make-before-break contacts. These switches have a spindle 0.25 in dia and 30 indexing.

Description		No.	Price
1 pole	12 way	1965	£0.55
2 pole	6 way	1966	£0.55
3 pole	4 way	1967	£0.55
4 pole	3 way	1968	£0.55

MICRO SWITCHES

	No.	Price
Plastic button gives simple 1 pole change over action Rating 10 amp 250V ac	1970	£0.29

OPTOELECTRONICS

NEW INCREASED RANGE — ALL 1ST QUALITY
LEDS (diffused)

O/no.	Type	Size	Colour	Price
1501	ARL209 (TIL209)	3mm (.125)	RED	£0.10
1502	MIL3232 (TIL211)	3mm (.125)	GREEN	£0.16
1503	MIL3331 (OP212A)	3mm (.125)	YELLOW	£0.16
1504	ARL4850 (FLV117)	5mm (.2)	RED	£0.10
1505	MIL5251 (TIL222)	5mm (.2)	GREEN	£0.16
1506	MIL5351 (MV5353)	5mm (.2)	YELLOW	£0.16
1509	FLV111	5mm (.2)	CLEAR (ill. Red)	£0.12

SUPER 'HI-BRITE' TYPE

1521	MIL32	3mm (.125)	RED	£0.11
1522	MIL52	5mm (.2)	RED	£0.11
1514	ORP12 Light dependent resistor			£0.70
1520	OCP71 Photo transistor			£0.40

LED CLIPS

1508/125	pack of 5	125 clips	£0.17
1508/2	pack of 5	2 clips	£0.21

DISPLAYS:

DL703 7 segment D.P. left (.3" height) RED Single Digit	Common Anode	o/no. 1523	£0.85
DL707 7 segment D.P. left (.3" height) RED Single Digit	Common Anode	o/no. 1510	£0.92
DL527 7 segment D.P. left (.5" height) RED Two-Digit Reflector	Common Anode	o/no. 1524	£2.08
DL727 7 segment D.P. right (.5" height) RED Two-Digit Light Pipe	Common Anode	o/no. 1512	£2.07
DL747 7 segment D.P. left (.6" height) RED Single Digit Light Pipe	Common Anode	o/no. 1511	£1.73

OPTO-ISOLATORS

Isolation Breakdown — Voltage 1500 — continuous fwd current 100mA
CIL74 Single-Channel 6 pin DIP standard type — optically coupled pair with infra-red LED Emitter and NPN Silicon Photo Transistor o/no. 1497 **£0.61**
CILD74 Multi-Channel 8 pin DIP Two Isolated Channels o/no. 1498 **£1.22**
CILQ74 Multi-Channel 16 pin DIP Four Isolated Channels o/no 1499 **£2.69**

MEL 11 (TIL81) NPN LIGHT DETECTOR
Silicon Photo Darlington Amplifier — VCBO 30v VECO 10v Ic 100mA Ptot.300mW IL Min 0.5 Typ.2mA ID 100mA nA o/no. 1496 **£0.29**

WIRE CONNECTORS

Entirely new range of connectors for Discrete wire. Uniquely designed Wirepost is soldered to the P.C. Board. A pre-stripped wire is inserted into the connector and easily locked by pressing the housing down. The wire is alternatively removed by lifting the housing. Tin alloy plated contacts ensure good as gold performance.

Housing consists of Thermo plastic polyster.

1728	Single connector in red/black or white	£0.12 inc. VAT
1729	Threeway connector black ONLY	£0.23 inc. VAT
1730	Fourway connector black ONLY	£0.28 inc. VAT

FUSE HOLDERS AND FUSES

Description	No.	Price
20mm × 5mm chassis mounting	506	£0.18
1¼in × ¼in chassis mounting	507	£0.14
1¼in car inline type	508	£0.18
Panel mounting 20mm	509	£0.23
Panel mounting 1¼in	510	£0.37

QUICK BLOW 20mm

Type	No.		Type	No.		Type	No.	
150mA	611	7p	1A	615	6p	3A	619	6p
250mA	612	6p	1.5A	616	7p	4A	620	10p
550mA	613	6p	2A	617	6p	5A	621	6p
800mA	614	8p	2.5A	618	7p			

ANTI-SURGE 20mm

Type	No.	Type	No.	Type	No.
100mA	622	1A	625	2.5A	628
250mA	623	2A	626	3.15A	629
500mA	624	1.6A	627	5A	630

All 8p each

QUICK-BLOW 1¼in

Type	No.	Type	No.	Type	No.
250mA	631	500mA	632	800mA	634

All 8p each

Type	No.	Type	No.	Type	No.
1A	635	2.5A	638	4A	641
2A	637	3A	639	5A	642

All 6p each

NUTS AND BOLTS

BA BOLTS — packs of BA threaded cadmium plated screws slotted cheese head. Supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
1in 0BA	839	£1.38	½in 4BA	846	£0.37
½in 0BA	840	£0.86	¼in 4BA	847	£0.29
1in 2BA	842	£0.75	1in 6BA	848	£0.46
½in 2BA	843	£0.52	½in 6BA	849	£0.24
¼in 2BA	844	£0.60	¼in 6BA	850	£0.29
1in 4BA	845	£0.51			

BA NUTS — packs of cadmium plated full nuts in multiples of 50.

Type	No.	Price	Type	No.	Price
0BA	855	£0.83	4BA	857	£0.35
2BA	856	£0.55	6BA	858	£0.28

BA WASHERS — flat cadmium plated plain stamped washers supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
0BA	859	£0.16	4BA	861	£0.14
2BA	860	£0.14	6BA	862	£0.14

SOLDER TAGS — Hot tinned supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
0BA	851	£0.46	4BA	853	£0.25
2BA	852	£0.32	6BA	854	£0.25

AUDIO LEADS

No.	Type	Price
107	FM indoor Ribbon Aerial	£0.69
113	3.5mm Jack plug to 3.5mm Jack plug. Length 1.5m	£0.86
114	5 pin DIN plug to 3.5mm Jack connected to pins 3 & 5. Length 1.5m	£0.98
115	5 pin DIN plug to 3.5mm Jack connected to pins 1 & 4. Length 1.5m	£0.98
116	Car aerial extension Screened insulated lead. Fitted plug and socket	£1.44
117	AC mains connecting lead for cassette recorders and radios. 2 metres	£0.78
118	5 pin DIN phono plug to stereo headphone Jack socket	£1.21
119	2+2 pin DIN plugs to stereo Jack socket with attenuation network for stereo headphones. Length 0.2m	£1.04
120	Car stereo connector. Variable geometry plug to fit most car cassettes, 8-track cartridge and combination units. Supplied with inlined fuse power lead and instructions	£0.69
123	6.6m Coiled Guitar Lead Mono Jack plug to Mono Jack plug Black	£1.72
124	3 pin DIN plug to 3 pin DIN plug. Length 1.5m	£0.85
125	5 pin DIN plug to 5 pin DIN plug. Length 1.5m	£0.85
126	5 pin DIN plug to Tinned open end. Length 1.5m	£0.85
127	5 pin DIN plug to 4 Phono Plugs. All colour coded. Length 1.5m	£1.49
128	5 pin DIN plug to 5 pin DIN socket. Length 1.5m	£0.92
129	5 pin DIN plug to 5 pin DIN plug mirror image. Length 1.5m	£1.21
130	2 pin DIN plug to 2 pin DIN inline socket. Length 5m	£0.78
131	5 pin DIN plug to 3 pin DIN plug 1 & 4 and 3 & 5. Length 1.5m	£0.95
132	2 pin DIN plug to 2 pin DIN socket. Length 10m	£1.13
133	5 pin DIN plug to 2 Phono plugs. Connected pins 3 & 5. Length 1.5m	£0.86
134	5 pin DIN plug to 2 Phono sockets. Connected pins 3 & 5. Length 23cm	£0.78
135	5 pin DIN socket to 2 Phono plugs. Connected pins 3 & 5. Length 23cm	£0.78
136	Coiled stereo headphone extension lead. Black, length 6m	£2.01
178	AC mains lead for calculators, etc	£0.52

TRANSFORMERS

MINIATURE MAINS Primary 240V

No.	Secondary	Price
2021	6V-0-6V 100mA	£1.04
2022	9V-0-9V 75mA	£1.04
2023	12V-0-12V 100mA	£1.29

MINIATURE MAINS Primary 240V
with two independent secondary windings

No.	Type	Price
2024	MT280-0-6V 0-6V RMS	£1.84
2025	MT150-0-12V 0-12V RMS	£1.84

1 AMP MAINS Primary 240V

No.	Secondary	Price	
2026	6V-0-6V 1 amp	£2.88	P.&P. 45p
2027	9V-0-9V 1 amp	£2.30	P.&P. 45p
2028	12V-0-12V 1 amp	£2.60	P.&P. 55p
2029	15V-0-15V 1 amp	£3.16	P.&P. 66p
2030	30V-0-30V 1 amp	£3.97	P.&P. 86p

STANDARD MAINS Primary 240V
Multi-tapped secondary mains transformers available in ½ amp, 1 amp and 2 amp current rating. Secondary taps are 0-19-25-33-40-50V. Voltages available by use of taps, 7, 8, 10, 14, 15, 17, 19, 25, 31, 33, 40, 25-0-25V.

No.	Rating	Price	
2031	½ amp	£3.91	P.&P. 86p
2032	1 amp	£5.06	P.&P. 86p
2033	2 amp	£6.27	P.&P. £1
2035	240V Primary 0-55V @ 2A Secondary	£7.30	P.&P. £1

SPECIAL OFFER
2042 240V Primary 0-20V @ 2A Secondary. By removing 5 turns for each volt from the secondary winding any voltage up to 20V @ 2A is easily obtainable. Ideal for the experimenter.
£1.50 P.&P. 86p

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INSTRUMENT CASES. In two sections, vinyl covered top and sides, aluminium bottom, front and back.

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156	11in	6in	3in	£2.92
157	6in	4¾in	1¾in	£1.79
158	9in	5¼in	2½in	£2.43

ALUMINIUM BOXES. Made from bright ali., folded construction each box complete with half-inch-deep lid and screws.

No.	Length	Width	Height	Price
159	5¼in	2¼in	1½in	£0.85
160	4in	4in	1½c0	£0.85
161	4in	2¼in	1½in	£0.85
162	5¼in	4in	1½in	£0.97
163	4in	2½in	2in	£0.87
164	3in	2in	1in	£0.60
165	7in	5in	2½in	£1.43
166	8in	6in	3in	£1.82
167	6in	4in	2in	£1.18

SLOPE front aluminium boxes with black vinyl base and sides & aluminium back, top & front — strong construction easily accessable.

169	2⅛in	5⅜in	2¾in	12in	3½in	8in	£5.45
168	1⅝in	7¼in	4in	16in	4½in	11in	£8.31

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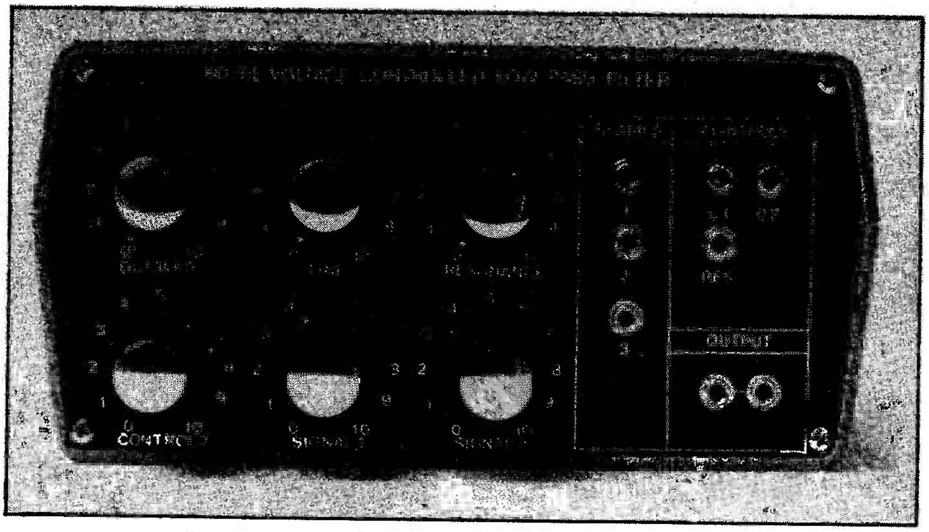
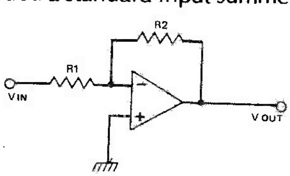
BARCLAYCARD VISA

PROJECT 80 FILTERS

Not one project but four. The Project 80 VCF can be constructed as any of the most useful configurations. Circuit design by Charles Blakey.



In the first article of this series (February 1980) it was stated the project is suitable for both the enthusiast and the beginner in electronic music. It is reasonable to assume that the enthusiast already has some equipment and so the ETI 80 modules offer the opportunity to extend, or upgrade, their current system. Assuming that the existing equipment is compatible with modules having an exponential frequency control response then one of the problems that is encountered is the level of signals employed. Most of the ETI 80 modules can readily be adapted to accept other signal levels. For example, we could have zero referenced the input to the following filters and omitted the buffer stage, although the high input impedance for some filters may have led to problems with noise pick-up. By including an op amp input stage we have avoided the latter potential hazard and at the same time provided a standard input summer.-



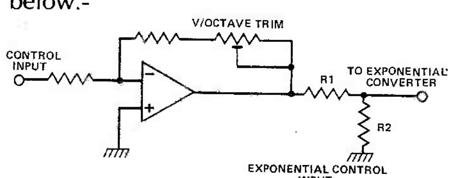
$V_{out} = \frac{R2}{R1} V_{in}$

$$\text{with } V_{out} = \frac{R2}{R1} V_{in}$$

If one is therefore currently using 5V P-P signals, instead of the 10V P-P employed in this project, then the only change required is to double R2 so that the other components around the special ICs employed remain unchanged. In the case of some synthesisers which combine the worst of both worlds and have very low signal levels and low input impedance then both R1 and R2 can be altered to normalise the input to that of the existing synthesiser.

Likewise, most modules will have a similar buffer at the output which allows the signals to be attenuated to their original level, for example in the case of the 5V signal then R2 has to be halved.

Another minor problem may be the frequency response characteristics, for example, a synthesiser with a 0.5V per octave scale. All ETI 80 modules will have one or more scaling resistors which in the case of the current filter design is of the type shown below.-



where R1 and R2 are scaling resistors to give approximately 18 mV to the exponential converter for each volt applied at the keyboard control input. For the above mentioned example the only change required is doubling R2.

The final problem of compatibility is likely to be power supplies. This is most easily overcome by having separate supplies for the modules employed from this project. In most instances, however, the ETI 80 series can be run from power supplies as low as ± 9 V but this will require a number of component changes. Digisound Limited will be pleased to advise readers of these changes.

Filters

This month we are featuring the four filters most widely used in music synthesisers. They are four pole filters with one volt per octave control of their cut-off, or centre, frequency. Voltage control of signal regeneration is also included.

Filters are normally used in three modes. Firstly, substractive synthesis, in which partials are substracted from complex waveforms to effect changes in tone quality. Next, in timbre modulation which allows more complex waveforms to be developed by continuously altering the amplitude of the partials present during the duration of the sound. The latter may be accomplished by using a low frequency oscillator to vary the cut-off frequency of the filter. A widely employed variation of the latter technique is the use of an envelope generator, triggered by the keyboard, to control the cut-off frequency. In this way a tone can be produced, using a low pass filter, which begins with the fundamental followed by an increasing number of partials. The third technique is resonant synthesis in which the regeneration of the signal is increased to a level which will cause the filter to oscillate on receiving a sharp impulse, eg from an envelope generator set to minimum time constants or from a square wave and so on. This technique is widely used to produce percussive sounds.

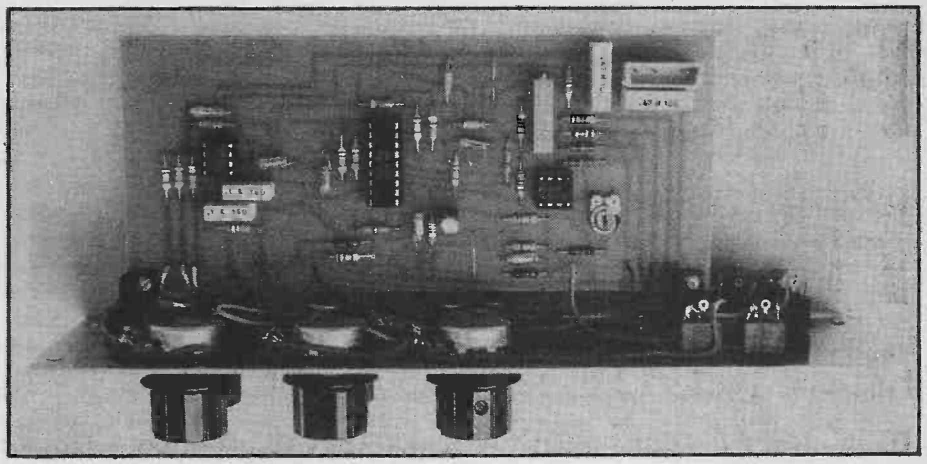
The four filter types provided are.-

Low Pass Filter. This will pass all frequencies up to the cut-off point and beyond this the frequencies are sharply attenuated at a rate of 24 dB/octave. By increasing the resonance control a band of frequencies around the cut-off point are emphasised and the more regeneration used the more 'electronic' the sound becomes. Low pass filtering is useful in simulating the tonal characteristics of several conventional instruments.

High Pass Filter. This passes all frequencies above the cut-off point and the roll-off below this point is again 24 dB/octave. The effect of high pass filtering is therefore to remove the fundamental and lowest partials and leave only the weak upper partials. It does not therefore find widespread use in substractive synthesis of waveforms although a sawtooth and a high pass filter will produce some bright string sounds. This filter is also of use in filtering white noise. It is not normal to include resonance control with a high pass filter because of its limited application but since its inclusion has a very small effect on the cost in the current design it has been included. Its effect is the same as with the low pass filter, namely, to emphasise a band of frequencies about the cut-off point.

Band Pass Filter. This will pass a band of frequencies at the pole frequency of the filter. It is derived from two poles of high pass followed by two stages of low pass filtering thus giving a roll-off of 12 dB/octave in either side of the centre frequency. The effect of the resonance control in this instance, however, is to emphasise the centre frequency and so effectively increase the roll-off. This filter is used in imitative synthesis but more commonly a number of band pass filters need to be employed to obtain realistic results. Similarly, a more versatile band pass filter may be created by using independent low and high pass filters so that the width of the pass band can be altered over a wide range.

Phase Shift Filter. This is an allpass filter with mixing of the original signal to create two deep notches. The effect of regeneration is to sharpen the corners of the notches and effectively increase their depth. The 'phasing' effect is well known and most of the low cost commercial 'phasers' only have two notches. A particular advantage of the design described below is its low noise but even so we believe that six notches are a minimum for good phasing effects.



Which Filter?

As one's experience in music synthesisers increases it will be found that good quality filters (low noise and tracking capability) are essential for both innovative and imitative synthesis and that this will usually be achieved by combining various types of filter in series or parallel. Our recommendation for beginners is to start with the low pass filter, which finds the most widespread use in music synthesis, and the state variable filter to be described in the next article since this will have low pass, high pass, band pass and notch responses.

Filter Design

The design is based on another customised IC from Curtis Electromusic Specialties, namely the CEM 3320, to realise the most important filter types employed in music synthesis. This voltage controlled filter IC has four independent filter stages which may be interconnected to provide a wide variety of filter responses. The pole frequency of the four stages is controlled by a single exponential generator which has a minimum range of ten octaves. The IC also includes a separate transconductance amplifier whose output is connected to the first filter stage and in the present design is used to provide manual or external voltage control of regeneration.

Some music synthesists argue that the ideal filter should have complete cut-off at its pole frequency. Certainly filters with a 24 dB/octave roll-off are considerably more useful than designs with lower roll-off. (12 and 24 dB/octave slopes will be included in the state variable filter design which is featured in the next article of this series). This combination of 24 + 12, or 24 + 24 dB/octave filters will provide the versatility we are aiming for in this project.

Each of the filters has been designed to accept our standard 10V P-P signal level and to output a similar signal level. The term 'similar signal level' is used since allowance has to be made for the enhancement of the centre frequency as the amount of feedback is increased through the resonance control. For example, the band pass filter has an output of about 3V P-P at lowest Q (no feedback) whereas at maximum Q this peak level will approach 11V. The filters are controlled over a 1000:1 frequency range and their lowest frequency is typically in the range 20 to 25 Hz. The standard one volt per octave frequency response is employed and when calibrated the filters will track the oscillators accurately over the important range of the keyboard. Beyond this range the one volt per octave control falls off but this is acceptable for filters. Manual and external voltage control of frequency are provided and the manual adjustment includes both coarse and fine adjustment. One of the external frequency control inputs has an attenuating potentiometer which is required when the filter is used in conjunction with an envelope generator or external waveforms for timbre modulation. Three signal inputs are included to simplify mixing of waveforms prior to filtering. Two of these have attenuating potentiometers and the third is fixed at one third of the maximum gain of the other two inputs. The fixed input may be altered to suit individual requirements and it may be coupled to a potentiometer external to the module.

Temp. Temper

Although the four filter stages of the CEM 3320 are fully temperature compensated the frequency control input is not. If the methods of construction outlined in the first article are followed then frequency changes due to temperature should not be a problem.

A major advantage gained by using the CEM 3320 is the low signal to noise ratio and also low distortion when compared to popular designs using discrete components.

Construction

Since the PCB is designed to accept four filter configurations care should be excercised with component placement and both the component overlays and circuit diagrams should be examined if there is any doubt. The spacing between PCB holes for resistors and polystyrene capacitors is 12.5 mm and for the electrolytic capacitors is 2.5 mm. If your component leads are of different lengths to the above then you are putting it in the wrong place!

Note the two wire links on the PCB and take particular care, as always, on orientation of the ICs. The control input to the resonance cell (pin 9 of IC 3) is a low impedance input at near ground potential. The two inputs to this cell, via R6 and R7 shown in Figure 2, can be used for either manual **or** external voltage control. To have both facilities requires the use of the recommended jack socket method of construction, or some other switching technique which is evident from the following. Dual operation is achieved by connecting a 24k resistor, R7A, to the +15V supply line to RV3 and then taking the output from RV3 via a jack socket to R7, so that the manual control is disabled when the external control is in use. In the latter case R6 need not be installed.

A number of the input and output connections to the PCB have two holes and this will apply to many of the ETI 80 modules. The second hole may be used for hard wiring but they are intended for future expansion of the system.

Calibration

A simple check can be made of the frequency control input and whether RV5 and RV6 have been wired up correctly. With IC3 removed and the coarse and fine controls fully anti-clockwise measure the voltage at the junction of R14 and R15 and adjust PR1 to obtain +155 mV. Now turn RV5 (coarse control) fully clockwise and the voltage should be about −25 mV.

Turn off power and insert IC3, power up, turn RV3 (resonance control) fully anti-clockwise and RV5 (coarse control) to about mid position. Measure the voltage at the output of the filter module and adjust PR2 until a zero reading is obtained. This offsets the DC voltage at the output of Pin 10 of IC3.

The last step is to calibrate the filter so that it will track the oscillators. The resonance control feedback resistor has been chosen so that the filter will oscillate when some frequency control is present, thus turning the filter into a low distortion sine wave oscillator. A calibrated VCO should be available at this time which will greatly simplify calibration of the filter. Any of the following techniques may be used in addition to treating it as an oscillator and using the methods described for the VCO.

1.Beat frequency technique. Apply about 3V5 to control input 1, which will become the keyboard input, to give a frequency of about 250 to 300 Hz when RV3 is rotated to the point where oscillation is sustained - as heard through one side of the amplifier. Connect a calibrated VCO to the other side of the stereo amplifier and apply an external control voltage to the VCO until there is zero beating. Increase voltage to both VCO and VCF frequency control inputs by exactly one volt and then adjust PR1 until no beat frequency is heard.

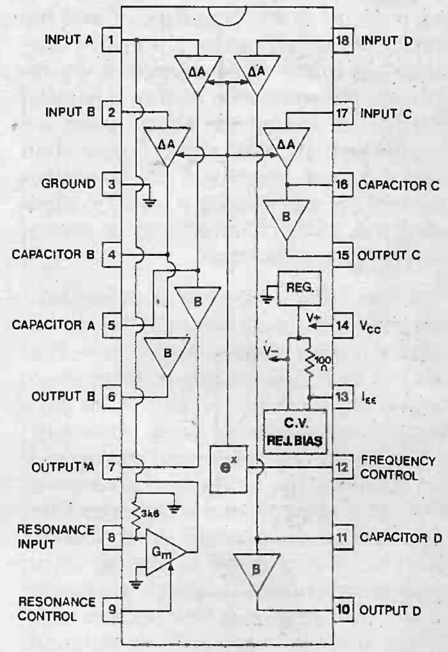


Figure 1. the CEM 3320 pinout.

HOW IT

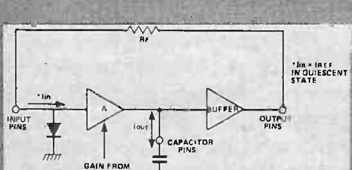
Each of the filter stages of the CEM 3320 contains a variable gain cell followed by a high impedance buffer. The variable gain cell is a current-in, current-out device (as opposed to the traditional voltage-in, current-out type) whose output current, I_{out}, is given by

$$I_{out} = (I_{REF} - I_{in})\ e^{-V_C/V_T}$$

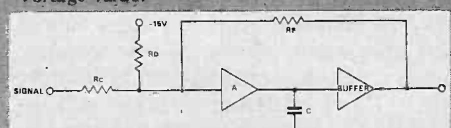
where $V_T = kT/q$ and $I_{ref} = \dfrac{0V48_{cc} - 1V3}{100k^*}$

$^*\pm 25\%$

The input to the variable cell is a forward biased diode to ground. The input thus presents a low impedance summing node at a nominal 650 mV above ground. The required input currents may therefore be obtained with resistors terminating at this input node.

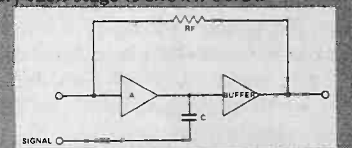


Thus each stage is set up with a feedback resistor, R_F, from the buffer output to the variable gain cell input and with the capacitor connected to the output of the variable gain cell. In the DC state, the buffer output will always adjust itself so that I_{REF} flows into the input. For lowest control voltage feedthrough and maximum peak to peak output signal, the quiescent output voltage of each buffer, V_{ODC}, should be $0.48\ V_{CC}$ − 0V65. In the present design where V_{CC} is +15 V, the feedback resistors (R21, R24, R26 and R29) are 100k, then the DC output of each buffer will be a nominal +6V5 and I_{REF} a nominal 60 uA. The output impedance of the variable gain cell, although high, has a finite value. This impedance is reflected back to the input as an AC resistance of nominally 1M in parallel with the feedback resistor, R_F, regardless of control voltage value:



If the first stage of the low pass filter is coupled to a ground-referenced direct coupled signal output, then the quiescent DC output will shift down 0V6 and a capacitor (C7) is used to avoid this situation. For the first stage the I_{REF} requirement is met using only R_F (R21). The subsequent stages should, however, be set for unity gain and since these will have the current from the feedback resistor (nominally 60 uA) as well as the current developed across R_C by the DC output of the preceeding stage (nominally 66 uA) it is necessary to sink the excess current and this is done with a bias resistor, R_b, of 240 k connected to the negative supply.

For the simplest case, the high pass filter, each stage is shown below



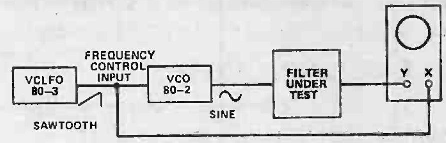
I_{REF} is supplied only through the feedback resistor, R_F, and the voltage gain is unity, irrespective of the value of this resistor. For best results, however, the impedance of the signal source to stage one should be low compared to $R_F/4$.

The band pass filter is derived by connecting two stages of high pass with two stages of low pass filtering. The allpass configuration is used to generate a phase shift filter by taking part of the original

2. Lissajours figures. Same procedure as (1) but outputs from VCO and VCF are coupled to the X and Y inputs of an oscilloscope to generate Lissajours figures, ie a stable circle using sine waves when both amplitude and frequency are matched.

3. Maximum signal amplitude. Another approach with an oscilloscope is to apply a signal of about 250 Hz from a calibrated VCO to signal input 1 of the filter and observe the output of the filter on the oscilloscope. Apply a voltage to control input 1 of the filter until the point where the output reaches its maximum amplitude is observed. A small amount of resonance will help. Increase control voltage to both VCO and VCF by exactly one volt and adjust PR1 until maximum amplitude is restored.

If an oscilloscope is available then the VCO and VCLFO may be used as a sweep frequency generator to examine the response characteristics of the filters. These should be connected as shown below.-



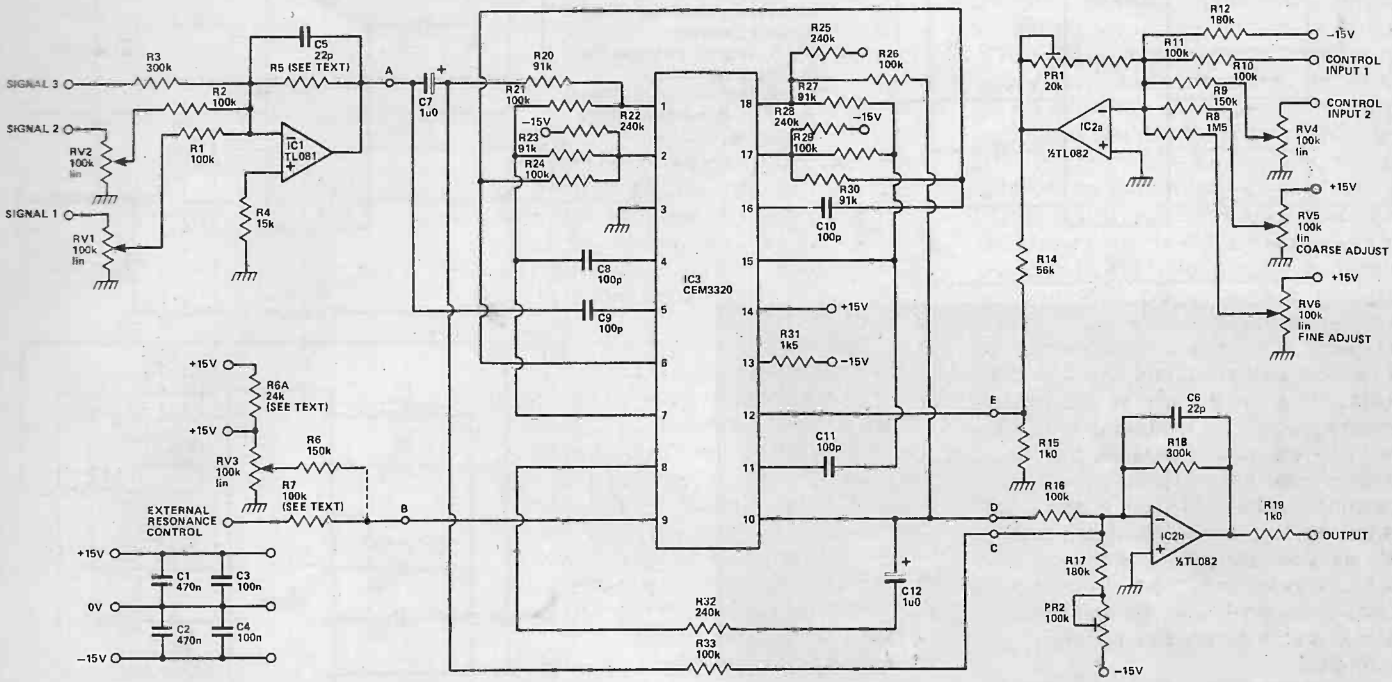


Figure 2. full circuit diagram of the phase-shift filter.

WORKS

signal, via R33, to the output stage. In both cases the purpose of resistors R20 to R30, when used, is evident from the above discussion.

The CEM 3320 contains a traditional transconductance type of amplifier. It has a separate signal voltage input (pin 8) and since this has an impedance of moninally 3k6 the input is referenced to ground and so when the signal is taken from the signal output of the IC a coupling capacitor (C12) is required. The output of the gain cell is connected to stage one of the filter (pin 1) and in this project the amplifier is used to provide voltage control of resonance. In controlling resonance a current is applied to pin 9 using R6 or R7. This input is of low impedance with a potential near ground and its characteristics are such that the transconductance of the cell increases more slowly with increasing current. The latter results in finer resolution as the critical point of oscillation is reached. The amount of signal feedback is governed by R32 and its value has been chosen such that with 100 uA of control current (our standard 10 volts via R7), oscillation will just occur, although operating conditions will influence the actual starting point. In other words, we have chosen the value so as to avoid sine waves of large amplitude which would become clipped in the first filter stage and cause a shift in frequency.

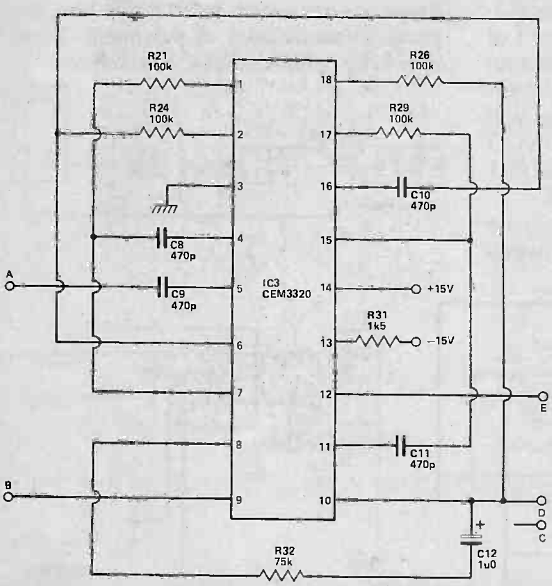
In order to minimise power dissipation the negative supply of the CEM 3320 is regulated at –3V9 with an internal shunt regulator. This reduces warm up drift of the pole frequencies on powering up as well as allowing virtually any negative supply greater than –4 V to be used. The current limiting resistor, R_{EE} (R31), must always be included and is calculated as follows

$$R_{EE} = \frac{V_{EE} - 2V7}{.008}$$

which for our standard –15 V supply requires a resistor of 1k5. A positive supply of +15 V is connected directly to pin 14 but supplies in the range +9 to +18 V may be used although this will influence both power dissipation and peak to peak output swing.

IC1 forms a conventional input summer for up to three signal inputs, two of which may be attenuated with rotary controls (RV1 and RV2) included on the panel. R5 determines the signal level into the filter and based on an input of 10 V p–p its value has been chosen such that the signal will not be clipped in the filter even when the maximum useful regeneration is applied. IC2b forms the output stage and the signal is amplified by R18 to ensure that the VCF will have approximately unity gain at maximum resonance. R17 and PR2 allow cancellation of the DC voltage at pin 10 of the CEM 3320. IC2b also serves as a buffer stage for IC3 since the buffers within the filter are not short circuit protected.

The frequency range of the filters is governed initially by the capacitors C8 to C11, which have been selected to provide a lower cut-off frequency in the range of 20 to 25 Hz. The CEM 3320 has an exponential converter within the device which simultaneously controls the current gain of each section. An input of 18 mV/octave is required to pin 12 and an increasing positive control voltage lowers the pole frequency of the filter. Furthermore, for best results the input to pin 12 should be maintained between –25 mV and +155 mV. IC2a therefore provides an input summer for two external control voltages (via R10 and R11), a coarse control (RV5) for a ten octave range and a fine control (RV6) over a one octave range. It also serves to invert the input voltage to the same sense as other modules, namely, an increasing positive voltage increases pole frequency; to sum an offset voltage through R12 to give an initial voltage at pin 12 of approximately +155 mV; and by adjusting the gain with PR1 to allow the one volt per octave response of the filter to be developed at the junction of R14 and R15.



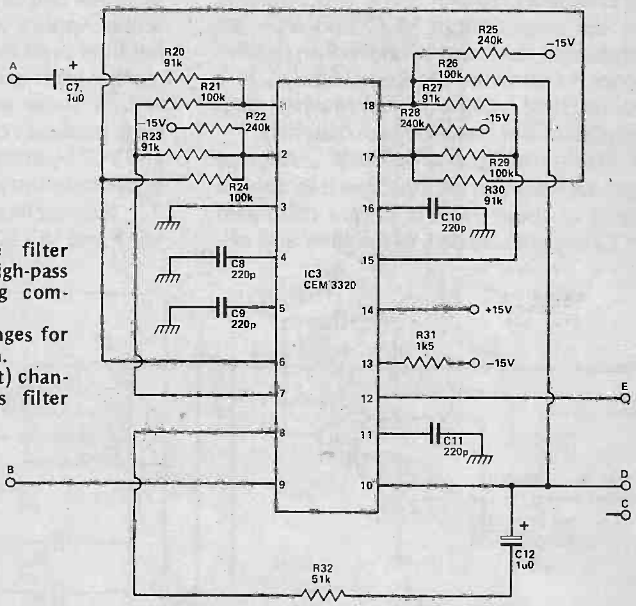
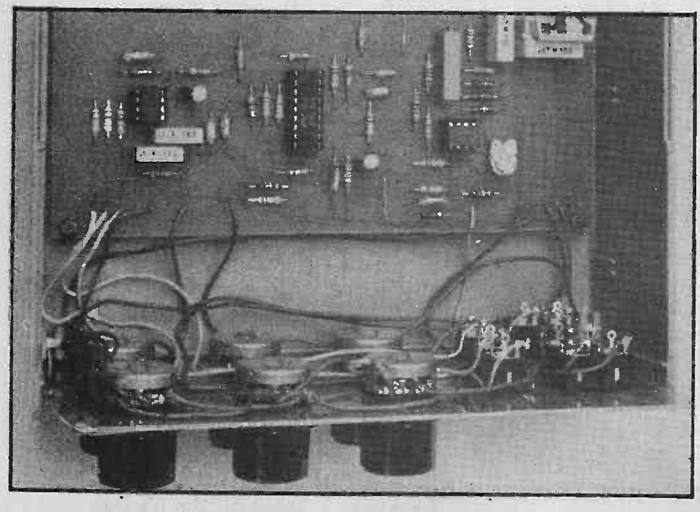
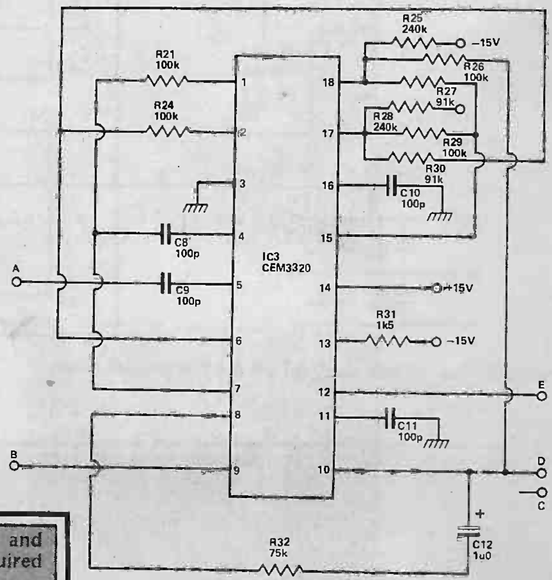


Fig.3. (left) the filter configured for high-pass operation showing component changes.
Fig.4. (right) changes for low pass operation.
Fig.5. (below right) changes for band-pass filter operation.





BUYLINES

The PCB and all components shown in the appropriate circuit diagram are available from Digisound Limmited for £13.20 per filter, inclusive of postage, packing and VAT. Please specify filter type required when ordering.

PARTS LIST

Components common to all filters

RESISTORS, 5%, ¼W carbon film

R1,2,7,16 21,24,26,29	100k
R3,18	300k
R4	15k
R6,9	150k
R8	1M5
R17	180k
R19	1k0
R31	1k5
R6A	24k

RESISTORS, 1%, ¼W metal film, 100ppm T.C.

R10,11	100k
R12	180k
R13	91k
R14	56k
R15	1k0

POTENTIOMETERS

RV1,2,3,4, 5,6	100k
PR1	20k multiturn cermet
PR2	100k carbon

CAPACITORS

C1,2	470n polyester
C3,4	100n polyester
C5,6	22p polystyrene
C12	1u0 PCB electrolytic

SEMICONDUCTORS

IC1	TL 081, or equivalent
IC2	TL 082, or equivalent
IC3	CEM 3320

ADDITIONAL COMPONENTS FOR LOW PASS FILTER. 80–6L

RESISTORS ¼W, 5% carbon film

R5	36k
R20,23,27, 30	91k
R22,25,28	240k
R32	51k

CAPACITORS

C8,9,10,11	220p polystyrene
C7	1u0 PCB electrolytic

ADDITIONAL COMPONENTS FOR HIGH PASS FILTER. 80–6H

RESISTORS ¼W, 5% carbon film

R5	24k
R32	75k

CAPACITORS

C8,9,10,11	470p polystyrene

ADDITIONAL COMPONENTS FOR BAND PASS FILTER. 80–6B

RESISTORS ¼W, 5% carbon film

R5	33k
R25,28	240k
R27,30	91k
R32	75k

CAPACITORS

C8,9,10,11	100p polystyrene

ADDITIONAL COMPONENTS FOR PHASE SHIFT FILTER. 80–6P

RESISTORS ¼W, 5% carbon film

R5	12k
R20,23,27, 30	91k
R22,25,28, 32	240k
R33	100k

CAPACITORS

C8,9,10,11	100p polystyrene
C7	1u0 PCB electrolytic

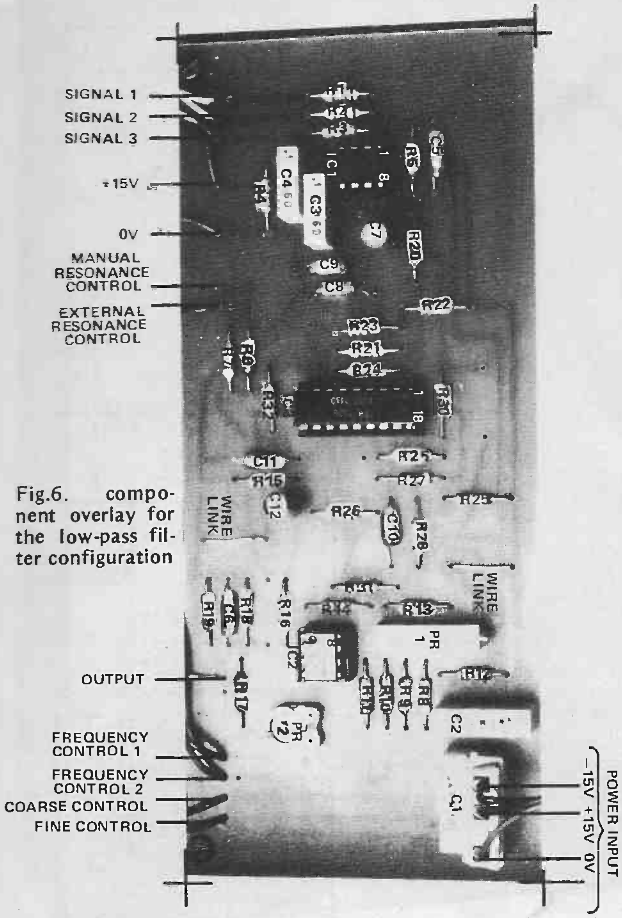


Fig.6. component overlay for the low-pass filter configuration

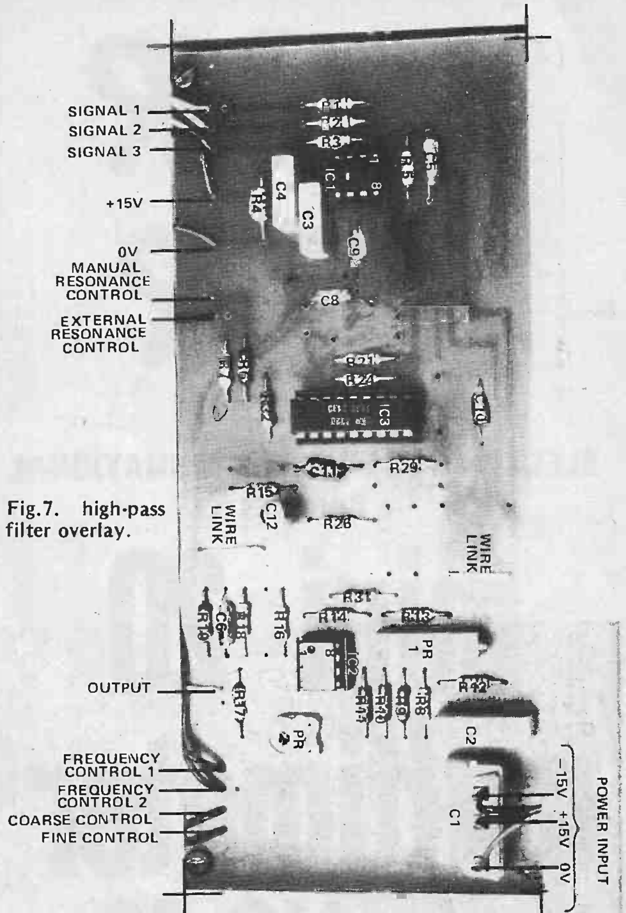


Fig.7. high-pass filter overlay.

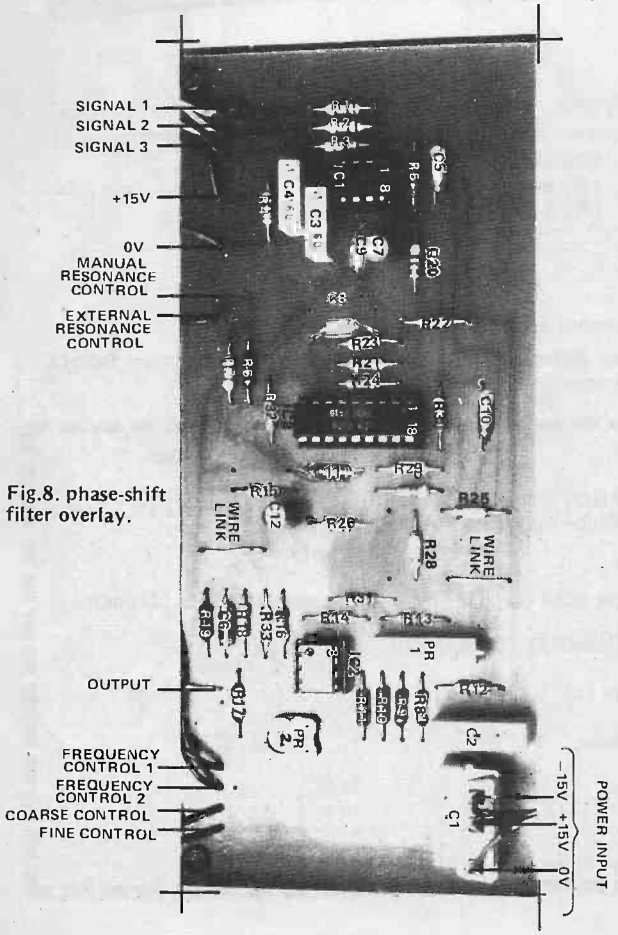


Fig.8. phase-shift filter overlay.

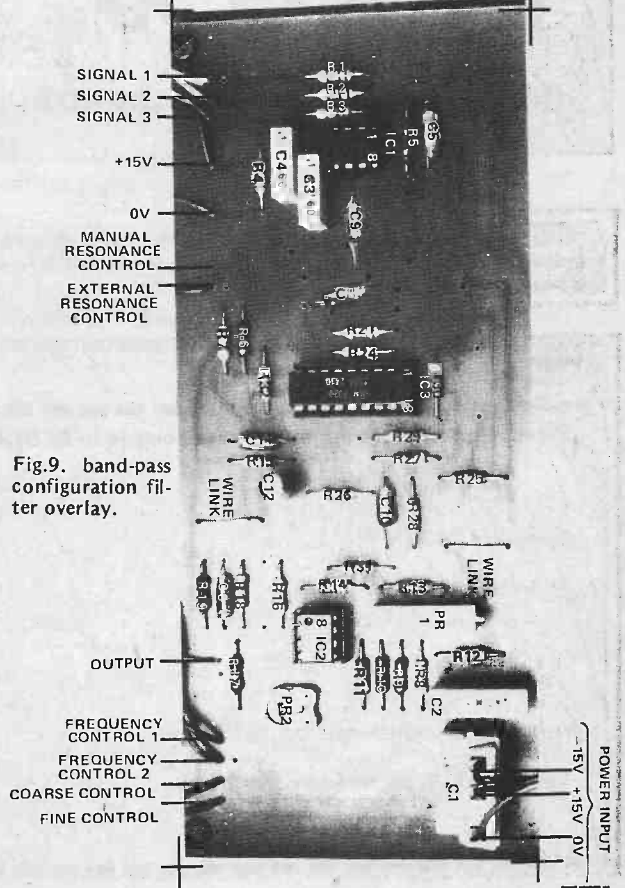


Fig.9. band-pass configuration filter overlay.

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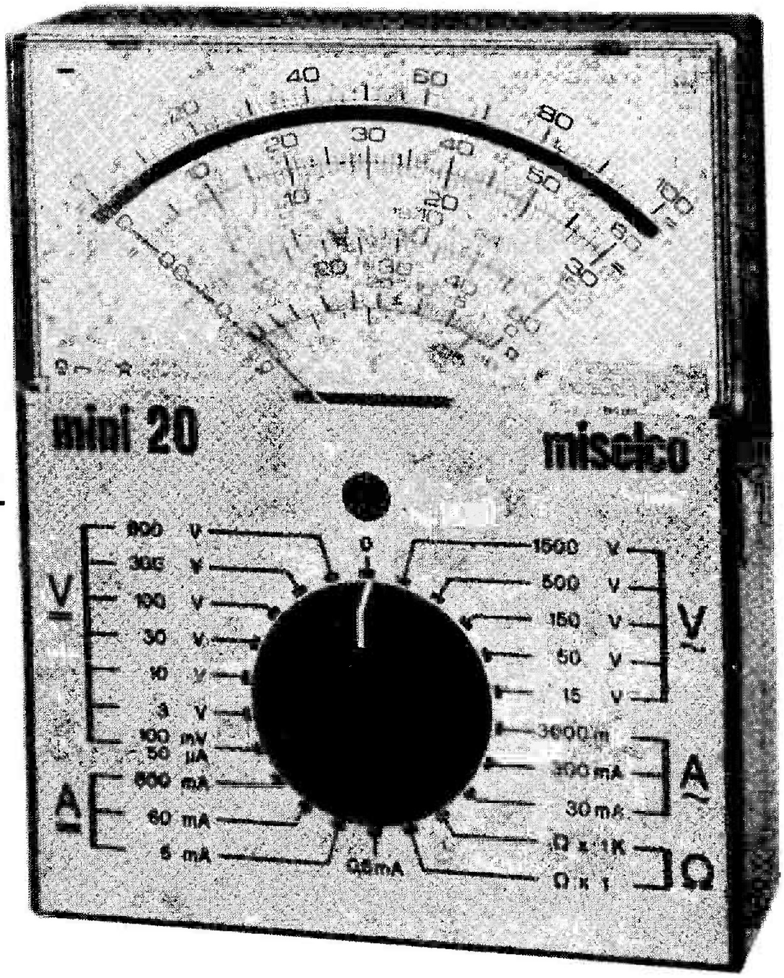

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MICROFILE

Henry Budgett reveals Nascom's new goodies and the latest club news.

A somewhat slimmer than usual Microfile this month owing to a distinct lack of anything much to talk about, and a surfiet of Tangerine! The springtime is generally supposed to be a time of blossoming forth and judging by my letters file on Computer Clubs they are no exception.

Clubbed To Death

Taking the pile in no particular order we have Mr J Fieldhouse of 18 Seaford Road, Broadfield, Crawley in West Sussex who informs me of the recent formation of a club. This is open to anyone with an interest in personal computers and it is hoped to hold weekly meetings with a newsletter to be published at regular intervals. If you live in the area contact him at the above address or ring on Crawley 542509. Tony Rycroft of the South Yorkshire Personal Computing Group has moved on and the group secretary, Paul Sanderson of 8 Vernon Road, Totley, Sheffield S17 3QE Tel 0742- 351895, is now the person to contact for details. They hold meetings on the second Wednesday of each month in Room F135 of St George's Building, Sheffield University. Another newly set up organisation is the Anglia Computer User Group which is open to anyone in East Anglia who has an interest in computers for either professional or hobby reasons. Contact can be made to Jan Rejzl at 128Templemere, Sprowston Road, Norwich NR3 4EQ or by phone on Norwich 402311.

Surrey is the target for the next micro invasion with the Surrey Micro Processor Society run by Mike Patrick of 28 West Drive, Cheam, Surrey. They are holding about two meetings a month with an annual sub of £5, £3 for juniors or OAPs, and currently have around 40 members. The West Midlands Amateur Computer Club have been updated and their vital information is that they meet on the second and fourth Tuesdays of each month. The venue is Elmfield School in Love Lane, Stourbridge and they usually start around 7.30. The sub for the year is £3 or £2 if still in full-time education. For more information contact John Tracey at 100 Booth Close, Kingswinford, West Midlands or ring Brierly Hill 70097. They are well equipped with 8 PETs, 12 N1s, 5 N2s 3 TRS 80s plus about 20 others. Anyone in mid Sussex? Well if there is - and you are interested in micros - contact Bernard Langton who is forming a micro club. Get in touch with him at 228 St Leonards Road, Horsham, Sussex RH13 6AU.

The Grampian Amateur Computer Society, well known for their spelling mistakes, have sent me an update. They meet every second Monday at the Holiday Inn, Bucksburn, Aberdeen and have over 30 members. All their news is published in a regular newsletter and they have their own Acorn. For further information contact the secretary at Orton Cottage, Burnside, Lumphanan, Kincardineshire, Grampian, Scotland. Whilst north of the border I shall mention the Scottish Amateur Computer Society who have sent me a copy of their Newsletter andBulletin. They meet on the first Wednesday of each month at the Grosvenor Hotel, Haymarket, Edinburgh at about 7.30pm. They publish the newsletter quarterly and for further information you should contact the secretary, Alastair Macpherson, at 6 Curriehill Castle Drive, Balerno, Edinburgh 14.

And whilst on the subject of newsletters, did you know that there was an Ohio Scientific UK User Group? Well neither did I. Tom Graves is the man to contact if you own one. C1 or 2 and Superboard are the current interests but they would like to expand to the disc systems. The address to write to is 19a West End, Street, Somerset BA16 0LQ.

System 80 Makes Two Into One

Nascom have at last turned the single board into a complete system with the launch of System 80. Basically all they have done is to produce a range of boards for the Nasbus and a case to put them all in. However, before you all start to think about long delivery times they do promise that all the boards are in the production state and although the launch is over the next few months they will all arrive.

The starting point is the case which accepts a "2" and its keyboard plus four more boards. Included is space for a power supply and sockets for printer and cassette. The bad news is that if you own a "1" you won't be able to spend your £85 unless you are prepared to do quite a lot of hacking to fit a bufferboard in, Vero are rumoured to have a rack system on the stocks that may well be the answer.

Next is the good news that Nascom have finally ditched the 16K RAM plane, the one labelled 'Instant Disaster', and produced one that offers a choice of 16, 32 or 48K of dynamic with locatable boundaries and page mode so you could have four on a "2"! Price is £225.

At last they are also announcing some I/O in the shape of a board with three PIOs, a CTC and a UART. Price is £45 for the board and TTL, £8.50 per PIO, £8.25 for a CTC and £16 for the UART. The graphics capability of the "2", not bad anyway, has been expanded out of all proportion with two new boards, a programmable graphics generator at £90 and a dual standard colour board whose price is not yet decided.

For those of you who are not satisfied with lowly cassette storage discs will be here soon. The board has been designed but due to component shortages it will be the last released, probably in July. The controller card is designed to handle up to four 5¼" units and will cost £127.50. It should also be possible to use 8" units but no support is planned. A complete dual double-sided, double-density system will set you back £690.

The second major item of news to emerge from the launch is that the "2" will now be sold at £225 but there will be no on-board RAM (4118) other than the video and scratchpad and no free 16K board. Some firms like Henry's are still doing the offer on their own so look out for bargains.

Tangy Fruit

After last month's little piece on the Microtan 65, which even got the unimpressable Mr Graham converted to micromania (see Kit Survey), I have been so swamped with calls and letters that I'm going to print the address so you can all go and pester them rather than me. Tangerine Computer Systems Ltd., Forehill, Ely, Cambridgeshire. Their telephone number is 0353-3633. The expansion board, Tanex, is now available and the slight delay was caused by one of the nastiest little problems I've heard in a while. The prototype worked, they laid out the board using a distributors data sheet and sent it off to be made up. Result of the exercise was that the PCB didn't work. The reason? Whoever drew up the data sheet muddled up a couple of IC pins and every board had to be scrapped. So a gentle word of warning, only use manufacturers genuine data, not some free give away!

Post Script

Two late items that arrived. The inaugural meeting of the Croydon Mini/Micro Computer Group is to be held on Tuesday 22nd of April at 7.00pm in the Central Reference Library, Katharine Street, Croydon. Anyone interested should contact Vernon Gifford, 111 Selhurst Road, London SE25 6LH. If you won't be able to attend but are still interested he would like to know your areas of special interest before the meeting if posible.

The second item is to explain why there is no ZX-80 follow-up as promised. Simple really, we haven't got one yet, but perhaps for next issue so don't despair.

ETI

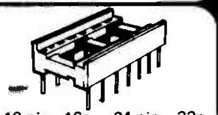
OPTO

LED's	0.125in.	0.2in	each
Red	TIL209	TIL220	10p
Green	TIL211	TIL221	15p
Yellow	TIL213	TIL223	15p
Clips	3p	3p	

DISPLAYS

DL704	0.3 in CC	130p
DL707	0.3 in CA	130p
FND500	0.5 in CC	100p

SKTS



Low profile by Texas

8 pin	10p	18 pin	16p	24 pin	22p
14 pin	12p	20 pin	18p	28 pin	26p
16 pin	13p	22 pin	20p	40 pin	38p

3 lead T018 or T05 skt. 12p each.
Soldercon pins: 100 for 60p.

PCBS

VEROBOARD

Size in.	0.1in.	0.15in.	Vero
25 x 1	16p	—	Cutter 110p.
2.5 x 3.75	52p	45p	
2.5 x 5	60p	55p	Pin insertion
3.75 x 5	70p	70p	tool 150p.
3.75 x 17	250p	210p	
SS pins/100	45p	45p	

Fibreglass board: 80p each.
Alfac — 33p per sheet.

RESISTORS

Carbon film resistors. High Stability, low noise 5%.

E12 series. 4.7 ohms to 10M. Any mix:

	each	100+	1000+
0.25W	1p	0.9p	0.85p
0.5W	2p	1.5p	1.3p

Special development packs consisting of 10 of each value from 4.7 ohms to 1 Megohm (650 res) 0.5W £8.50. 0.25W £5.30.

METAL FILM RESISTORS

very high stability, low noise rated at ¼W 1%. Available from 51ohms to 330k in E24 series. Any mix:

	each	100+	1000+
0.25W	4p	3.7p	3.5p

POTENTIOMETERS

Preset vertical or horizontal 100 ohms – 1M 6p
Rotary 5K-2M2 Log or Lin single . 30p
Rotary 5K-2M2 Log or Lin double 90p
Slide 60mm travel 5k-500k Log or Lin, single 60p
Suitable knobs for above with coloured caps in red, blue, green, grey, yellow and black. Rotary controls 16p each. Slide type 12p each.

MISC.

Murata Ultrasonic Transducers	350p pair
64mm 8 ohm speakers	100p each
64mm 64 ohm speakers	100p each
SRB 17W soldering iron	430p each
Reel of 22swg solder (39.6m)	320p each
Desoldering tool	510p each
Precision screwdriver set	170p each
Titan Electric drill	1095p each
Minaiture 606 and 909 at 100mA transformers	110p each

SWITCHES

TOGGLE

Standard	SPST 36p	DPDT 50p
Miniature	SPDT 75p	DPDT 85p
Subminiature	SPST 58p	DPDT 78p

SLIDE

Standard . . . . . . DPDT 17p
Miniature . . . . . . DPDT 16p

ROCKER (10A rating)

SPST 34p each. SPST 46p each.

ROTARY

1P12W, 2P6W, 4P3W or 3P4W 51p each
Key operated DPDT (Yale key) 395p each

PUSH

Non locking - push to make 16p each
- push to break 22p each
Locking - SPST 75p each
- DPDT 100p each

REGULATORS

LM309K	140p
LM317T	220p
LM323K	480p
LM723	40p

100mA + ve		1A + ve		1A – ve	
78L05	30p	7805	70p	7905	85p
78L12	30p	7812	70p	7912	85p
78L15	30p	7815	70p	7915	85p

TRANSISTORS

AC127	22p	BC548	11p	TIP32C	60p
AC128	22p	BCY71	16p	TIP2955	66p
AC176	22p	BCY72	15p	TIP3055	53p
AD161	40p	BD131	40p	ZTX107	12p
AD162	40p	BD132	40p	ZTX108	12p
BC107	12p	BD139	33p	ZTX300	14p
BC108	10p	BD140	33p	ZTX500	15p
BC108C	12p	BFY50	23p	2N3053	25p
BC109	12p	BFY51	23p	2N3054	56p
BC109C	12p	BFY52	23p	2N3055	50p
BC147	9p	MJ2955	100p	2N3702	9p
BC148	9p	MPSA06	16p	2N3704	9p
BC177	16p	MPSA56	16p	2N3706	9p
BC178	16p	TIP29C	60p	2N3819	20p
BC182	10p	TIP30C	48p	2N3904	10p
BC182L	10p	TIP31C	50p	2N3905	10p
BC184	10p			2N3906	10p
BC184L	10p			2N5459	33p
BC212	10p			2N5777	50p
BC212L	10p				
BC214L	10p				

DIODES

1N914	4p	1N4006	7p
1N4148	3p	1N5401	14p
1N4002	5p	BZY88ser.	8p

1N4148 £1.50 per 100.

CAPACITORS

POLYSTYRENE

High quality foil type. 63V working, 5% tol.
22pf to 100pf . . . . 7p each
1500pf to 0.01uF . . . . 9p each

TANTALUM BEAD

0.1, 0.15, 0.22, 0.33, 0.47, 0.68
1 & 2.2uF @ 35V . . . . . . 10p each
4.7, 6.8, 10uF @ 25V . . . . . 18p each
22 @ 16V, 47 @ 6V, 100 @ 3V . . 22p each

MYLAR

0.001, 0.01, 0.022, 0.033, 0.047 . . . 4p each
0.068, 0.1 . . . . 5p each

POLYESTER

Mullard C280 series
0.01, 0.015, 0.022, 0.033, 0.047, 0.068, 0.1. 6p ea.
0.15, 0.22 . . . . 8p each
0.33, 0.47 . . . . 12p each
0.68 . . . . 17p each
1.0uF . . . . 22p each

CERAMIC

Plate type 50V. Available in E12 series from 22pF to 1000pF and E6 series from 1500pF to 0.047uF . . . . 2p each

MINIATURE TRIMMERS

Miniature film type, in 1.4pF – 5pF, 2pF – 22pF, 2pF – 22pF, 2pF – 10pF, 5.5pF – 65pF. 22p each

RADIAL LEAD ELECTROLYTICS

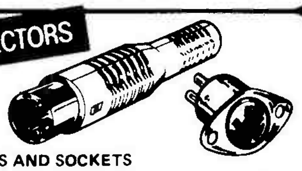
63V	0.47	1.0	2.2	4.7	10	6p each
			22	33	47	8p each
	100					16p each
			220			20p each
25V	10	22	33	47		6p each
	100					8p each
		220				12p each
				470		18p each
	1000					28p each

PACKS

Specially developed packs intended for development work.

¼W CF resistor, 10 each value E12 series 4.7 ohm to 1 Megohm (650 total) . 530p each
½W CF resistor, 10 each value E12 series 4.7 ohm to 1 Megohm (650 total) . 850p each
¼W MF 1% resistor, 10 each value E24 series 51 ohms to 33oK (930) . . 2950p each
Preset potentiometers 5 each value from 100 ohms to 1 Megohm (65) . 390p each
Polyester capacitors 5 each value 0.01 to 2.2uF (70) . . . . . 690p each
Ceramic plate capacitors 10 each value 22pF to 0.01uF (310) . . . . 575p each

CONNECTORS



DIN PLUGS AND SOCKETS

	plug	chassis socket	line socket
2 pin	8p	8p	12p
3 pin	12p	10p	12p
5 pin 180°	12p	11p	17p
5 pin 240°	14p	11p	22p

JACK PLUGS AND SOCKETS

	unscreened	screened	socket
2.5mm	10p	15p	8p
3.5mm	10p	16p	9p
Standard	16p	30p	19p
Stereo	23p	39p	22p

1mm PLUGS AND SOCKETS

Suitable for low voltage circuits, Red & Black. Plugs: 7p each. Sockets: 8p each.

4mm PLUGS AND SOCKETS

Available in blue, black, green, brown, red, white and yellow. Plugs: 12p each. Sockets: 13p each.

STEVENSON

Electronic Components

CMOS

		4023	20p	4054	120p	4502	120p
		4024	50p	4060	120p	4507	60p
		4025	20p	4063	120p	4508	330p
		4026	160p	4066	60p	4510	80p
		4027	45p	4068	20p	4511	90p
4000	20p	4028	85p	4069	20p	4512	80p
4001	20p	4029	85p	4070	20p	4516	80p
4002	20p	4031	220p	4071	20p	4518	80p
4006	90p	4033	150p	4072	20p	4520	80p
4007	20p	4036	350p	4073	20p	4527	90p
4008	95p	4039	300p	4075	20p	4528	90p
4011	30p	4040	110p	4076	90p	4529	150p
4012	20p	4041	85p	4077	20p	4531	150p
4013	35p	4042	80p	4078	20p	4532	130p
4014	80p	4043	95p	4081	20p	4538	160p
4015	80p	4046	110p	4082	20p	4543	110p
4016	30p	4048	60p	4086	75p	4566	170p
4017	65p	4049	45p	4093	60p	4558	120p
4018	90p	4050	45p	4095	110p	4559	420p
4020	100p	4051	70p	4098	120p	4581	330p
4022	100p	4053	80p	4501	20p	4585	110p

LSTTL

		74LS47	80p	74LS126	45p	74LS175	90p
		74LS48	90p	74LS132	80p	74LS190	90p
74LS00	16p	74LS54	22p	74LS136	50p	74LS191	90p
74LS01	22p	74LS73	35p	74LS138	75p	74LS192	90p
74LS02	16p	74LS74	35p	74LS139	75p	74LS193	90p
74LS03	22p	74LS75	40p	74LS151	60p	74LS195	90p
74LS04	16p	74LS76	40p	74LS155	65p	74LS196	90p
74LS08	22p	74LS78	45p	74LS156	80p	74LS197	85p
74LS10	22p	74LS83	68p	74LS157	70p	74LS221	100p
74LS13	38p	74LS85	85p	74LS158	65p	74LS251	70p
74LS14	65p	74LS86	40p	74LS160	75p	74LS266	35p
74LS20	22p	74LS90	40p	74LS161	68p	74LS290	80p
74LS21	22p	74LS93	55p	74LS162	80p	74LS365	55p
74LS27	28p	74LS95	65p	74LS163	80p	74LS366	55p
74LS30	22p	74LS107	45p	74LS164	80p	74LS367	55p
74LS32	30p	74LS114	40p	74LS165	80p	74LS368	55p
74LS37	40p	74LS123	80p	74LS173	135p	74LS386	50p
74LS42	60p	74LS125	45p	74LS174	95p	74LS670	200p

TTL

		7442	40p	7493	30p	74157	40p
		7445	50p	7496	38p	74164	55p
7400	12p	7447	50p	74121	29p	74165	55p
7402	12p	7448	45p	74123	40p	74174	55p
7404	14p	7473	23p	74125	38p	74177	50p
7408	16p	7474	23p	74126	36p	74190	50p
7410	14p	7475	26p	74132	46p	74191	50p
7413	24p	7476	25p	74141	48p	74192	50p
7414	39p	7485	55p	74145	48p	74193	50p
7420	14p	7486	18p	74148	90p	74194	50p
7427	22p	7490	30p	74150	55p	74196	50p
7432	18p	7492	30p	74154	68p	74197	50p

LINEAR

		LM10	400p	LM3909	72p	TBA800	80p
		LM301A	30p	LM3914	280p	TBA810S	110p
		LM308	70p	LM3915	280p	TDA1008	350p
709	40p	LM318	85p	LM3911	120p	TDA1022	630p
741	18p	LM324	52p	LM13600	160p	TDA1024	120p
747	50p	LM339	55p	MC1496	80p	TDA2020	360p
748	35p	LM348	100p	LM1458	40p	TL071	75p
7106	850p	LM377	170p	LM1830	180p	TL072	135p
AY-1-0212	660p	LM378	230p	MC3340P	135p	TL074	200p
CA3046	70p	LM3795	410p	MC3360P	135p	TL081	45p
CA3080	75p	LM380	80p	MM57160	650p	TL082	85p
CA3130	90p	LM381	140p	NE531	110p	TL084	125p
CA3140	50p	LM382	120p	NE555	23p	TL170	60p
FX209	820p	LM383	200p	NE556	60p	XR2206	390p
ICM7555	100p	LM386	90p	NE566	120p	XR2207	450p
ICM7556	POA	LM387	120p	NE567	120p	ZN414	80p
LF347	135p	LM389	100p	NE570	420p	ZN419	POA
LF351	45p	LM391	170p	NE571	460p	ZN424	150p
LF353	85p	LM1310	140p	NE5537	POA	ZN425E	420p
LF355	92p	LM2917	280p	RC4136	100p	ZN460	360p
LF356	95p	LM2924	160p	SAD1024	1310p	ZN1034	230p
LF357	92p	LM3900	60p	SN76477	230p		

MICRO

				CPU's		SUPPORT	
		2112	220p				
		2114LP	420p	6800	650p	6810	350p
		4116	620p	8080A	610p	6821	600p
		2708	680p	Z80	1090p	6850	550p
21L02	120p	2716	1980p			AY5-1013	370p

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computing today

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STOCKMARKET SIMULATION: If you lie awake at night dreaming of what you would do with that £1000 gift that will always arrive in the post tomorrow, dream no longer. In a remarkable game program written for the TI59 we have a complete stockmarket where you can buy and sell, wheel and deal, bear and bull to your hearts content.

Whilst the stock exchanges of reality are curious and wonderful establishments this game is based on proper theories and a full and detailed explanation of the processes needed is given. So, if you don't own a TI59 do not despair you will be able to use the information to implement the game on virtually any programmable system.

So if you want to be among the market leaders next month invest your sixty pence in our May issue, it could be the best investment you'll ever make.

DRIVEN TO DESPAIR?

Does your car or motorcycle seem to want more money than you bargained for? The author of our Home Finance program presents a second offering which will cater for your automotive expenses.

The program runs on the family PET but is easily adaptable to any BASIC using system with the PETs facilities. Access is available to a number of accounts for details of repair and servicing costs and reminders are given about the life expectancy of wearable items such as tyres.

If you depend on your car and can't account for the money you spend, load up and discover where its all going to. Rumour has it that Panther De Ville owners with that optional PET may be buying all copies so get to the newsagents early.

TRITON REVISITED ETIs own computer system is over a year old now, and changes have been made since its conception that make it rather more than a single board computer.

In our continuing series of owners reports on popular machines John Hiscott takes his system through the stages of development and lays his observations open to the public eye.

TERMINOLOGY

No, that's not the art of making connections, but a glossary of the "hundred most used terms" in home and hobby computing. Many of our enquiries start out with, 'I can't tell the difference between RAM and ROM' so we decided to reveal all.

As an aid to simulating conversation this pull out extra should not be missed, you might even learn the elusive art of confusion!

DORAM

a de boer company

Buying one of our project packs will save you the frustration of tracking down those evasive components that hold up the completion of your project. Our packs include PCB, all the electronic components, sockets, solder and a description!

AUDIO

- Equaliser (9832). Single channel audio equaliser with slidepots
  - with turnpots **£17.70**
  - with preset pots **£15.60**
- UAA180 LED meter (9817). A two channel display meter with LEDs **£13.95**
- Peak programme meter (9860). For use with UAA180 LED meter to give stereo audio display **£13.00**
- Luminant (9949 1+2+3). A novel LED audio level indicator **£13.00**
- Parametric Equaliser (9897).
  - Filter section (9897-1) **£20.70**
  - Tone control section (9897-2) **£6.45**
- Audio analyser (9932). An analyser which can pinpoint the deficiencies in a particular audio chain or environment **£5.20**
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- Consonant (9945). A complete audio control preamplifier **£5.75**
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- Topamp (80023). Hybrid audio power amplifier with OM 931 (Output 30 Watt) **£34.30**
  - with OM 961 (Output 60 Watt) **£18.50**
- Stentor (79070). A portable amplifier ideally suited for PA **£33.40**
- Assistentor (79071). A preamp for use with Stentor **£30.00**
- Elektornado (9874). A 2 x 50 Watt or single 100 Watt power amplifier **£7.00**
- Electret microphone pre-amp (9866). Compact design that fits into the mike **£19.50**
  . . . . **£4.85**

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  - LED display (supplied without relay) **£23.20**
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- Power supply for timebase **£5.40**
- Universal timebase (78100). Crystal controlled time base **£18.70**
- ¼ GHz counter (9887 1+2+3+4). Excellent kit count up to 250 MHz **£98.15**
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- Audio analyser (9932). An analyser which can point the deficiencies in a particular audio chain or environment **£14.80**
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- TV scope advanced version (9969 1/3). Converts basic scope to 100KHz bandwidth **£48.25**
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- Digifarad (79088). A digital capitance meter with a wide range **£25.10**
- Gatedipper (79514). Checks the resonant frequency of a circuit **£16.00**

HOME

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- Elekdoorbell (79095). Program your own signature tune **£22.00**
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- Ultrasonic transmitter (audio) (79510) **£7.65**
- Ultrasonic receiver (audio) (79511) **£9.95**
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- Slave station **£10.85**
- Alarm unit **£3.10**
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- Junior computer (80089 1+2) Now in stock. Ask for details . . . ! **£92.80**

MICROPROCESSOR μP

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- SC/MP Board and RAM Input/Output Board (9846 1+2). These two units demonstrate the working of the SC/MP chip (National Semiconductor) Data is fed in by digital switches and read out by LED's (databus) **£27.60**
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- Memory extension (9863). You will be able to work with interrupt requests now and the card contains 3/4K of RAM and a 1/2k of Eprom **£49.95**
- Bus Board. A simple way of inconnecting the various boards of the system.
  - Extension for 3 boards (9857) **£3.35**
  - Extension for 6 boards (80024) **£5.40**
- Hex input/output board (9893). You can work in hexadecimal format now via 16 alphanumeric and 10 control keys. Output is displayed on 8 seven segment displays **£52.65**
- ELBUG. This is the monitor programme stored in 3 Eproms **£37.00**
- Power supply (9066). Gives an output of +5 volt — 3 amp and 12 volt — 0.5 amp which is more than enough to run the complete system (including transformers) **£20.95**
- 4K RAM card (9885) 4096 x 8 bits of memory to expand the system **£92.55**
- Cassette interface (9905). This board enables you to record and replay programs on a simple cassette recorder **£14.95**
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- Elekterminal (9966). One of the cheapest and most reliable systems for displaying data on to a domestic television **£69.55**
- Elekterminal Extension (79038). With the aid of the extension board the memory capacity of the elekterminal can be expanded to four pages (each of 16 lines and 64 characters) **£35.50**

MUSIC

- ★ Organ (7911 db). A new concept in organ-building. This five-active organ has 12 voices, sustain and tremelo with touch controlled switching.

The PCB construction keeps the amount of wiring to a minimum. The organ is built in modular form with the possibility of adding extensions at a later date. One rhythm unit is already available
- Organ less keyboard **£149.00**
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(Kit includes power supply with transformer, all PCBs, connectors, components).

Music synthesizer Format. The Elektor Format is an instrument of advanced specifications that bears comparison with many commercially available synthesizers, but at a fraction of the cost.
- Interface (9721-1) **£18.15**
- Interface receiver (9721-2) **£3.60**

(These two kits links keyboard and instrument)
- Power supply (9721-3). Including transformer and heatsink **£32.35**
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INFRA RED REMOTE CONTROL SYSTEM

Make things happen at a distance without lifting a finger. There is no limit to the application of our ultra-versitile IR60 control system. Part 1: receiver

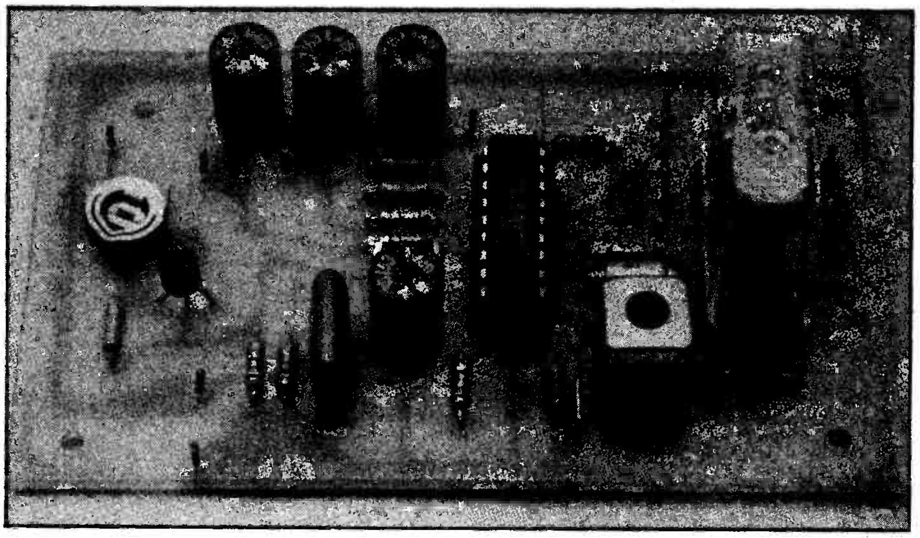
Multi function hand-held remote-control facilities are the 'in-thing' in modern Hi-Fi systems and music centres, but also have lots of other potential applications in domestic fields such as lighting and heating control, home security control, etc. We have never published a **really** sophisticated remote control system in ETI - until now.

Like all good modern remote control systems, our system uses an infra-red data link which is highly efficient, gives a good range, is not unduly directional and which, unlike ultrasonic systems, is remarkably interference-free. (Ultrasonic systems are, incidentally, now regarded as rather quaint, even though they do still occasionally appear in amateur-designed form in some of the other electronic magazines).

So what is so special about our system and what does it do? The system comprises two basic units, a hand-held 16-key transmitter and a mains-powered receiver-decoder unit. The two units together give control of three independent 64-step analogue channels, 16 'selector' channels, two bistable channels, and one on/off relay channel or switch. The hand-held unit is powered by a PP3 battery, which gives an operating life of about six months in normal use and gives a typical control range of about 15 metres.

The control system uses state-of-the-art LSI chips in the transmitter and receiver and is highly sophisticated in both technology and performance. The outputs of the receiver consist of three analogue voltages, one relay output, one 4-bit binary output and two single-bit binary outputs. How you interface these outputs to external devices is largely up to you: a few notes on the subject are given in this month's 'Designer's Notebook': we'll also be presenting some suitable interface projects and systems in future issues of ETI.

The control action of the system is very sophisticated and is best understood by refering to Tables 1 and 2, which give detailed descriptions of the transmitter switch functions and the receiver output functions



Receiver board of the IR60. Details of the transmitter will follow next month.

SWITCH NUMBER	PIN CODE	FUNCTION	RECEIVER OUTPUT ACTION
1	1c	STANDBY (OFF)	Turns relay RLA off.
2	2c	ON	Turns relay RLA on.
3	1b	MUTE	Reduces volume output level rapidly to zero.
4	83a	VOLUME +	Increases volume output level.
5	83b	VOLUME –	Decreases volume output level.
6	83c	ANALOGUE 1 +	Increases Analogue 1 output level.
7	83d	ANALOGUE 1 –	Decreases Analogue 1 output level.
8	84a	ANALOGUE 2 +	Increases Analogue 2 output level.
9	84b	ANALOGUE 2 –	Decreases Analogue 2 output levels.
10	1d	RESERVE 1	Switches Reserve 1 (RSV1) output between high and low states on alternate operations.
11	2d	RESERVE 2 / ON	Switches Reserve 2 (RSV2) output between high and low states on alternate operations: Turns RLA on.
12	2a	PROGRAM STEP + / ON	Increments binary channel-select output by one step per operation: Turns RLA on.
13	2b	PROGRAM STEP – / ON	Decrements binary channel-select output by one step per operation: Turns RLA on.
14	5a	CHANNEL 1 / ON	Sets binary output to 0000 (Channel 1) state: Turns RLA on.
15	6d	CHANNEL 8 / ON	Sets binary output to 1110 (Channel 8) state: Turns RLA on.
16	8d	CHANNEL 16 / ON	Sets binary output to 1111 (Channel 16) state: Turns RLA on.

Table One: receiver output functions of the IR60.

OUTPUT FUNCTION	TRANSMITTER CONTROL SWITCHES	DESCRIPTION
STANDBY (OFF)	1,2,11,12,13,14, 15.16.	Relay output that can be used to switch power to external circuitry. The relay can be turned on via transmitter switches 2,11,12,13,14,15 or 16. The relay can be turned off via STANDBY (OFF) switch 1 only.
VOLUME	3,4,5. (also 1 and 2)	An analogue output that can be varied from 0V to approximately 14 volts in in 64 discrete steps. SPAN time (from min to max or vice versa) is approximately 8 seconds. Output level can be increased by pressing and holding transmitter switch 4 or decreased via switch 5: when these switches are released the prevailing level is stored and maintained. The output can be rapidly reduced to zero by operating MUTE switch 3 or STANDBY (OFF) switch 1; subsequently touching switch 4 returns the 'sound' output to its previous level. The analogue output voltage can be used to control voltage-controlled attenuators, amplifiers, filters, etc.
ANALOGUE 1	6,7.	An analogue output (similar to VOLUME) that can be varied from 0V to 14 volts in 64 discrete steps. Output level can be increased via transmitter switch 6 or decreased via switch 7.
ANALOGUE 2	8,9.	An analogue output (similar to VOLUME) that can be varied from 0V to 14V in 64 discrete steps. Output level can be increased via switch 8 or decreased via switch 9.
RESERVE 1	10. (also 1).	A bistable output that switches between low (0V) and high (14V) states on alternate operations of switch 10. The output switches to the high state when STANDBY (OFF) switch 1 is operated.
RESERVE 2	11. (also 1).	A bistable output that switches between low and high states on alternate operations of switch 11. The output switches to the low state when STANDBY (OFF) switch 1 is operated.
CHANNEL-SELECT OUTPUTS	12,13,14,15 and 16.	A 4-bit binary output that can be put into 16 possible states; the output can be used to select any one of 16 channels via a suitable decoder/multiplexer. Channel 1 (0000) can be selected directly via switch 14. Channel 8 (1110) can be selected directly via switch 15. Channel 16 (1111) can be selected directly via switch 16. The output/channel selector can be incremented upwards one step at a time via transmitter switch 12, or downwards via switch 13.

Table 2: transmitter control switch functions.

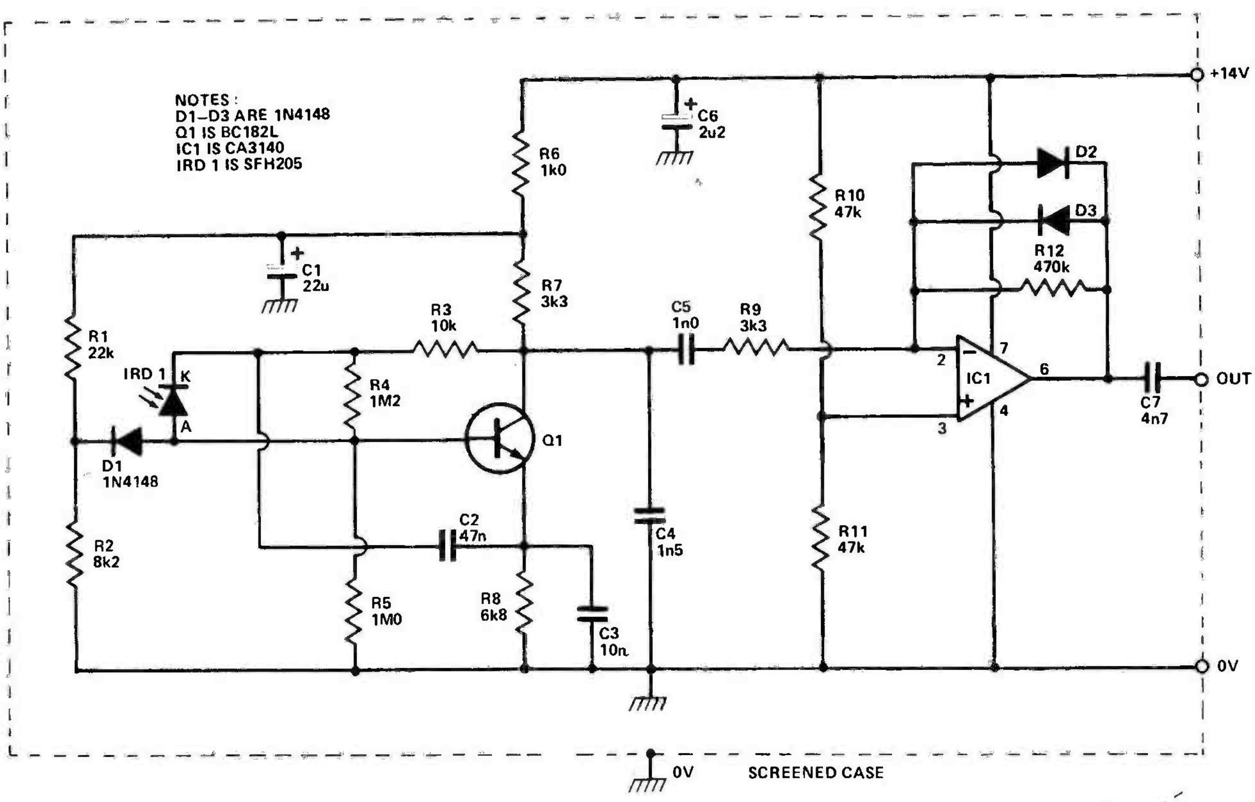
respectively. Note that several of the transmitter switches give multi-function operation.

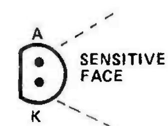
Construction: The Receiver Unit

Before committing yourself to the construction of this project, note that access to an oscilloscope may be required when initially setting up the system. If you have such access, you can proceed with reasonable confidence. Full constructional details of the complete receiver unit are given in the present article: details of the transmitter construction and setting up procedure waill be given next month.

The receiver unit is built up on three separate PCB's and the unit is uncased. This method of construction allows the receiver unit to be built into an existing Hi-Fi outfit, etc.

Start construction by building the power supply board. Note that Q4 must be mounted on a suitable heat sink. We recommend the use of a 35 volt component in the C16 position, even though our prototype is fitted with a 25 volt device. Check that the completed unit produces an output of about 14 volts.





SFH205 CONNECTIONS

Fig. 1. Full circuit diagram for the receiver-preamp PCB of the control system. Note the orientation of the SFH 205 shown right as it is a little unusual.

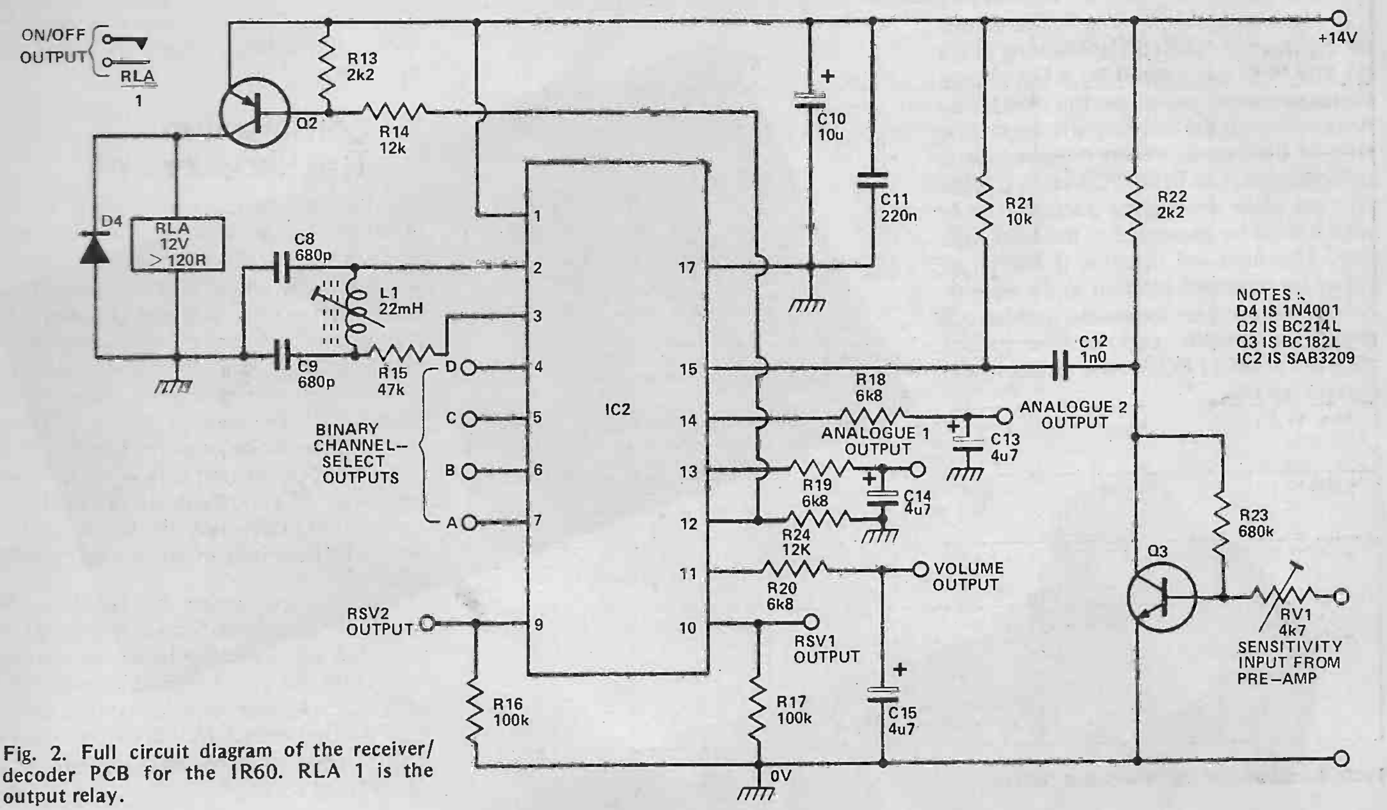


Fig. 2. Full circuit diagram of the receiver/decoder PCB for the IR60. RLA 1 is the output relay.

HOW IT WORKS

The coded infra-red signal from the transmitter is detected and amplified by the receiver unit and ultimately causes some receiver output function to occur. The receiver unit comprises three main sections, the infra-red receiver preamplifier, the main receiver/decoder unit and the power supply.

The transmitted IR code signal has a basic frequency of about 30 kHz (half of the transmitter clock frequency) and is detected by IRD1 in the receiver preamp and amplified first by Q1 and then by IC1. A problem in designing IR preamplifiers is that the circuit not only has to provide high gain for long range operation but also must not saturate when the transmitter is placed only a few inches from the receiver.

With the latter point in mind, R1-D2-D1 and C2 are used to prevent the bias point of Q1 shifting under heavy drive conditions. D2 and D3 clip the level of the final IC1 output signal, to prevent overdriving of following stages. The values of C2-C3-C4-C5 and C7 are chosen to make the preamplifier reasonably frequency selective, thereby ensuring a good low-noise figure. The preamp unit must be mounted in a screened case.

The output of the preamp is further amplified by Q1 on the main receiver/decoder board and then fed to the pin 15 signal input terminal of IC2, the P—MOS LSI receiver chip. This chip is provided with a clock oscillator (L1-C8-C9-R15) which is tuned to the transmitter clock frequency (double the serial code frequency). The chip checks the serial code input signal for correct number of bits, bit duration, etc, processes it and then 'dumps' the resulting code signal into a register, from which it is then converted into a useful output action.

The IC2 outputs from pins 4 to 7 form a 4-bit binary signal that can be used to externally select any one of 16 channels. The outputs of pins 9, 10 and 12 are single-bit signals that can be set high or low via the transmitter commands: the output of pin 12 is used to activate a relay (which can be used for switching power to an external circuit, etc) via Q2.

The IC provides three analogue output signals (at pins 11, 13 and 14). Each of these outputs takes the form of a 1 kHz (approx) square wave that can have its mark/space ratio (and thus its mean level) varied over a full span in 64 discrete steps via the transmitter command signals. These variable mark/space signals are converted to DC analogue voltages via low-pass filters (C13-R18, C14-R19, C15-R20) and can be used to control external voltage-controlled attenuators and amplifiers (for remote gain control) and filters (for remote tone control), etc.

The preamp and main receiver/decoder boards are each powered from a regulated 14 volt supply derived from the mains via T1-D5-D6-C16 and series-regulator network Q4-ZD1-R25. The circuit is required to supply current up to only a couple of hundred milliamps.

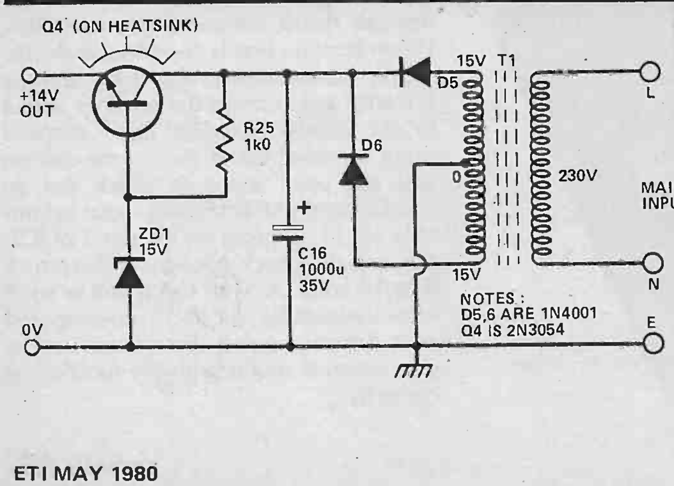
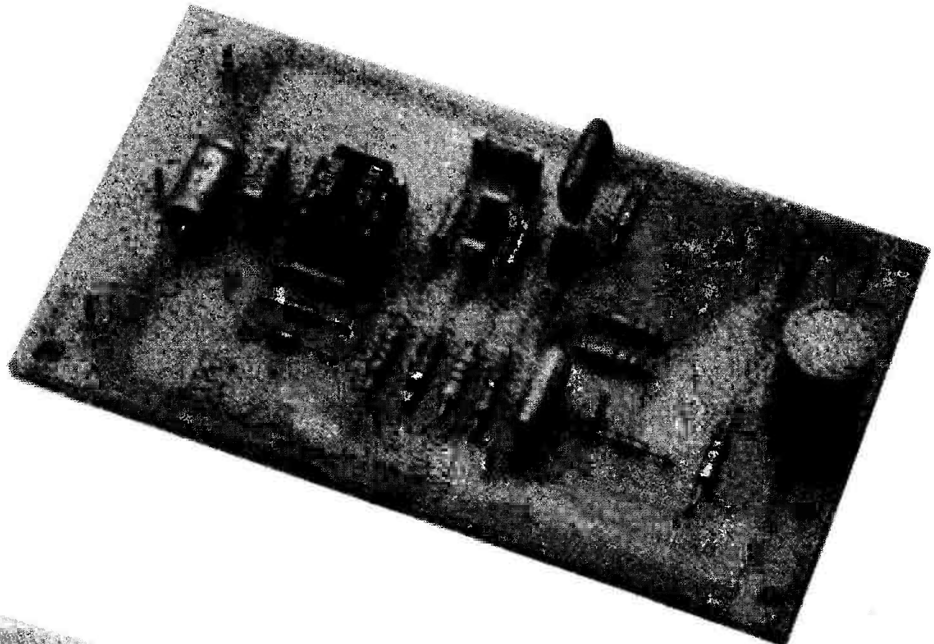


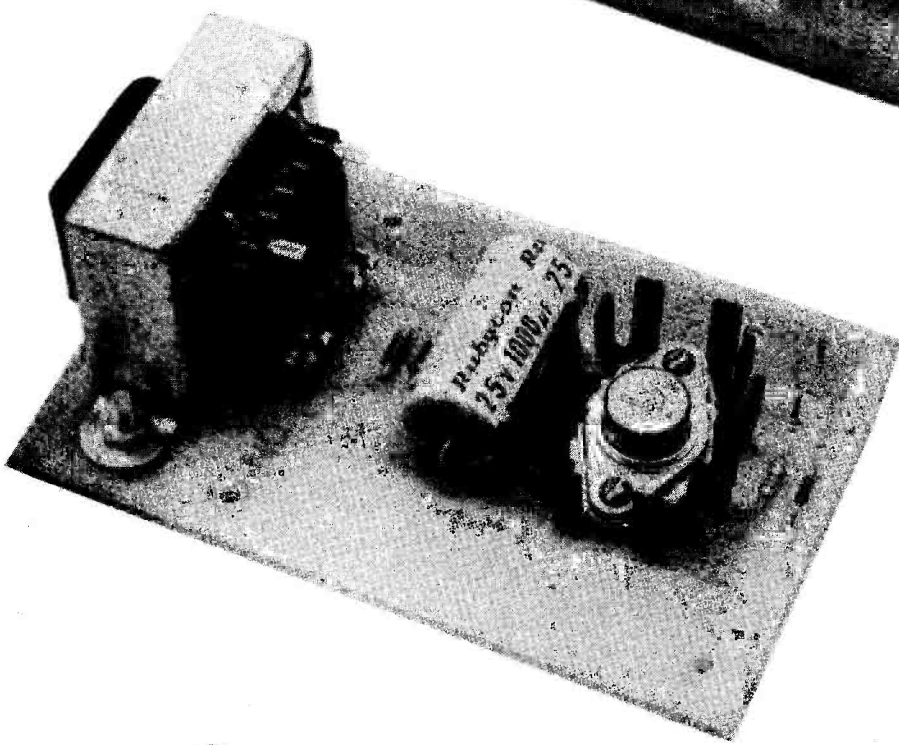
Fig.3. (left) circuit diagram of the PSU for the IR60 system.

BUYLINES

The SAB3209 IC could present a problem for your local component emporium. However, Electrovalue and Watford Electronics are stockists for this IC. The relay and infra-red detector can also be purchased from Watford Electronics. L1 was obtained from Ambit International. All other components are common types and should not pose any problem.

Next, build the pre-amp PCB as shown on the overlay. The odd positioning of C1 on this PCB was caused by a last-minute correction to our prototype: this mod is also responsible for the two empty holes on one side of the board. When construction is complete you can fit the PCB into a screened case (dare we suggest a tobacco tin?), which must be grounded to the zero volts line. The infra-red detector (I RD1) can either be mounted external to the case or can be mounted on the inside, looking out through a suitable aperture. Take special care to connect I RD1 to the circuit in the correct polarity.



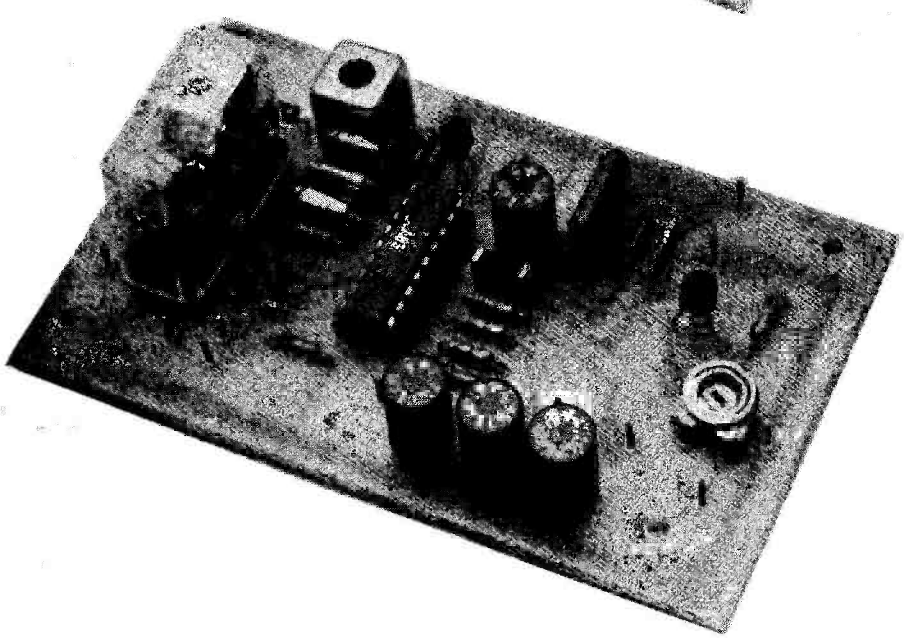


Shown here are the three PCBs which comprise the IR60 receiver system.

Top: the preamp board.

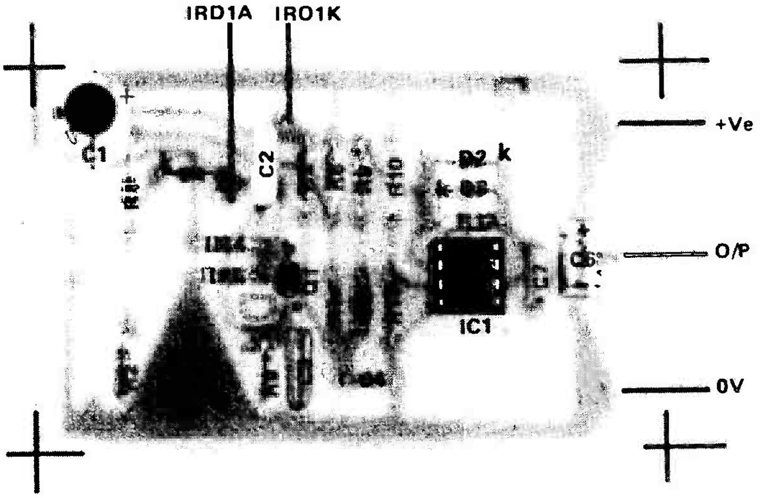
Left: a PSU suitable for driving the system.

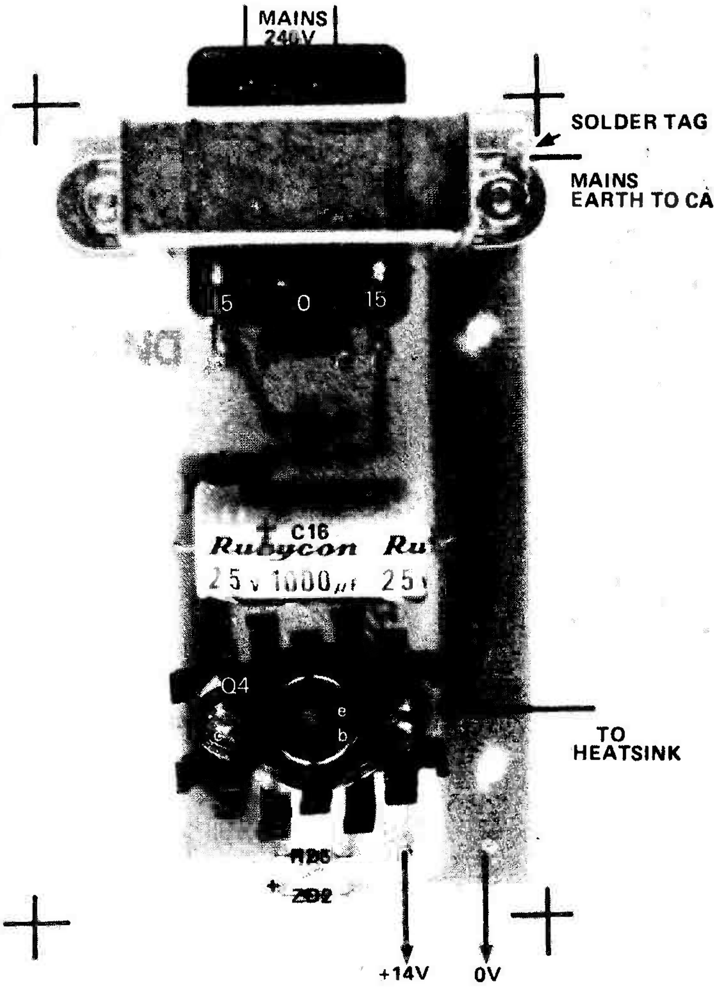
Below: the decoder board.



Finishing Off

Finally, build up the main receiver/decoder board, complete with relay RLA. When construction is complete, make the supply connections to the board and the pre-amp and connect the pre-amp output to the receiver/decoder input terminal using screened cable. Switch the unit on and use your 'scope to check that an approximately 60 kHz clock signal (adjustable via L1) appears on the pin 3 of IC2. You can also check that signal-input pin 15 is at 14 volts DC with half a volt or so of noise (adjustable via RV1) superimposed on it. If the two points above check out OK your receiver unit is probably functioning correctly.





PARTS LIST

RESISTORS All ¼W, 5%
- R1 22k
- R2 8k2
- R3,21 10k
- R4 1M2
- R5 1M0
- R6,25 1k8
- R7,9 3k3
- R8,18,19,20 6k8
- R10,11,15 47k
- R12 470k
- R13,22 2k2
- R14,24 12k
- R16,17 100k
- R23 680k

POTENTIOMETERS
- RV1 4k7 min horiz preset

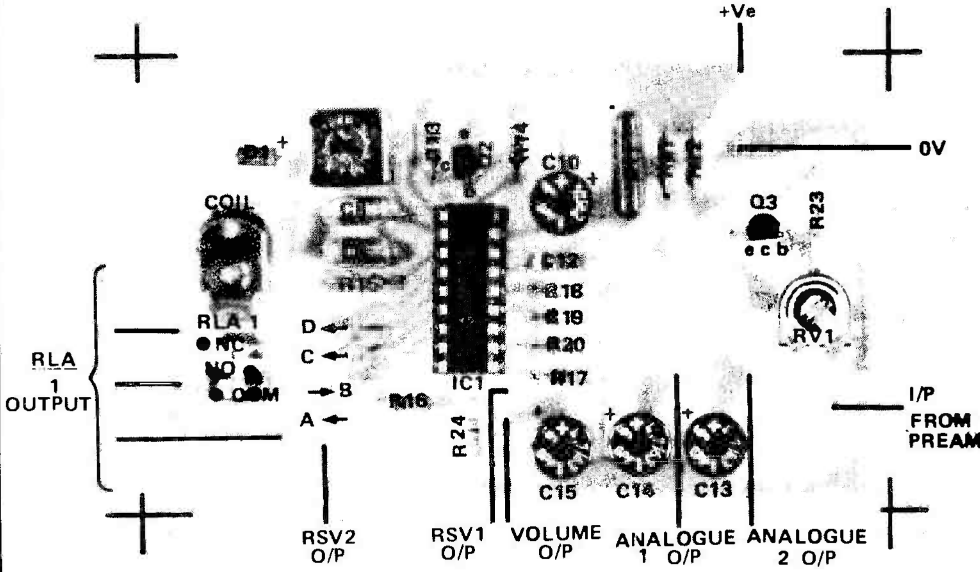
CAPACITORS
- C1 22u 63V PCB electrolytic
- C2 47n polyester
- C3 10n polyester
- C4 1n5 polycarbonate
- C5 1n0 polycarbonate
- C6 2u2 63V electrolytic
- C7 4n7 polycarbonate
- C8,9 680p polystyrene
- C10 10u 63V PCB electrolytic (Siemens type)
- C11 220n polyester
- C12 1n0 polycarbonate
- C13,14,15 4u7 63V PCB electrolytic (Siemens type)
- C16 1000u 35V electrolytic

SEMICONDUCTORS
- IC1 CA3140
- IC2 SAB3209
- Q1,3 BC182L
- Q2 BC214L
- Q4 2N3054
- D1–3 1N4148
- D4–6 1N4001
- IRD 1 SFH205
- ZD1 15V 400mW zener

MISCELLANEOUS
- RLA 12V > 120R SP C/O PCB relay
- L1 22 mH variable coil type 87BN132 HM2
- T1 15-0-15 8VA
- Screened case 115 x 65 x 35 mm

These overlays are for the PCBs in the receiver system. Reference to these and the photos on the facing page should facilitate construction.

Next month: Transmitter details.



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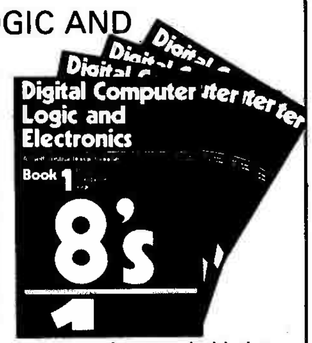

This course is designed as an introduction to digital electronics and is written at a pace that suits the raw beginner. No mathematical knowledge is assumed other than the use of simple arithmetic and decimals and no electronic knowledge is expected at all. The course moves painstakingly through all the basic concepts of digital electronics in a simple and concise fashion: questions and answers on every page make sure that the points are understood.
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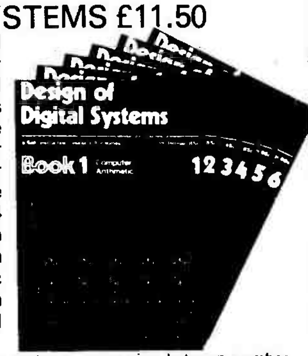

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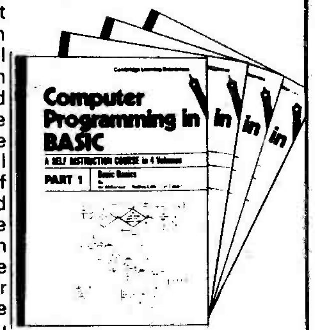

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HEISENBERG'S UNCERTAINTY PRINCIPLE

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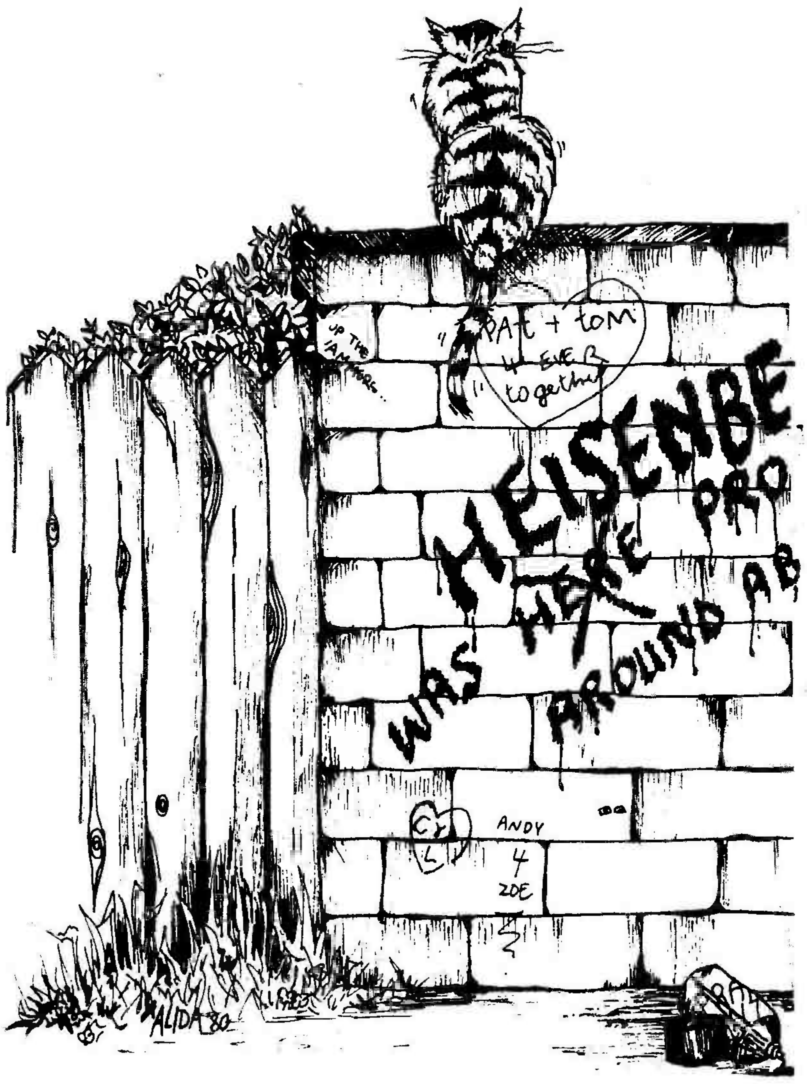
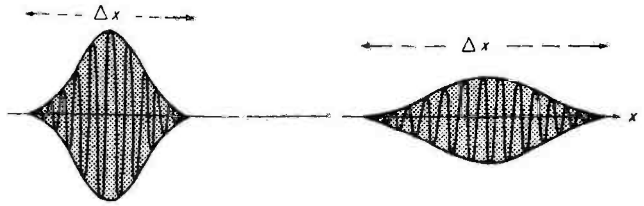
Most people who read a lot of science fiction (as I must confess I do) have probably heard of Heisenberg's Uncertainty Principle at some time or other, but the vast majority are, if you'll pardon the pun, very uncertain as to its nature. Well, never fear; a paragraph or two hence you, too, will be able to confuse friends, relatives and the cat....

Exactly Where?

The uncertainty principle as such was first stated by a German physicist, Werner Karl Heisenberg, in the late 1920s. He said, essentially, that it is impossible to measure both the position and momentum of particle simultaneously. Now this wasn't quite such a stupid statement as it sounds - what he actually meant by this was that, in measuring either the position or momentum of a particle, you must necessarily be affecting the other in a way which is unpredictable and, in the case of small particles such as electrons, significant. At this point the reader may feel inclined to cry out 'Ah, but I can tell exactly where something is just by looking at it and that doesn't affect its momentum, does it?'. Well, sorry to disappoint you, but you're wrong on two counts. You cannot tell *exactly* where something is just by looking at it - there is a slight uncertainty of the order of the wavelength of the light you are using - and even looking at a thing *does* affect its momentum. Light, you see, is made up of particles. In order to look at an object, it is necessary to bounce some light particles - called photons - off that object. Now these particles carry momentum, and so when they bounce off the object, they must necessarily change its momentum, as well. For normal objects, as large as the ones we're used to, this doesn't make a lot of difference, but if you start working on the atomic scale, with electrons, etc, then a photon or two can make a lot of difference. Before we say any more, let's have a look at the basic equation that Heisenberg actually used (No need to get worried - it's the only equation we'll see, and isn't all that difficult to understand).





Energy and mass are equivalent. The position of a particle, therefore, cannot be measured with absolute certainty. There must always be an uncertainty of Δx in the measurement of x.

$$\Delta p \times \Delta x \geqslant h/2\pi$$

In this equation, the symbol Δp stands for the uncertainty in the momentum of an object, Δx stands for the uncertainty in the object's position, the symbol h stands for a constant (known as 'Planck's Constant') and the symbol $\geqslant$ means 'is at least as big as'. Heisenberg said, then, that if we find the product of the uncertainties in position and momentum, then they will be at least as big as $\frac{h}{2\pi}$, which has a value of about 1.05×10^{-34} joule seconds. (Exactly why it is measured in units called joule-seconds is rather irrelevant to the present discussion, so we shall leave it for some other time). Now, as you can see, this is a pretty small value approximately given by a zero followed by a decimal point and thirty three more zeros before we put a 1 down. This explains why we do not see the effects of the uncertainty principle in real life - given the uncertainty in position or momentum of an object that we have found experimentally, the uncertainty in the other can still be incredibly small. Let us take the case of the magazine you are presently holding. We will suppose, for the sake of simplicity, that, using a very good microscope you can measure its position accurate to within one wavelength of light, or about 0.00005 centimetres (which is about as accurate as you could get, using light). Then we find from the uncertainty principle that the magazine must have a momentum whose uncertainty must be at least $\frac{h}{2\pi \times \pi x}$ or about 0.0000000000000000000000000002 kg m s^{-1}

Speedy Accuracy

In other words, the most accurately you can measure the velocity of this object will *still* give an uncertainty of approximately 0.0000000000000000000000000001 metres per second. This isn't much..... no wonder we don't notice the effects of the uncertainty principle in everyday life - they are too small! It's a different matter on the atomic scale, though. Suppose we want to measure the position of an electron accurate to, say, the width of an atom. If we work this one out (in case anyone out there does want to, the width of a hydrogen atom is about 10^{-10} metres, and the mass of an electron is 9×10^{-31} kg) we find that the uncertainty is something pretty big - roughly a million metres per second. As a result, while the uncertainty principle seems to have little direct use in our lives, it is pretty important to physicists!

Effective Measurement

In fact, once you start thinking about it, all the uncertainty principle says is that it is impossible to measure something without affecting it in some way and this is almost common sense. As we have seen, looking at something to check its position must necessarily affect its momentum. It is impossible to measure the voltage across, say, a capacitor, without removing a little of the charge, and so lowering the voltage. You cannot check the pressure in a car tyre without the gauge you use removing a little of the air, and so on.

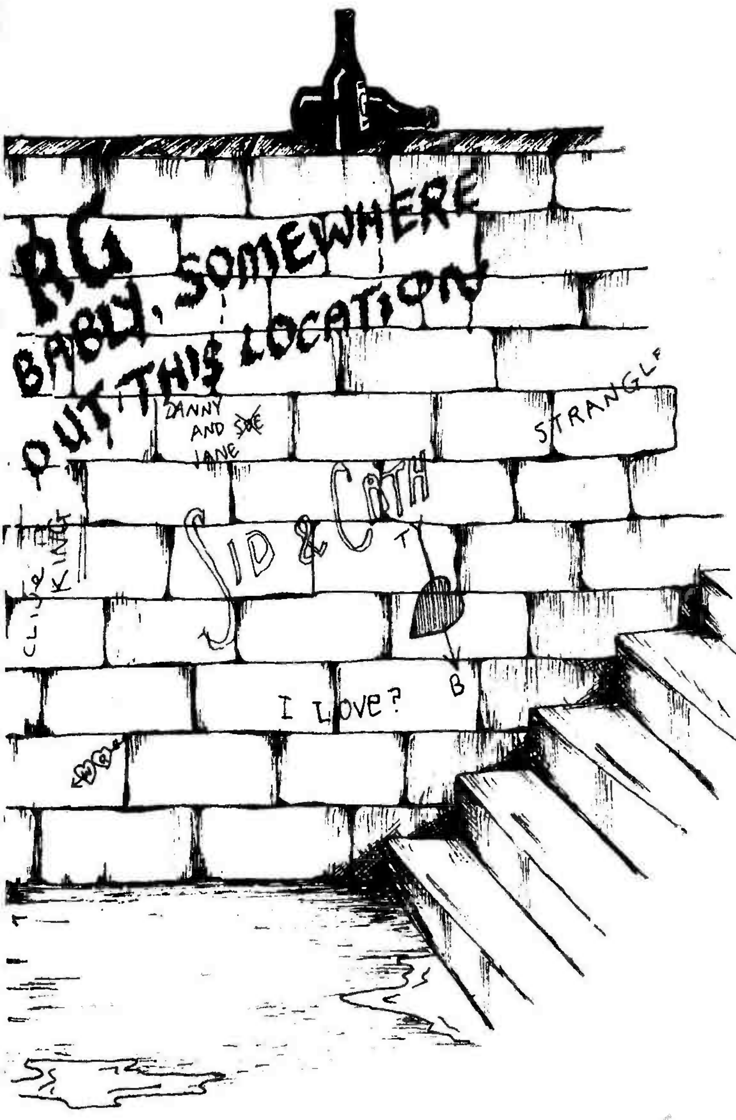
Impossible Position

Heisenberg's Uncertainty Principle is that it is impossible to measure position or momentum of an object without affecting the other in a random and unpredictable way. In the same vein, Albert Einstein once proved from the uncertainty principle that it is impossible to measure both the energy and time involved in an interaction. This is rather less obvious than the other cases we have examined, but it is indeed so.

How Smart Is Alec?

The uncertainty principle, then, means that we can no longer, in physics, talk of the exact position, momentum, etc of a particle; we can only talk in terms of probabilities - where a particle is likely to be, what the average velocity of a bunch of particles is likely to be under given circumstances, and so on. That is, until some smart alec comes along and proves it all wrong......

ETI



ETI JUNE 1980

WHAT TO LOOK FORWARD TO IN OUR NEXT ISSUE! ON SALE MAY 2ND.

DESIGNERS HANDBOOK

Now this is the one that even we've been waiting for. Many is the rainy Sunday that has passed with the enthusiast huddled intent over his workbench. Many too are the times he has howled loud into the storm when a project fails to operate for the want of one small piece of circuitry to link this with that or that with this, that or the other.

Information to allow him to design his own circuits quickly and simply is sadly lacking. Books take everything too seriously and at too much length. Looking anything up takes hours — by which time the rain has stopped and . . . . . .

Next month we present our Analogue Designers Handbook from the man of many nodes, Tim Orr. He presents the quick and easy way to amplifiers, filters, oscillators etc. etc. — and they'll be all your own work! Can you afford to miss it?

DRUM SYNTHESISER PROJECT

No, I don't believe you've never heard one of these. Just about every single produced in the last millenium has those noises all over it. You know, those noises — the ones that sound like a cat being stepped on backwards at great speed.

If you really don't know what we're going on about you'd better read ETI next month hadn't you?

HOUSE WIRING

So you think you know how it's done eh? Just wait until you pull the bathroom cord one day and the toast pops up: switch on the hall light only to have the TV burst into life . . . . Before long the house is a mass of ripped out wiring and is echoing to the sound of slamming front doors as enraged spouses storm into the sunset. Don't do it until you've read our superb article from Ray Marston next month!

FM LINE DISTRIBUTION

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TAPE RECORDER RESPONSE OPTIMISATION SYSTEM

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ANTI-MATTER

Better forget the Star Trek reaction pods. Throw away the tickets to another Universe. Instead read our explanation of the real truth (?) behind around and for anti-matter.

Articles mentioned herein are in an advanced state of preparation, however, circumstances may dictate charges to the final contents.

AUDIOPHILE

What have lovely Latin ladies got to do with metal? What has D-day got to do with hi-fi? Confused? You won't be after this month's episode of... Audiophile. Ron Harris tries to put some iron in his system with Sony's new TCK 55 II

It all started with a phone call one dark and rainswept Tuesday.

'Metal' said the voice on the phone.

'Well no-one's perfect' said I defensively.

'No no metal *tapes*' said the voice hurriedly.

'Plastic poodles' said I not wishing to appear dim.

'Why did you say that?' enquired the voice, a little hurt.

'I dunno, seemed to fit somehow' said I, reddening rapidly.

'Look here, if you persist upon being silly...........'

'You started it mush. What metal anyway?........' that was the magic question and the golden key to communication. It transpires that the voice belonged to Mr. Sony (UK) wishing to discourse upon the subject of iron tapes and machines to play them on. Our telephone operator introduced him as a, quote, geezer wot wants to iron someit art wiv yer, unquote. Articulate our switchboard.

Despite this highly inauspicious genesis the word about heads to pass ferric substances across at 1/78 IPS managed to find an editorial ear and this month's Audiophile came, screaming, into the world.

Some Sony Day

As the sidehead says the machine I'm looking at is a new model from Sony, the TCK55 II. One of a range of metal-ready decks. Sony get themselves a fair few mentions herein, simply because they have a superb PR department and make some excellent hi-fi (or is that the influence of the PR men again?). Whenever we've needed something quickly (which is always) or have cried out into the night for assistance, they have been one of first people to put out a helping hand - so once I had decided it was time to take a look at reasonably priced (i.e. less than a Rolls) example of this new fangled metallic machinery it came as no surprise to find them ready and able to help at shorter than short notice.

It was also they who gave birth, in this country, to the Elcaset - a tape format much beloved of this particular editorial personage. I find it hard to forgive you lot out there for killing it off the way you did. Why did not hordes of you besiege hi-fi shops and hand over vast sums of money to procure an EL7? It was a magnificent medium and one that I will long defend as having been all that cassettes were *supposed* to have been.

Still, people see things differently I suppose. I dare say that there is *one* Englishman, somewhere, who remebers D-day for walks in the park, kisses in the sunshine and falling gently in love with a beautiful Latin lady over a candlelit dinner, treasuring the day for the warmth in her eyes...

Switch In Appearance?

Metal tapes look set to provide that vital step-up in cassette performance that has been missing so far. At a price. Their transient handling and H.F. extension is far enough superior to the more normal oxide blends to be acknowledged as a new standard of performance.

It is the fact that much higher levels of signal can be recorded at high frequencies (over 6 dB at 15 kHz) *for the same distortion figure* that gives the new formulation a much cleaner top end performance and transient behaviour. Distortion overall should also be lower.

Equalisation for the new type has been standardised at 70 uS (the same curve as for CrO_2 tapes) but bias has to be around 10 dB higher, due to the iron's much higher coercivity. Erase heads too must therefore be capable of more 'muscle' to achieve a satisfactory 'wipe-out'.

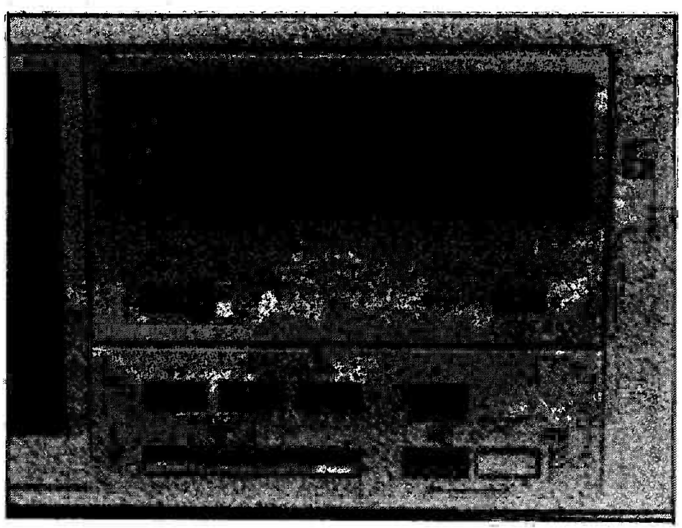
This extra electronics manifests itself, as usual, as an extra switch on the front panel! In the case of TCK55 II considered here an extra slide position on both the bias and equalisation selectors.

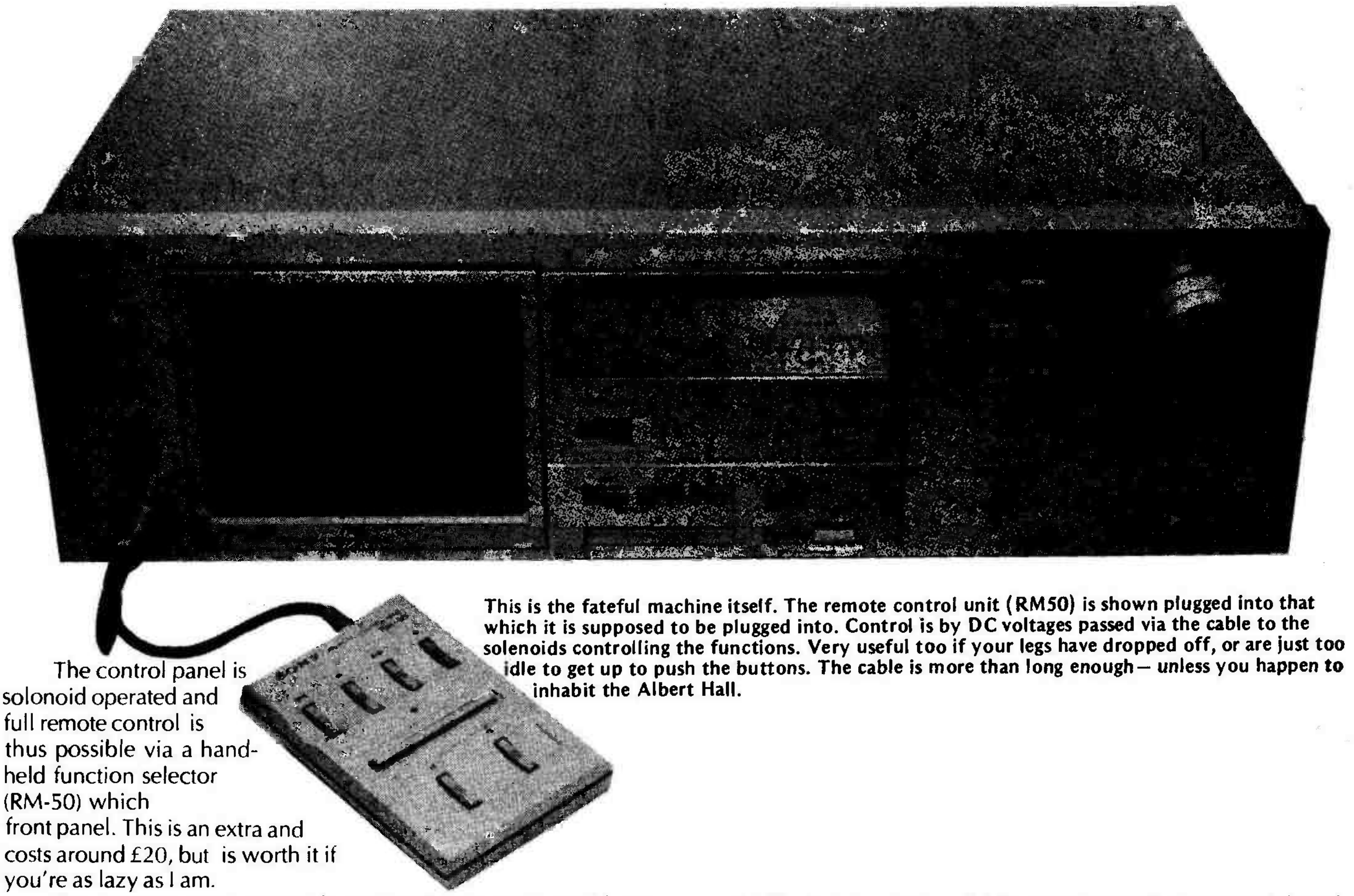
Facilitating Uses

This machine offers a goodly number of features, for its price, and one of the nicest is called 'AUTO-PLAY'. Pressing both the Rewind and Play buttons causes the machine to rewind to the start of the tape then begin playing automatically. No more standing by the deck counting down the seconds while your tea goes cold.

Of course if we could all remember to reset the memory to 000 every time, then that function could serve this requirement too, but do we? No chance! A simple and useful addition then, and like all the best ideas obvious once you see it!

Metering too is well thought out here. Normal VU meters monitor each channel for average readings and a centre bar of LEDs reads peak level. Between the two it is easy to obtain a good setting - and to see how woefully slow VU meters are! With metal tapes you set higher than normally and peaks up to +4 dB produced no audible distortion or compression, thereby proving both the tape and head circuitry.





This is the fateful machine itself. The remote control unit (RM50) is shown plugged into that which it is supposed to be plugged into. Control is by DC voltages passed via the cable to the solenoids controlling the functions. Very useful too if your legs have dropped off, or are just too idle to get up to push the buttons. The cable is more than long enough— unless you happen to inhabit the Albert Hall.

The control panel is solonoid operated and full remote control is thus possible via a hand-held function selector (RM-50) which front panel. This is an extra and costs around £20, but is worth it if you're as lazy as I am.

The controls work smoothly and positively and I could not possibly fault them. Somehow though I didn't *like* them at all. No criticism implied they were just not to my taste.

As usual with this company's offerings the whole n operates with a smoothness and efficiency that is totally prok nal. It makes me almost wish a button would drop off or sometl ,- anything to show some fallibility in those inscrutible Or ental designers.

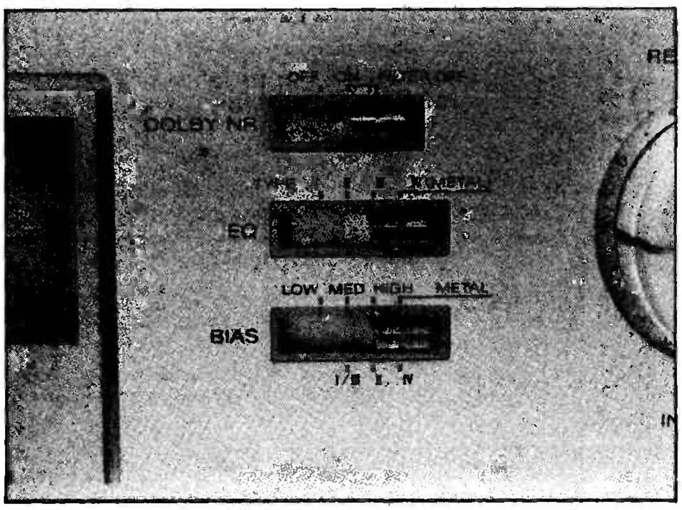
Mute Point

Another unusual feature is the 'REC. MUTE' which provides for four-second blank periods to be inserted into the recordings automatically. Sony say it is useful for removing radio commercials and the like. I contend the point not at all, being totally confused by the thing.

Making recordings on the TCK55 II proved to be very easy indeed, with the LED metering quickly proving its worth in use. I tried the machine with a wide selection of tapes, from Sony's own new AHF and Metal to TDKs SA and MAR formulations. Generally speaking the best results came from their own brand and Maxell. EXCEPT when I reached the iron settings. More of that in a moment.

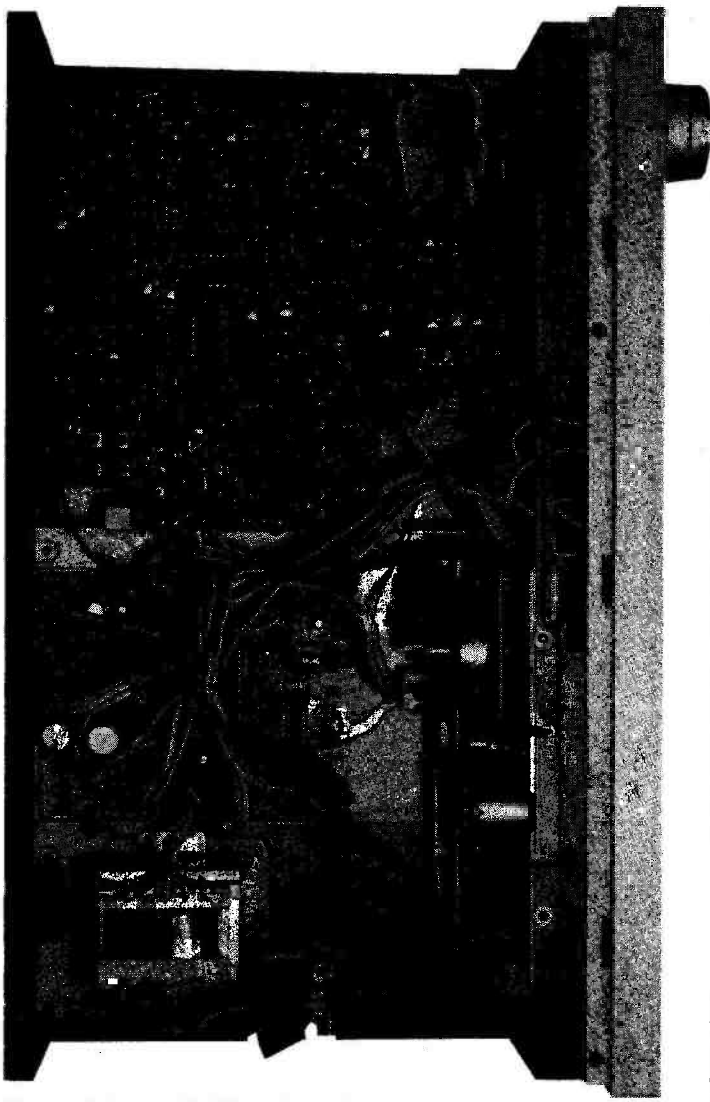
Wow-What Flutter?

On test the TCK55 II came out very well indeed. Taking an extract from the results:- (overleaf)



Far left: a close-up of the metering provided on the TCK55 II and the control panel beneath it. Note the LED column which reads peak level better than meters ever could. Not a new idea, but well executed here.

Left: the bias and equalisation controls. Sony provide a useful table which gives recommended settings for a wide variety of tape types in their instruction book. The numerals on the panel refer to this table. Strangely my sample of the machine seemed over-biased for Sony's own metal tape, preferring instead TDK's formulation. There's loyalty for you!



Above: oh how unfair! The TCK 55 II stripped naked before the world. PCB construction is to a commendably high standard.

TABLE ONE :— TEST RESULTS

Input sensitivity (line)	**90 mV**	
Wow and Flutter (DIN)	**±0.08%**	
Frequency response:-		
TDK SA tape	**30 - 16 kHz ±2 dB**	
SONY AHF tape	**33 - 15 kHz ±3 dB**	
SONY METAL tape	**40 - 15 kHz ±4 dB**	**see text**
TDK METAL tape	**26 - 18 kHz ±2 dB**	**see text**
MAXELL UDXL 1 tape	**30 - 16 kHz ±3 dB**	
MAXELL XDXL 2 tape	**30 - 16 kHz ±2 dB**	
Spooling time (C60)	**1 min. 4 sec.**	
Distortion (333 Hz):-		
METAL tape at Dolby level	**0.9%**	
SONY AHF at Dolby level	**1.6%**	
Dynamic Range (TDK METAL)	**+67 dB**	
S/N ratio, Dolby on, TDK METAL, (10 kHz)	**−64 dB**	

I don't propose to spend weeks mulling over those figures, just the interesting ones need to be mentioned. Firstly that W/F rating I didn't believe and so I did it again. OK so now I believe it. Just. It's pretty good!!!

I am surprised by the Sony metal tape results and would listen to claims that I had some bad tapes. TDK metal performed superbly at all times.

Using TDK metal really showed what a difference this tape is capable of making to a sound system. With care taken in the recording stages this £200 cassette deck produced results that were all but indistinguishable from the original disc. There remains none of the tell-tale compression, dullness or lack of life that would betray an average recording.

This is not the first metal deck I've listened to, but if one includes the price in the consideration, then it is certainly the most impressive. Even a year ago this standard of sound from a cassette at £200 would have been nonsense, an ad. man's dream.

Sound Out

I compared the TCK55 II to an EL7 Elcaset machine and a Revox B77 reel-to-reel and on sound alone it was difficult to tell them apart. The Revox was running at 7½ ips and undoubtedly turned in the most accurate reproduction of the three. It would, however, take a good pair of ears and very high quality source material to allow it to be reliably distinguished from the far cheaper TCK55 II. Even then only on a good day with the wind in the right direction....

I would very much like to lay hands and ears on the TCK75, a machine which a little bird tells me is better yet and more versatile, albeit at higher cost. However, there can be no doubt that the TCK55 II itself is an imposing statement of the quality reproducable from the (high price) medium of metal tapes. It performs exceedingly well on the more mundane formulations too and can be highly recommended to anyone in search of a tape machine to add to his domestic sound system.

●

Moaner's Return

Following my moan in the February issue about the non-availability of racks for Pioneer systems (unless you want to shell out a few hundred pounds for a complete system) I had a few interesting phone calls. It seems that Britain, for the time being, is the odd man out as far as Pioneer racks are concerned. I'm told that most European countries will supply Pioneer racks as separate items. However, if you have problems with the foreign lingo, why not go west, young man? If you should find yourself in the Republic of Ireland in the near future, make a bee-line for 41 Fitzwilliam Street in Dublin. There you'll find the emporium of Radio Import Ltd, who will be more than happy to flog you a brand new Pioneer rack on its own. Get in touch with them for latest prices, but as a guide the Rolls-Royce of the range - the CB 900 - will set you back a shade over £100. Sounds expensive, but a CB 900 from Pioneer on this side of the Irish sea will be around £90 when it finally becomes available - in about three months. Ian Graham

●

Let Us Say

Below an epistle from a man of taste who is undeservedly threatened by his own brother due to an unsatiable craving to play bass guitar. There are problems, however. Read on....

25th February 1980
Dear Audiophile,

I have an electric guitar which I intend to 'play' through my brother's Hi-Fi system. However we have been told that to do so will damage the Hi-Fi.

Is this correct? If so what can I do about it? At present my brother brandishes a length of lead plumbing whenever I pick up my guitar - other people only do this when I touch the strings.

While on the subject, how about a project for a guitar practice amp - with a headphone output for the sake of neighbours' sanity?

Finally, we entirely agree with your opinions about Felicity Kendal. We strongly suggest that you attempt to have published the enclosed picture. This will help convert those unbelievers who may have been unconvinced by the previous photo - A commendable effort but not as fine a likeness as she deserves.

Yours faithfully,
L Rickwood.
Norwich

26th February 1980
Dear Sir,

Bass guitars and hi-fi don't mix. Sad, but true. Attempts to replay said stringed thing in this manner will probably result in one wall of your room being re-papered with a pair of speaker cones.

Good for the decor but lousy on the music. This is due to the amount of energy that the guitar will produce and the shape of the note. With no processing. i.e. recording, disc cutting etc. etc. (and no automatic level control!!!) you are more than liable to blow the bass speakers straight out of the cabinets.

As this is the point at which I suspect your kin will begin to rearrange your anatomy this is a Bad Thing. By all means use a pair of good dynamic headphones with the amplifier - this you will not damage. The headphones should survive better than your ears and are therefore safe!

I enclose a circuit for a practice amplifier we haven't got around to publishing, but which Hobby Electronics shortly will, - it might interest you more than that length of lead plumbing. Buy yourself a good 12" PA speaker to go with it.

As to a better picture of Felicity.........

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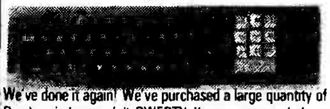

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SERVO TESTER

So your radio control has lost control and you have no way of knowing whether the offending component is receiver or servo. Fear not. All is not lost yet, ETI's Project Team provide the answer.

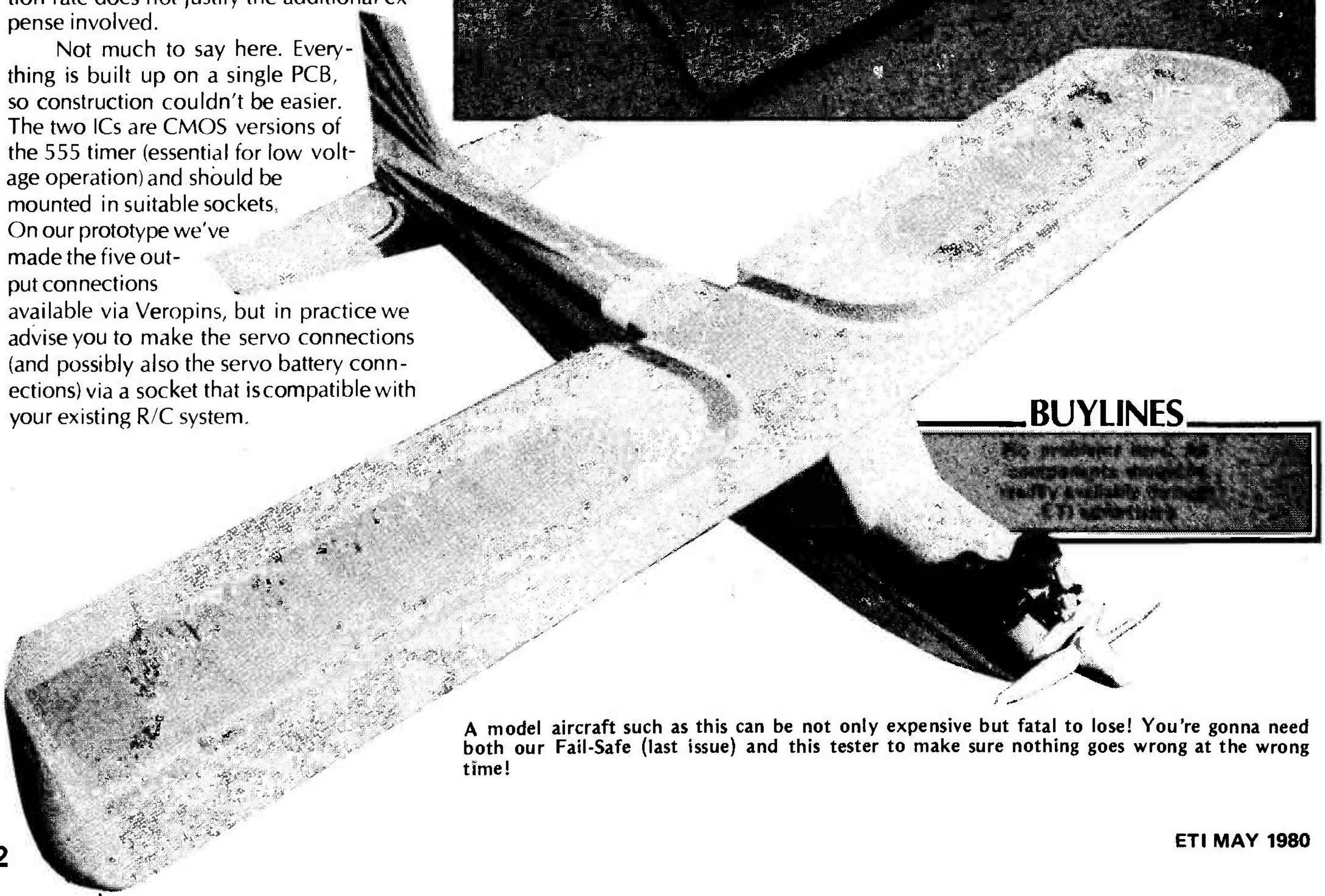
So your model is not functioning correctly and you're not sure of the cause of the trouble. Is it the transmitter, the receiver, or the servo? If your servo is a modern 3-wire positive-pulse type (aren't they all?) you can rapidly eliminate it from your list by simply coupling it up to our servo tester. The tester is powered from the servo's supply battery and feeds standard fully-variable 1 mS to 2 mS 'decoder' output pulses to the servo input for test purposes. The test set also features a pulse 'trim' control and incorporates variable frame length (1 mS to 28 mS) and pulse-amplitude controls, for the benefit of those enthusiasts who like to really put a servo through its paces.

The entire test set is built up on a single PCB and can be powered from all servo supplies in the 3 to 12 volts range. As you can see from the photos, we've not bothered to box the unit, since its probable utilisation rate does not justify the additional expense involved.

Not much to say here. Everything is built up on a single PCB, so construction couldn't be easier. The two ICs are CMOS versions of the 555 timer (essential for low voltage operation) and should be mounted in suitable sockets. On our prototype we've made the five output connections available via Veropins, but in practice we advise you to make the servo connections (and possibly also the servo battery connections) via a socket that is compatible with your existing R/C system.

BUYLINES

No problems here. All components should be readily available through ETI advertisers.



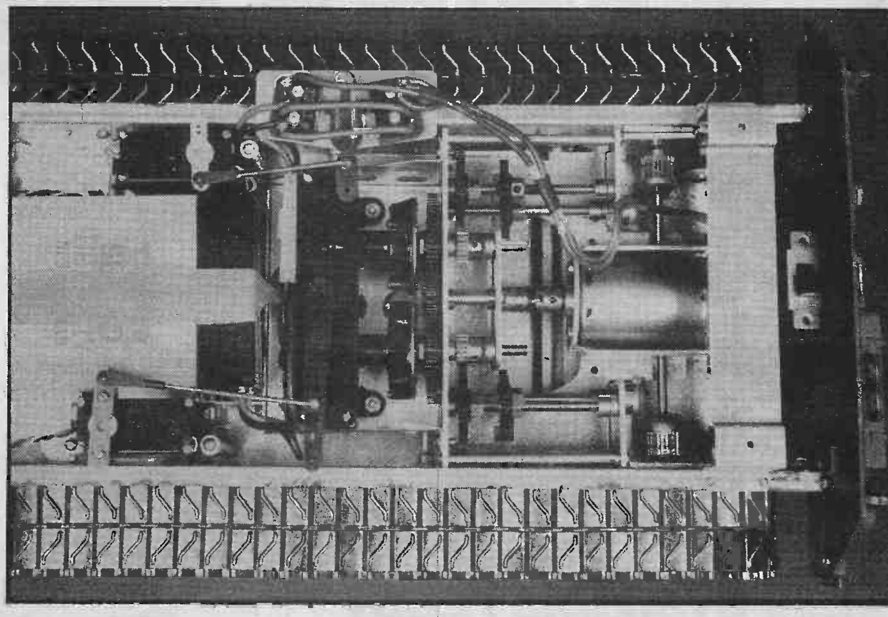
A model aircraft such as this can be not only expensive but fatal to lose! You're gonna need both our Fail-Safe (last issue) and this tester to make sure nothing goes wrong at the wrong time!

HOW IT WORKS

In a conventional multi-channel 'proportional' radio control system a variable-width (1 mS to 2 mS) pulse is passed to each servo via the transmitter — receiver — decoder 'link' roughly once every 20 mS (the frame time). The pulse width of each channel is variable at the transmitter (via a joy-stick, etc) and determines the position of the servo. At 1 mS the servo may, for example, be full left, at 1.5 mS 'neutral' and at 2 mS full right.

Our servo test set works by internally generating a conventional positive control pulse at a normal frame rate and feeding the pulse directly to the servo input. The unit is powered from the servo's own battery supply via the D1–C1 decoupler network. Circuit operation is quite simple. IC1 is wired as a free running astable multivibrator and acts as the 'frame' generator. The frame length is variable from 13 mS to 28 mS via RV1 and is used to trigger pulse-generating monostable IC2 via C3. The output pulses of IC2 are fed to the servo input via amplitude control RV2. The output pulse widths are variable over the nominal range 1 mS to 2 mS via RV3 but can be 'trimmed' over a limited range via RV4.

IC1 and IC2 are CMOS versions of the 555 timer and give stable operation at supply potentials down to about 3 volts.



Above: the Servo layout on the ETI Leopard Tank used for our R/C project last year. Servo failure here could result in total destruction of a very expensive model — and whoever happened to be in the way when those metal tracks cease to obey commands!

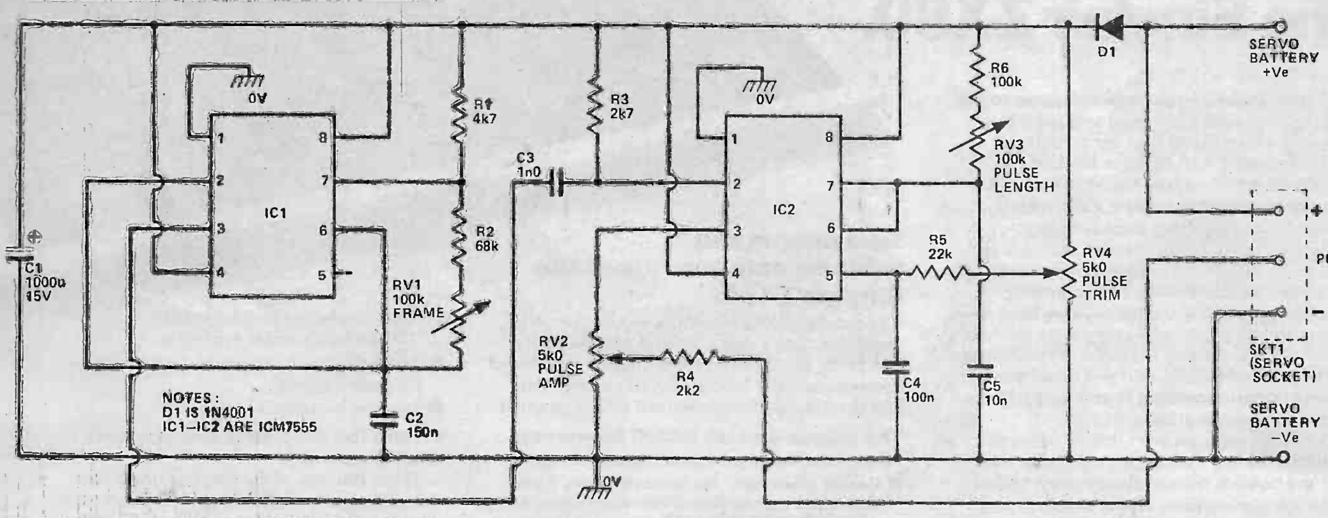


Fig.1. Full circuit diagram for the Servo Tester.

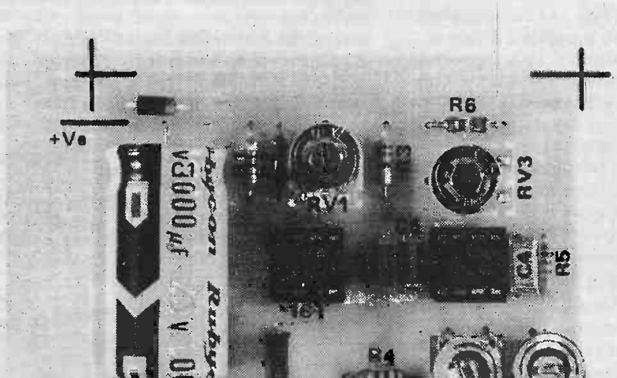


Fig.2. (left) the component overlay for the unit.

PARTS LIST

RESISTORS	All ¼W, 5%
R1	4k7
R2	68k
R3	2k7
R4	2k2
R5	22k
R6	100k
POTENTIOMETERS	
RV1,3	100k min horiz preset
RV2,4	4k7 or 5k0 min horiz preset
CAPACITORS	
C1	1000u 25V electrolytic
C2	150n polycarbonate
C3	1n0 polycarbonate
C4	100n polycarbonate
C5	10n polycarbonate
SEMICONDUCTORS	
IC1,2	ICM7555
D1	1N4001

ETI

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	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	8.95	
	Memory Expansion Board(s) (each one takes up to 3K bytes).	12.00	
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	Sinclair ZX80 Manual(s) (manual free with every ZX80 kit or ready-made computer).	5.00	
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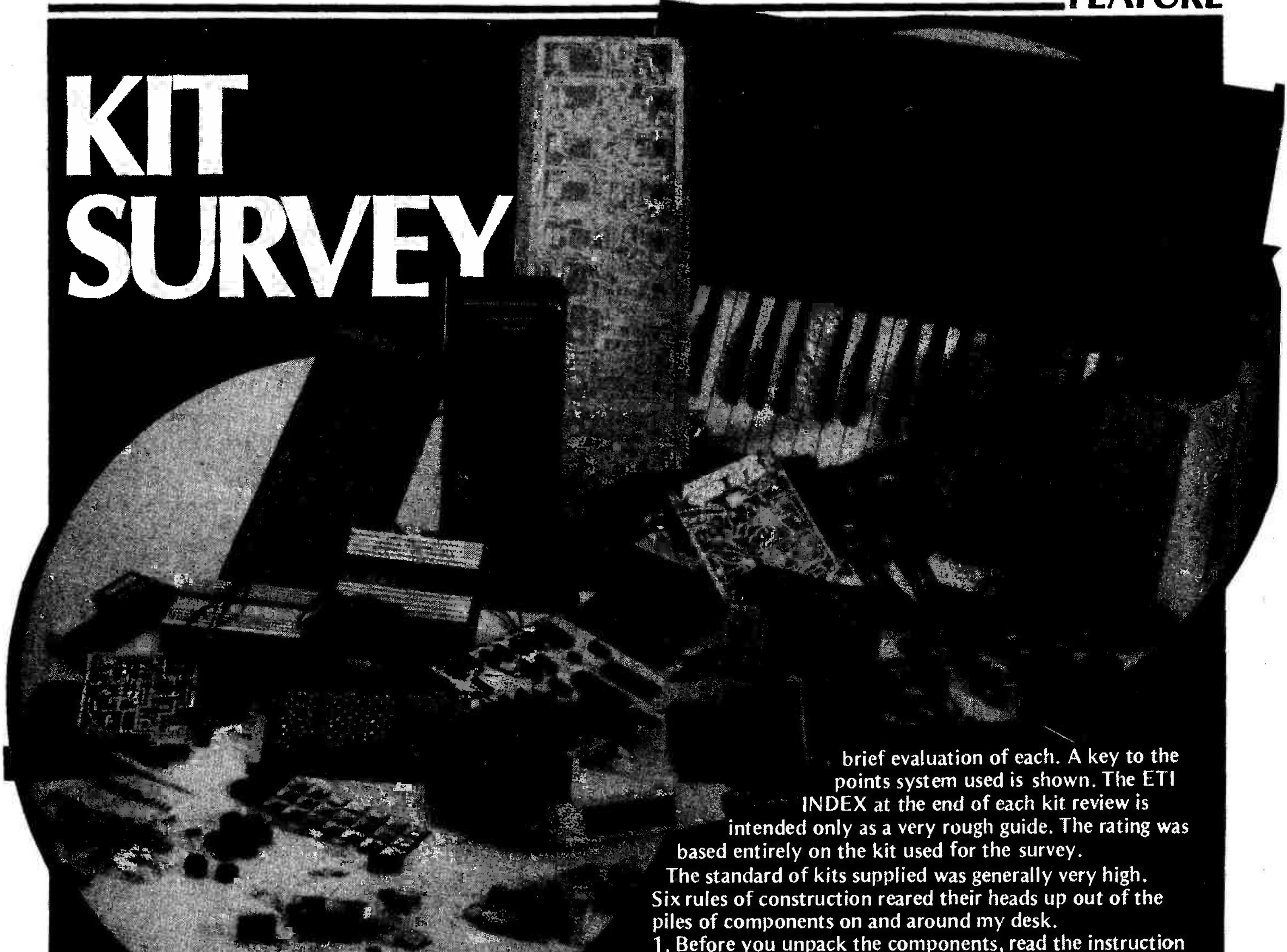
KIT SURVEY



You have, no doubt, heard of the much-quoted phrase, first uttered by French philosopher Rene Descartes — I pay income tax, therefore I am. If you want to stop your wallet slimming faster than you feed it, one way of curtailing the financial anorexia is to buy the kit version of your favourite amplifier, electronic ignition, computer, etc. The range of kits available seems to be endless. We decided to get as many of them as possible together in one place to find out what you get for your money.

I invited about 40 companies to send me kits for our survey. All accepted my invitation, but only 20 or so came up with the goods in time. Some were awaiting delivery of components (mains transformers, displays, etc.) and were unwilling to send part kits. Others seemed reluctant to take advantage of some free publicity.

You'll notice that there are few kits in the audio or hi-fi market. In the earliest stage of preparation of the survey it was decided to exclude any kit built from modules. This automatically excluded some of the household names in high quality amplifier design. It would also have been impractical to include loudspeaker kits, each requiring a cabinet. This pruning of the available merchandise was necessary to cut down the size of the survey to something manageable.

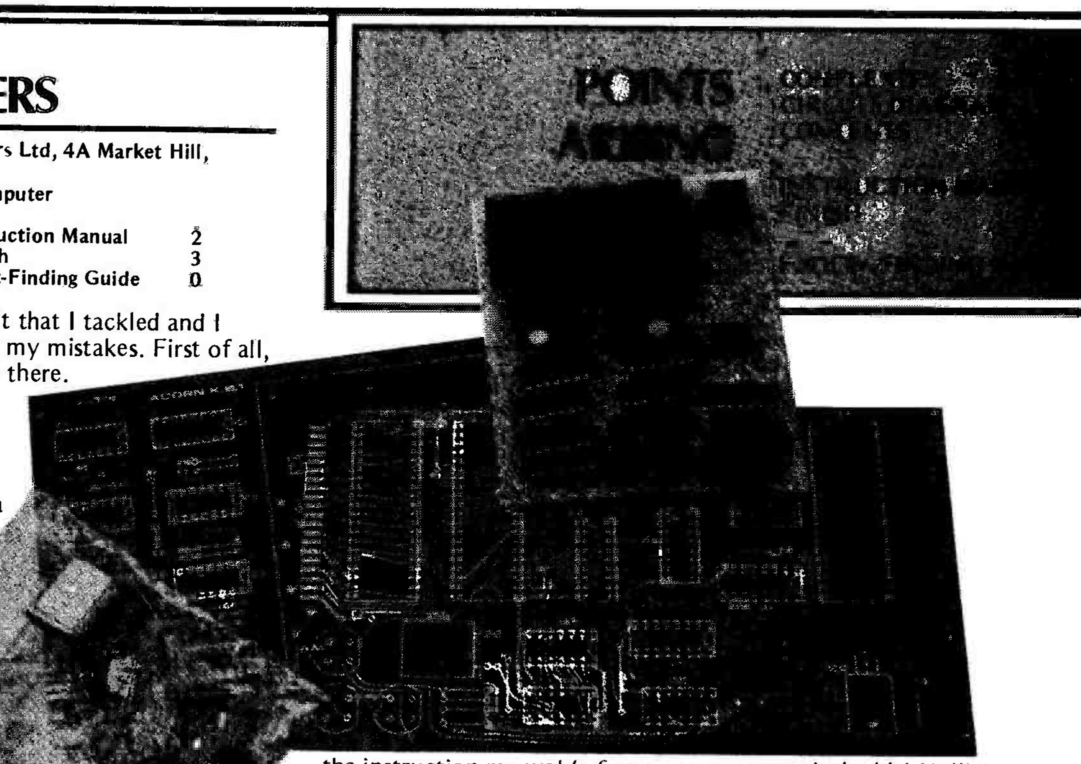
I built as many of the kits as time permitted and made a brief evaluation of each. A key to the points system used is shown. The ETI INDEX at the end of each kit review is intended only as a very rough guide. The rating was based entirely on the kit used for the survey.

The standard of kits supplied was generally very high. Six rules of construction reared their heads up out of the piles of components on and around my desk.

1. Before you unpack the components, read the instruction manual through at least once and look out for warnings about component handling. Some kits contain fragile displays and/or static sensitive CMOS ICs. If you find a note of errata, write the corrections in at the appropriate places.
2. Check that the kit is complete. Work your way down the component list and tick off each component as you check it.
3. Have a look at the PCB. Make sure there are no solder bridges between tracks.
4. Make sure you have the right tools for the job. If you try to build a microcomputer board with a hot poker or an oxyacetylene torch, you're likely to come to grief. For the fine work I invested in a low voltage (6 volts at 1 amp) iron with a fine tip and used 22 swg solder. (A temperature-controlled soldering station is even better). You'll also need long-nosed pliers, sidecutters, a couple of small screwdrivers (one slot and one Philips) and a pair of wire strippers.
5. When you begin construction, follow the instructions in the correct order. It's sometimes tempting to leave a particularly difficult or tedious part of the kit and work on something a little more interesting.
6. Don't be too eager to plug in the finished kit and try it before you've checked it properly for mistakes. Look for blobs of solder bridging across PCB tracks. Check that diodes, electrolytic capacitors, transistors and ICs have all been put in the right way round. Where possible use IC sockets. It's not only extremely difficult to unsolder an IC from a board but, if you're using a double-sided board, you can irreparably damage the board.

ACORN COMPUTERS

Company	Acorn Computers Ltd, 4A Market Hill, Cambridge.		
Kit	Acorn Microcomputer		
Price	£70.20		
Complexity	C	Instruction Manual	2
Circuit Diagram	1	Finish	3
Contents	0	Fault-Finding Guide	0



This was the first microcomputer kit that I tackled and I learnt a lot from it — mainly from my mistakes. First of all, *do* check that all the components are there. Companies do make mistakes. Acorn sent an incomplete keyboard assembly. One phone call later and the missing bits were on my desk next day — good service and worth a couple of bonus points on the ETI Index.

As with the majority of these kits, component positions, but not values, are marked on the PCB, so a good, clear components list is essential. I turned from the construction part of the manual to the end to find the components list. This list should, I feel, be included within the construction section. The layout of Acorn's manual encourages the constructor to use the sections out of order — potentially disastrous. So, the second of the cardinal rules 'read the instruction manual *before* you even unpack the kit'. Unlike Microtan 65, Acorn does not display its wares on a television set. It uses a small seven segment display. While building the kit I had nightmares about the eyestrain I was bound to suffer trying to read this tiny display. Wrong again. In fact, angled properly, the display is perfectly adequate.

Acorn's manual gives full details of power supply requirements. An attractive 'User's Manual' introduces the machine and how it works, with details of the 6502 microprocessor, including application programs.

ETI INDEX 8C

ALTEK

Company	Altek, 1 Green Lane, Walton-On-Thames, Surrey.
Kit	Shadow VLF/TR discriminating metal locator
Price	£79.70
Complexity	B
Circuit Diagram	1
Contents	3
Instruction Manual	3
Finish	3
Fault-Finding Guide	0

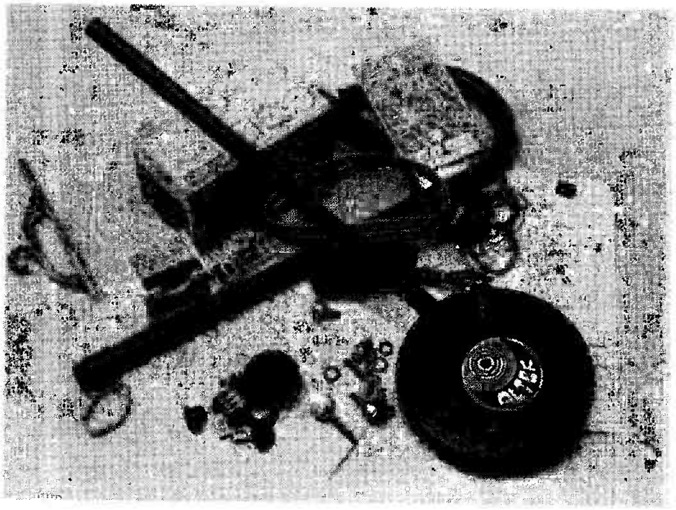
ETI featured this most discriminating of metal locators in the March 1980 issue. The project was an instant success, the demand far surpassing even Altek's own expectations.

The kit includes all the necessary hardware — a case for the electronics, handle, adjustable shaft and search head. I've had a number of phone calls and letters from DIYers who want to make their own search head to save some money. Altek are reluctant to release full details of the coil assembly, understandably. They have also told me that even if full details were published, the coil assembly would be beyond the capabilities of most home constructors, requiring sophisticated test gear to set it up properly.

The kit assembly instructions assume some electronics experience, but if you do run into problems, Altek are just a phone call away. Construction doesn't pose any particular problems. The plastic case supplied is not drilled, so a bit of elbow grease is called for. Altek make things as easy as possible by marking the hole centres on the case and providing a paper drilling template. Before you start ventilating your case, notice that the PCB mounting bosses are closer together at one end of the case than the other, so the case has a front and a back.

Before you rush out and dig up your back garden, remember that use of a metal locator requires a licence. Altek's kit includes an application form. You can buy the shadow VLF/TR Quad Mode Discriminator (to give it its full title) manual from Altek for £1. If you're starting out in metal locating and find the VLF/TR kit a little on the pricey side or you'd like to cut your teeth on something a little less complex, there are metal locators in Altek's range to suit just about everyone's needs and pocket.

ETI INDEX 10B



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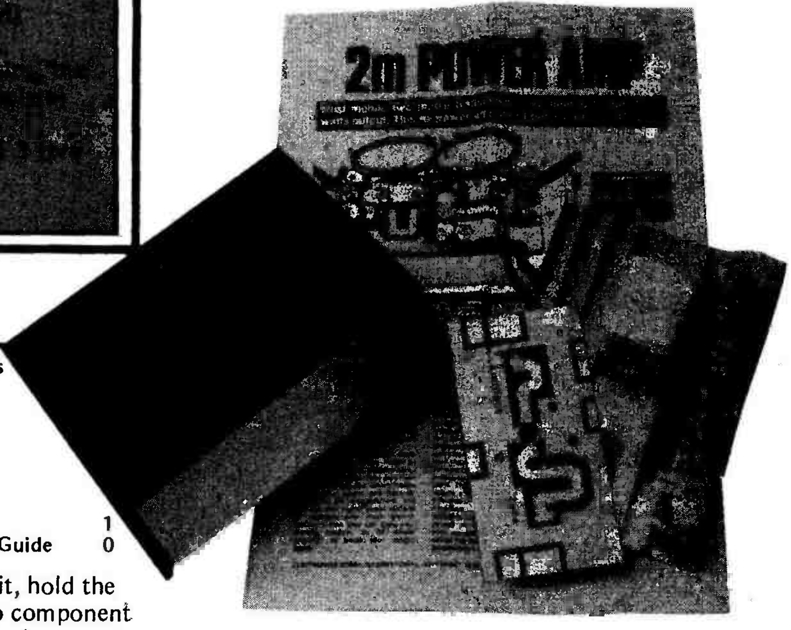


CATRONICS

Company	Catronics Ltd, Communications House, 20 Wallington Square, Wallington, Surrey SM6 8RG.		
Kit	40 W 2 m Power Amplifier		
Price	£22		
Complexity	B		
Circuit Diagram	1		
Contents	3	Finish	1
Instruction Manual	2	Fault-Finding Guide	0

When you unpack your 2 m Power Amplifier kit, hold the PCB up to the light and find that there are no component mounting holes, don't write a nasty letter to Catronics demanding a drilled PCB. The components are mounted on the *foil* side of the board. Before you pick up your soldering iron, read the instruction leaflet. Two points are worthy of note. If the power transistor is cracked, chipped or broken, run for the hills. The transistor contains beryllia, a toxic compound, so read the warning carefully. Secondly, before you begin, note that the heatsink and case should be taped together, so that you can drill the mounting holes. Input and output holes also have to be drilled in the blank case. Thereafter construction is no problem. The component overlay is a little difficult to follow, but the inclusion of a photo of the PCB is very helpful.

Catronics, the VHF communications specialists, also supply a complete kit for the ETI VHF Airband Converter (Dec1979).
ETI INDEX 7B

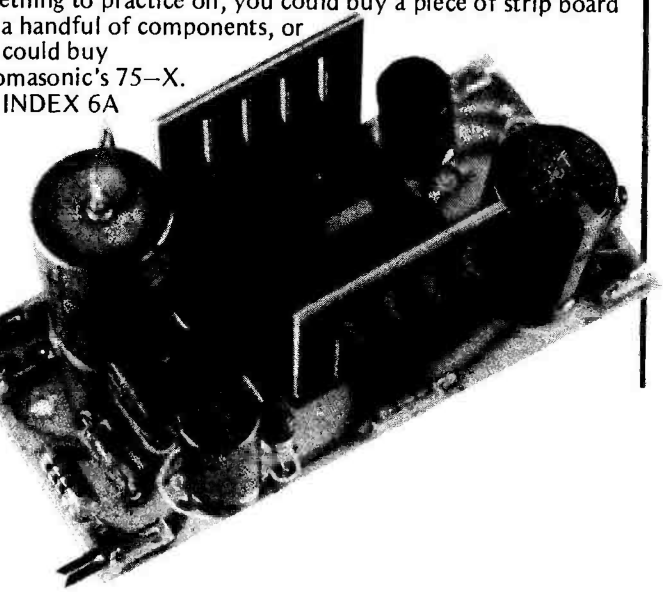
CHROMASONIC ELECTRONICS

Company	Chromasonic Electronics, 56 Fortis Green Road, Muswell Hill, London N10 3HN.		
Kit	75–X 10 Watt Audio Amplifier		
Price	£3.95 + VAT		
Complexity	A	Instruction Manual	2
Circuit Diagram	1	Finish	0
Contents	3	Fault-Finding Guide	0

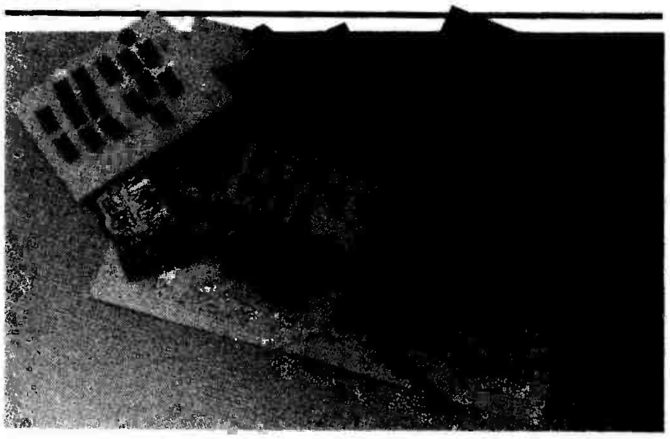
Chromasonic sent me a sample of their 75–X 10 watt audio amplifier. They also have a 7 watt version – the 75–B – based on the TBA10AS IC. The heart of the 75–X is a TCA940. The first step of construction is to snip off three unwanted pins of the IC. Take a few seconds to identify the right pins. You'll feel very silly if you cut the wrong ones. Thereafter construction is very straightforward.

Neither a power supply nor a loudspeaker are included in the kit. However, circuit diagrams are provided for the amplifier itself, a suitable power supply and tone control network.

If you've never soldered a joint in your life and you want something to practice on, you could buy a piece of strip board and a handful of components, or you could buy Chromasonic's 75–X.
ETI INDEX 6A



CLEF PRODUCTS



Company	Clef Products (Electronics) Ltd, 16 Mayfield Road, Bramhall, Cheshire SK7 1JU.		
Kit	Electronic Rotor CPK 1200.		
Price	£89.00		
Complexity	C	Instruction Manual	2
Circuit Diagram	1	Finish	3
Contents	3	Fault-Finding Guide	0

When I considered including electronic organs, pianos, etc in the kit survey I had nightmares about crates of woodwork and keyboard assemblies walling me in behind my desk. So, I asked Clef Products if they could simply send me a sample PCB and component packs.

They sent an electronic rotor – a device designed to electronically simulate a two speed mechanical rotor – speaker system and also provide a three-phase chorus generator to enhance organ tones and produce a string chorus effect. For your £89 you get a large bag bulging with boards and components. An 8" x 5" PCB contains the full rotor – chorus

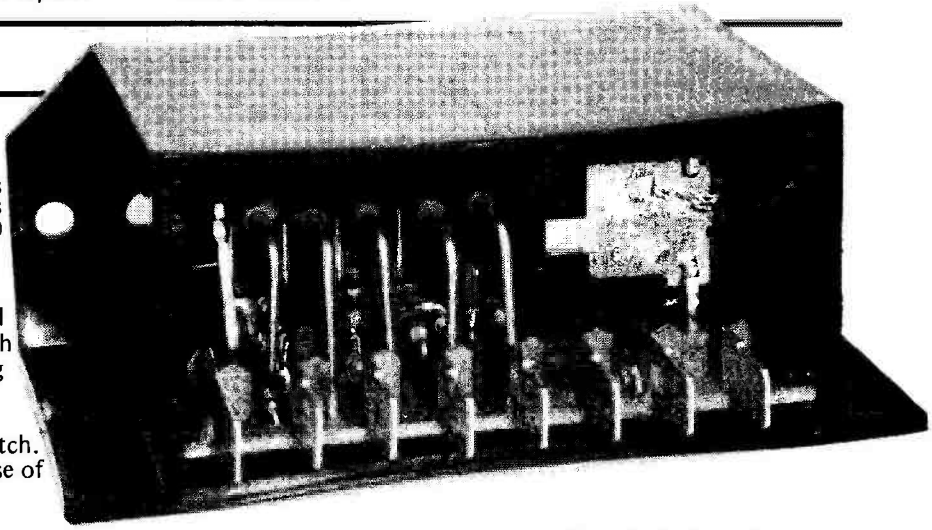
system, using some twenty ICs. Sockets are provided for all of them – that's what I like to see. (Have you ever tried desoldering a duff chip?). The second (2¼" x 2") board carries components for the low impedance stereo headphone driver circuit. Mains power supply components are also supplied.

The PCBs are labelled with component values, rather than numbers. Some legends are a little indistinct, so a full components listing is given as a double check. All nine controls are included as preset pots on the PCB, but you can replace them with external pots, if necessary. Holes in the PCB allow operation of the presets if you want to keep the controls on-board.

If you already have an electronic organ, you can add on this unit for some interesting effects, or you could use it as an experimenters' kit for use with your own signal source. A system interconnection diagram is provided, showing the unit placed between the signal source and existing power amplifiers.

ETI INDEX 9C

COMPU-TECH SYSTEMS



Company	Compu-Tech Systems.		
Kit	Car Security System		
Price	£11.95 + Siren (£7.75)		
Complexity	B	Instruction Manual	3
Circuit Diagram	1	Finish	3
Contents	3	Fault-Finding Guide	0

This design from Compu-Tech was published in ETI last month. It's an add-on unit for the ETI car alarm (also designed by Compu-Tech) published in December 1978. The original unit protected both the car itself (by monitoring all doors and disabling the ignition when set) and the car's accessories. There is an entry and exit delay before the horn is sounded, so you don't have to fit any external switch.

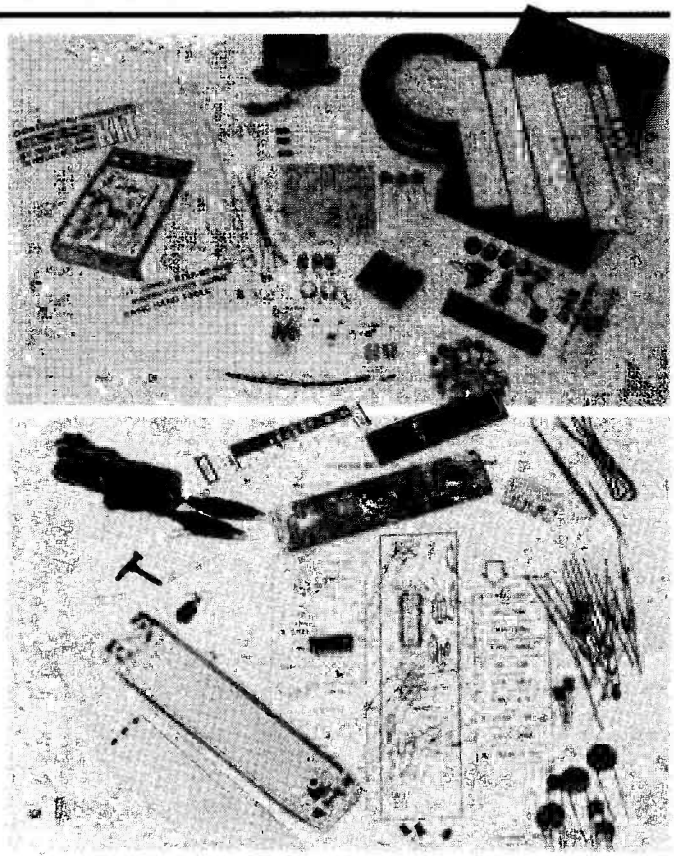
Construction is quite straightforward and the use of the familiar Incar connectors allows the unit to be fitted easily to almost any car.

The later add-on unit allows simultaneous sounding of the horn and flashing of lights and brake lights when the alarm is activated, whilst maintaining complete isolation between these circuits when in normal use.

Both kits are constructed on compact PCBs, housed in attractive, weather resistant plastic cases. A complete kit of parts for the original alarm unit is still available from Compu-Tech for £14.75 (PCBs only – £1.00 each). You can buy a complete kit of parts for the add-on system for £11.95 (siren £7.75 extra and PCBs only £1.00 each). Both kits and siren are available for £29.95 all inclusive (a saving of £4.50).

ETI INDEX 10B

CONTINENTAL SPECIALTIES CORPORATION



Company	Continental Specialties Corporation, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ.		
Kit	Logic Probe Kit LPK–1		
Price	£11.92 + VAT		
Complexity	A		
Circuit Diagram	1		
Contents	3	Finish	3
Instruction Manual	3	Fault-Finding Guide	1

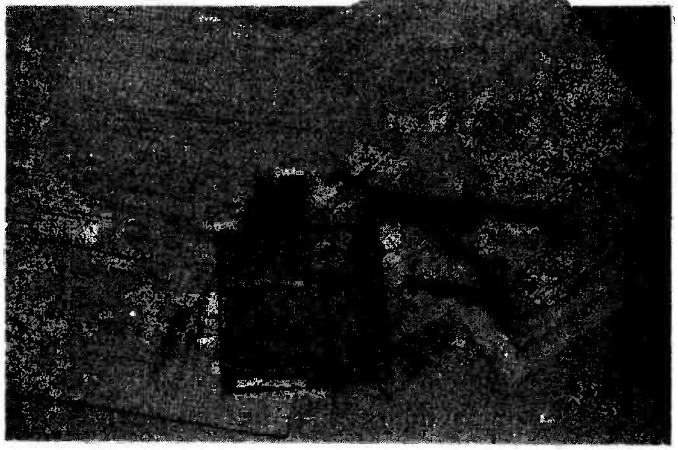
CSC, better known for their Proto-Board and Experimentor Systems, say you can build this full-performance logic probe kit 'in just a few hours of easy assembly'. I think even a newcomer to project building should be able to have a working probe in a lot less than a few hours with the aid of CSC's excellent, step-by-step instruction manual. The most difficult operation is persuading the PCB to fit inside the compact case – so no constructional problems here.

The 203A 'powered' Proto-Board is now also available as a kit (the 230AK) – a sturdy box with a large area of Proto-Board on top and a 5 V at 1 A and separate internally adjustable 7–18 V at 0A5 supplies inside.

The 230AK kit came in handy when I finished my Microtan computer kit. The 5 volt, 1A outlet was the perfect power supply. Then I used my completed logic probe kit to inspect the logic state of the computer chip pins.

ETI INDEX 11A

DIGISOUND



Company	Digisound Ltd, 13 The Brooklands, Wrea Green, Preston, Lancashire PR4 2NQ.		
Kit	24 dB per octave low pass VCF		
Price	£18.08		
Complexity	B	Instruction Manual	3
Circuit Diagram	1	Finish	3
Contents	3	Fault-Finding Guide	0

Digisound sent me a kit from outside the ETI 80 range (the modular synthesiser series which we began in February this year). They sent a 24 dB/octave low pass voltage controlled filter with voltage control of resonance. Coarse and fine pot controls give a range of ±5 octaves and ±1 octave respectively.

With the PCB and component pack you will receive two important pieces of paper. The first gives some general notes on construction with details of Digisound's technical service, should you be unable to get your kit working. The second includes a circuit diagram, component overlay, component lists and more detailed construction, testing and calibration notes. For calibration you'll need a previously calibrated VCO.

Digisound's kits seem to have a lot less paperwork with them than other kits of comparable cost and complexity. However Digisound manage to pack a great deal of useful information into a small space and yet keep it perfectly readable and understandable.

ETI INDEX 10B

ELECTRONIC DESIGN ASSOCIATES

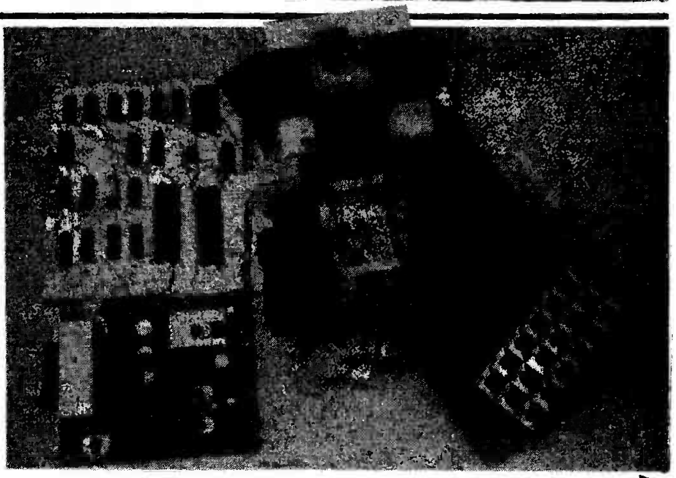
Company	Electronic Design Associates, 82 Bath Street, Walsall WS1 3DE.		
Kit	Sparkrite X5 inductive discharge Electronic Ignition		
Price	£16.95		
Complexity	A	Instruction Manual	3
Circuit Diagram	1	Finish	3
Contents	3	Fault-Finding Guide	1

This spark of genius arrived well packaged with separate component packs. The instructions include a 'how to solder' section and the parts list gives resistor colour codes, so you're not likely to go wrong unless you're colour blind. EDA also operate an after-sales technical advice service, just in case you *do* have any problems. If you're not often under the bonnet of your Rolls, don't worry, fitting instructions are included.

All in all a useful, attractive and easy to build kit. When it's finished you don't have to bolt it on somewhere. It comes complete with clips, so that you can simply push it on to your coil. Connection is then a matter of attaching a few wires to the existing circuitry and you're off. No more cold morning push starts.

ETI INDEX 11A

GP INDUSTRIAL ELECTRONICS



Company	GP Industrial Electronics, Skardon Works, Skardon Place, North Hill, Plymouth PL4 8HA.
Kit	Softy EPROM Programmer
Price	£115 + PSU (£23)
Complexity	C
Circuit Diagram	1
Contents	3
Instruction Manual	1
Finish	3
Fault-Finding Guide	1

Henry Budgett of Computing Today, anxious to put his expert computing knowledge to good use, got cracking on this one (and soon wished he hadn't). He reports that the PCB is double-sided but not plated through, so you have to make some two hundred connections before you can put the first

KIT FINDER

	Acorn Computers	Altek Instruments	Ambit International	Aura Sounds	Cambridge Kits	Catronics	Chromasonic	Chromatronics	Clef Products	Comp Comp Comp	Compu-Tech Systems	C S C	Crofton Electronics	Digisound	Electronic Design Associates	Electro-Tech Components	GJD Electronics
ALARMS											■						■
AMPLIFIERS						■	■										
CASSETTE DECKS																■	
COMPUTING	■									■							
DICE																	
DOLBY																	
DOOR CHIMES								■									
ELECTRONIC IGNITION															■		
GAMES																	
LIGHT SHOW																	
METAL LOCATORS		■															
RADIO CONTROL			■														
SYNTHESISERS				■					■					■			
TELETEXT																	
TEST GEAR			■									■					
TIMERS					■												
TUNERS						■											
TV CAMERA													■				

The addresses of companies who did not supply-kits for the survey, but who are included in the quick index, are shown below. The addresses of companies who did supply kits are shown with the appropriate kit report.

Ambit International,
200 North Service Road,
Brentwood, Essex.

Aura Sounds,
14-15 Royal Oak Centre,
Brighton Road,
Purley, Surrey.

Cambridge Kits,
45 Old School Lane,
Milton,
Cambridge CB4 4BS

Chromatronics,
River Way,
Harlow, Essex.

Comp Comp Comp.,
14 Station Road,
New Barnet,
Herts EN5 1QW

Crofton Electronics Ltd.,
35 Grosvenor Road,
Twickenham,
Middlesex.

Electro-Tech Components Ltd.,
364 Edware Road,
London W2

GMT Electronics,
Freepost,
Birmingham B19 1BR

To use this quick index, decide what sort of kit you want. If you want a Dolby system, for instance, look across the Dolby row until you come to a black hole. The company at the head of that column, Integrex, supplies the kit you want.
Computers of all sorts and their accessories all go by the name of computing in this index, so thumb through the magazine for the company's advertisement to find out exactly what they can supply. Clocks have been included under the heading of timers.

	GMT Electronics	GP Industrial Electronics	Heathkit	Henry's Radio	Integrex	Interface Components	Intracept Electronics	Jayen Developments	Jeremy Lord Synthesisers	LSM Products	Maplin Electronics	Menorcrest	Nascom	New Bear Computing	NIC	Powertran Electronics	Science Of Cambridge	Suretron Systems	Tandy	Tangerine Computers	Technalogics	Technomatic	TK Electronics	Transam	Watford Electronics	William Stuart Systems
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Interface Components Ltd.,
Oakfield Corner,
Sycamore Road,
Amersham,
Bucks. HP6 6SU

LSM Products,
PO Box 51,
Caterham,
Surrey CR3 6UO

Maplin Electronic Supplies Ltd.,
PO Box 3,
Rayleigh,
Essex SS6 8LR

Menorcrest Electronics Ltd.,
1 Hatton Court,
Ipswich, Suffolk.

Nascom Microcomputers Ltd.,
92 Broad Street,
Chesham,
Bucks.

Newbear Components,
40 Bartholomew Street,
Newbury,
Berks.

Science of Cambridge Ltd.,
6 Kings Parade,
Cambridge,
Cambs CB2 1SN

Tandy,
Bilston Road,
Wednesbury,
West Midlands WS10 7JN

Technalogics Ltd.,
8 Egerton Street,
Liverpool L8 7LY

Technomatic Ltd.,
17 Burnley Road,
London NW10

Transam Components Ltd.,
12 Chapel Street,
London NW1

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Telephone: Plymouth (0752) 28627

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Shadow VLF/TR. Full specification discriminator, not just ferrous/nonferrous indication. It works by measuring the conductivity of the target, now you can reject nails bottle caps even aluminium foil and ring pull tabs! Full ground effect exclusion over normal or high permeability soils.
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Complete kit now only £79.70 inc. VAT & post!!
Individual parts: Search head **£21.33** PCB £6.80 Case £5.33 Adjustable shaft assy. £5.10. LM393 £1.12. Manual (gives more info. than ETI article — and extra function) £1.12. **All inc. VAT & post!** (Other parts also available separately)

Shadow TR/1B

Shadow TR/1B (illustrated). A true transmit receive/induction balance detector at a budget price for anyone who doesn't need discrimination. Waterproof and thermally insulated search head. Good sensitivity. Built-in speaker and headset jack. **Complete kit £25 + VAT** (post & Pkg. **£1.80.**

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Matching stereo headphones for all Shadow models £4.90 + VAT (post paid).

Beginners BFO model. A very detailed assembly manual and pre-wound coils make this an ideal first project. Simple high efficiency circuit. Full size (not a toy) but weighs only 300gms (10.5ozs) with battery! FREE STETHOSCOPE HEADSET with every order. **ALT3 kit: £12 + VAT** (post £1.80). Padded high Z headphones **£4.50 + VAT** (post paid).

Shell Kit. Consists of the (hard to find) hardware items, for detectors of your own design. Fully adjustable shaft with handle, search head mouldings (int. diam. 185mm) with hinge assembly, special clips to mount your own control housing (any box is suitable). Completely non-metallic and undrilled. With assembly instructions **£8.25 + VAT** (post £1.50).

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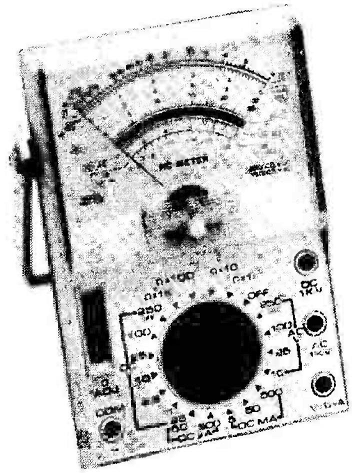
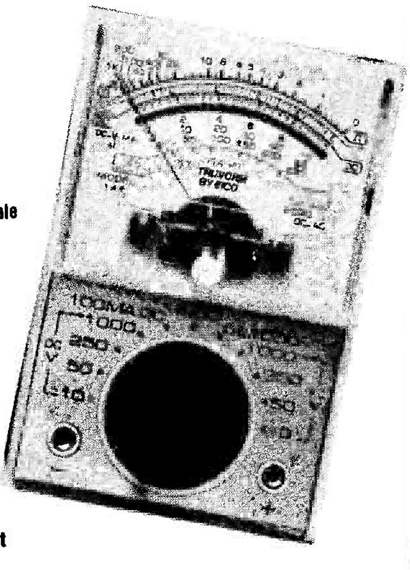


Specification:	Model HM-102	Model HM-101
Voltage	DC: 0.25, 1, 2.5, 10 25, 100, 250, 1000 AC: 10, 25, 100, 250, 1000	DC & AC 10, 50 250, 1000
Sensitivity	DC: 20,000 Ohms/Volt AC: 10,000 Ohms/Volt	2,000 Ohms/Volt
Decibels	–20 to + 20 db	–10 to +22 db
DC Current	50, 500μA 5, 50, 500mA	100mA
Ohmeter	30 Ohms centre scale Four Ranges: 0.6 k.Ohms 0.60 k.Ohms 0.600 k.Ohms 0-6 M.Ohms	60 Ohms centre scale Two ranges: 0-10 k.Ohms 0-1 M.Ohms
Power Supply	Single 1.5V cell	Single 1.5V cell
Size	135 x 91 x 39mm	90 x 60 x 29mm
Weight (incl. battery)	280 gms.	92 gms.
	Mirrored scale Overload protection Carrying handle doubles as bench stand	Mirrored scale



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Also available: Delpak voltage regulators and power supplies, Delpak keypads and keyboards, Futaba keyboard switches, Futaba vacuum fluorescent displays, I.Cs. from OKI; Power amplifiers, filters, stereo image width control, compressor/expander, active crossovers, power supplies, plus all pots, switches, etc.

MAGNUM AUDIO LTD. **Dept. ETI 5, Hazelbury Crescent Luton LU1 1DF. Tel: (0582) 28887**
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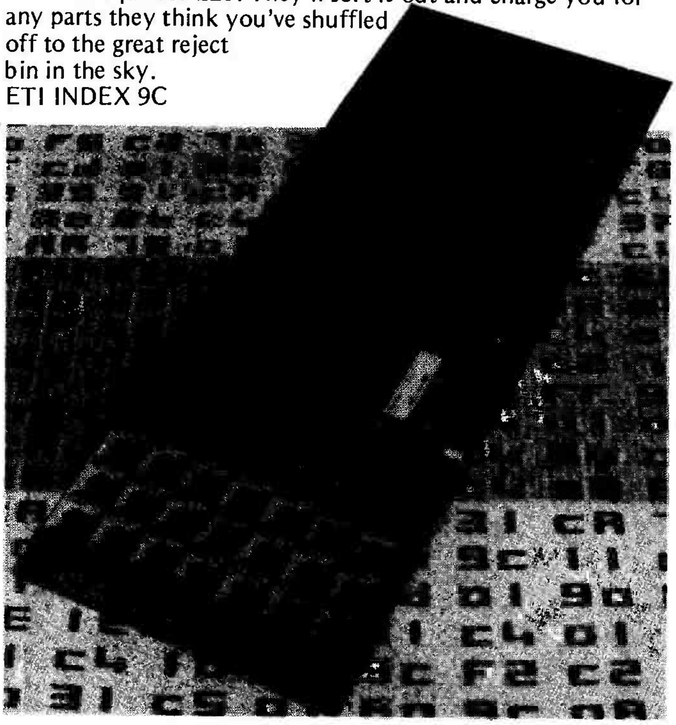
component in. The parts list is incomplete (not listing the modulator or the hardware – nuts, bolts, keys, etc). Constructional notes are almost non-existent. However, a warning is included for the constructor – 'A professional level of understanding is expected and assumed.'

This is definitely *not* a kit for beginners as a thorough knowledge of computer systems is required to build it into your system. At £115 it's a bit pricey, especially if you don't understand what you're doing. If you *do* end up with an expensive book-end, send it back to GP Industrial Electronics with a cheque for £20. They'll sort it out and charge you for any parts they think you've shuffled off to the great reject bin in the sky.
ETI INDEX 9C



HEATHKIT

Company	**Heathkit, Bristol Road, Gloucester GL2 6EE**		
Kit	**Quartz Clock Timer GC–1415**		
Price	**£43.63**		
Complexity	**B**	**Instruction Manual**	**3**
Circuit Diagram	**1**	**Finish**	**3**
Contents	**3**	**Fault-Finding Guide**	**1**

Heathkit's excellent instruction manual greatly simplifies construction of this sophisticated quartz clock/timer, bringing it within the range of ability of more constructors. That makes sound economic sense. The more people who are capable of building the kit, the bigger the potential market.

Although it's not the simplest of kits, Heathkit's manual assumes nothing. It starts from the basics with notes on soldering. The kit is intended for installation in your car (a mounting bracket and adhesive pads are supplied), but, with the addition of a 12 volt DC supply, you have a 12 hour, 4 digit clock with trip-timer and stopwatch functions attractive enough to grace your mantlepiece (at home, not in the car!). If you *are* going to fit it in your car, full fitting instructions are given for negative earth vehicles.

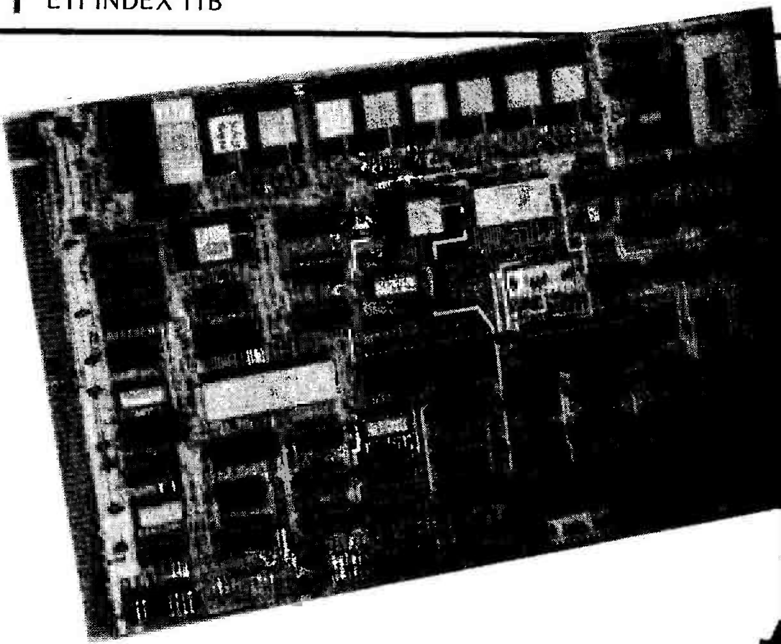
I haven't a great deal to say about this kit – the sign of satisfaction and trouble-free construction, well-known, to be typical of the well-prepared and presented Heathkit products.
ETI INDEX 11B

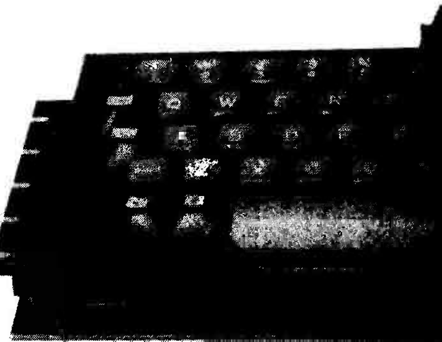
HENRY'S RADIO

Company	**Henry's Radio, Computer Kit Division, 404 Edgware Road, London W2.**
Kit	**Nascom 2**
Price	**£295 + VAT**
Complexity	**C**
Circuit Diagram	**1**
Contents	**2**
Instruction Manual	**3**
Finish	**3**
Fault-Finding Guide	**1**

If you're not already acquainted with Nascom 2 or anything of comparable constructional complexity, opening the boxes of boards and seemingly endless bags of components can be a traumatic experience. There are an awful lot of holes in the PCB that have to have something soldered into them. Where to begin the endurance test?

The manual offers good advice. 'Do *not* begin construction now. Read through all the documentation at least twice.' Construction times can range from under 10 hours to over 40, 30 hours being the average. The manual advises you not to work for more than 2 or 3 hours at a stretch – good advice. It then goes through each stage of construction with diagrams, where necessary. This isn't the sort of kit that you can start on the dining room table and clear the bits away every time dinner, tea, supper, etc come around. That's the easiest way to lose bits and destroy chips. Find a place where everything can lie undisturbed for days at a time. It also helps if you



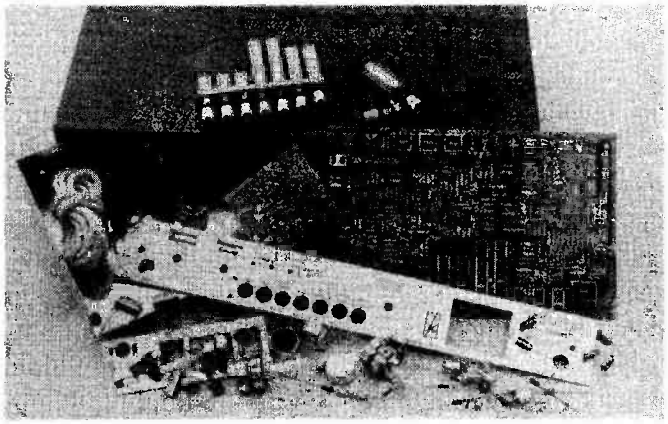


INTEGREX

Company	Integrex Ltd, Portwood Industrial Estate, Church Gresley, Burton On Trent, Staffordshire DE11 9PT.		
Kit	Dolby Noise Reducer		
Price	£50.48		
Complexity	C	Instruction Manual	2
Circuit Diagram	1	Finish	3
Contents	3	Fault-Finding Guide	0

If you bought a cassette deck without Dolby noise reduction and don't feel like trading it for a machine with Dolby, you could build the Integrex Dolby Noise Reducer as a separate unit. Integrex claim that their design is the only 'add-on' Dolby processor kit in the world.

Integrex's preface to the construction notes advises you to check that all the components have been packed and sent in good condition. It may seem obvious, but it's always worth reminding the newcomer to kit-building. The remainder of the instruction leaflet takes the form of a reprint of the magazine article describing the system. One useful feature is the inclusion of a note of the most common constructional errors – collect one bonus point as you pass go in lieu of a point for the absent troubleshooting guide.

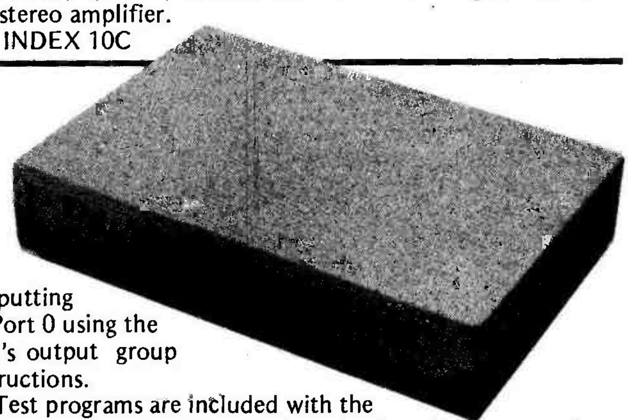


The PCB and components come with all the necessary hardware – an aluminium chassis and an attractive mahogany sleeve. The unit matches other Integrex products in both appearance and electronically, in terms of input/output signal parameters and standardised DIN sockets. So, having built your Dolby system you can then build a matching FM tuner and stereo amplifier.
ETI INDEX 10C

INTRACEPT ELECTRONICS

Company	Intracept Electronics Ltd, 203 Picton Road, Liverpool L15 4LG.		
Kit	Nascom colour graphics board		
Price	£22.50		
Complexity	B	Instruction Manual	2
Circuit Diagram	1	Finish	2
Contents	3	Fault-Finding Guide	0

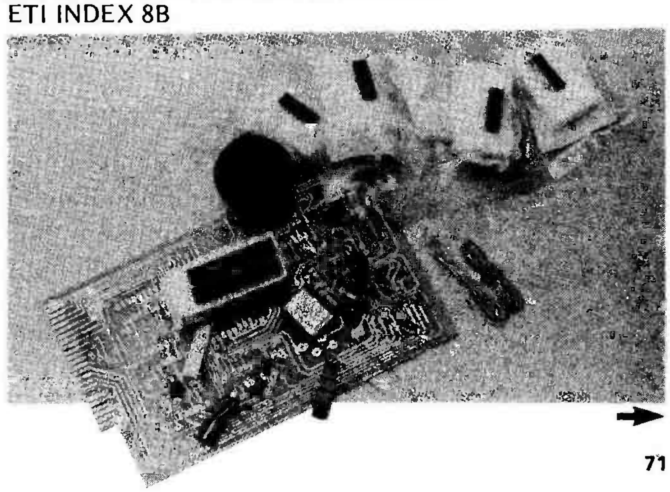
If you already have a Nascom 1 or 2, this kit enables you to produce colour graphics under software control. The background can be set to one of eight colours (including black and white) by altering the contents of address 0C00 or by



outputting to Port 0 using the Z80's output group instructions.

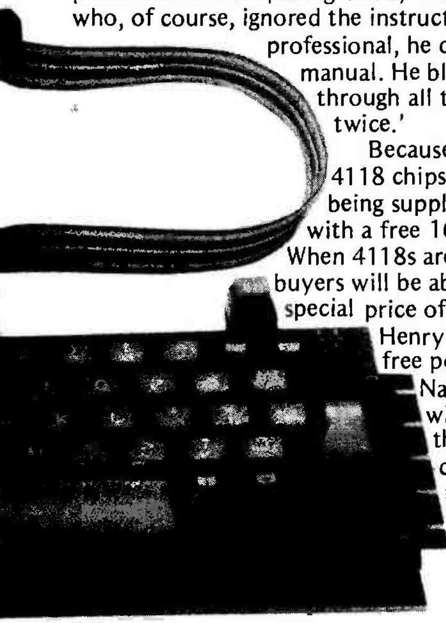
Test programs are included with the instructions to ensure that the board is functioning properly (Nasbug and Nas-Sys versions are supplied).The colour graphics modulator may be used with Nascom 1 or 2 and the appropriate alterations to Nascom's main board in order to use the colour graphics option are given, together with a testing procedure.

Intracept also supply a colour bar generator kit primarily for the field service engineer. It's a useful diagnostic tool for troubleshooting colour telly faults. It can display the standard waveforms and colour bar pattern. From them, if you know what you're doing, you should be able to spot decoder faults (incorrect matrixing, ident, colour balance, demodulator phasing, delay line adjustment, etc.). The five patterns available (blank raster, grey scale, cross-hatch, colour bar and red raster) should enable a service engineer to accurately adjust and service colour television in the home.
ETI INDEX 8B

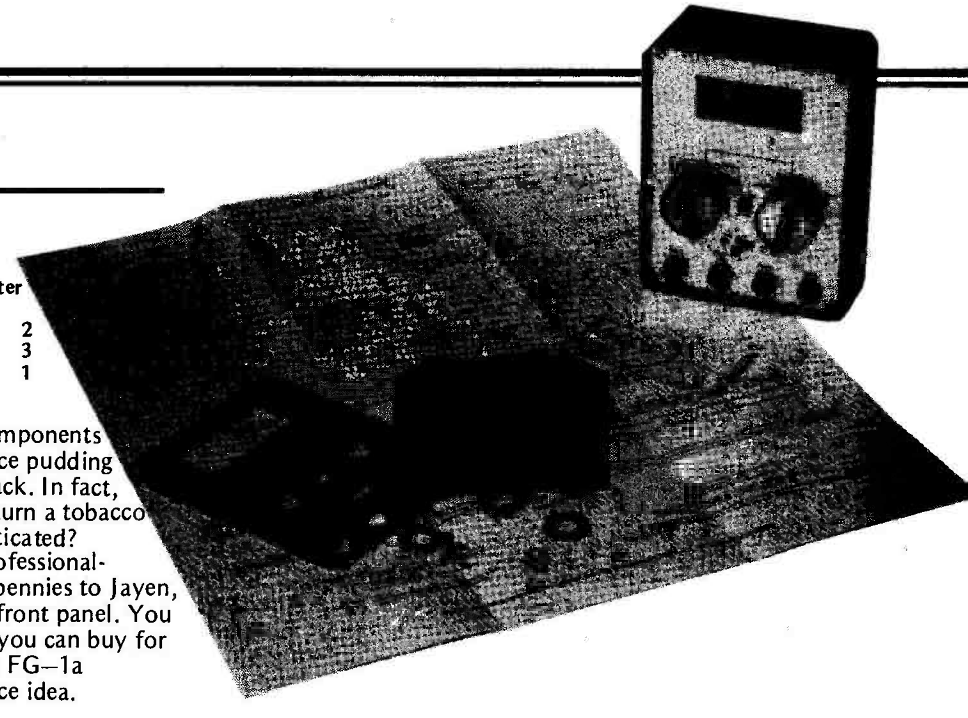


have a high SQ (stamina quotient) or BT (boredom threshold) because there is a lot of intricate soldering to get through before you come to the interesting bit – switching on. The only serious error a careless constructor might make is in the connection of the keyboard to the processor PCB. It is possible to plug the keyboard into the wrong position. Then, at switch-on you find you no longer have a working keyboard. This was drawn to my attention by a recent phone call to Computing Today from an electronics engineer who, of course, ignored the instruction manual. Being a professional, he didn't need to read the manual. He blew up his keyboard. 'Read through all the documentation at least twice.'

Because of the non-availability of 4118 chips, Nascom 2s are currently being supplied without the 4118s, but with a free 16K dynamic RAM board. When 4118s are again available, Nascom 2 buyers will be able to get hold of them at the special price of £80 + VAT for the 8K. Henry's Radio are also offering a free power supply. If you get your Nascom 2 from Nascom, without 4118s and without the 16K RAM board you can expect to pay £225.
ETI INDEX 10C



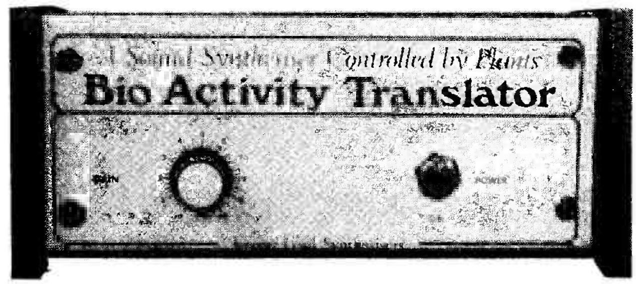
JAYEN DEVELOPMENTS



Company	Jayen Developments, 21 Gladeside, Bar Hill, Cambridge CB3 8DY.		
Kit	Jaykit DM—2DigitalMultimeter		
Price	£5.45		
Complexity	B	Instruction Manual	2
Circuit Diagram	1	Finish	3
Contents	3	Fault-Finding Guide	1

I must confess that the idea of a kit without components struck me as about as useful as a handful of rice pudding for resurfacing the M1. However, I take it all back. In fact, it's not a bad idea at all. What do you need to turn a tobacco tin project into something a shade more sophisticated? You could start with a well-made PCB and a professional-looking front panel. Well, if you send off your pennies to Jayen, that's exactly what they send you — PCB plus front panel. You also get a shopping list for components, which you can buy for £23.75 from an address given by jayen. Jaykit's FG—1a Function Generator is also sold in this form. Nice idea.
ETI INDEX 10B

JEREMY LORD SYNTHESISERS



Company	Jeremy Lord Synthesisers Ltd, 3 Charterhouse, Eltringham Street, London SW18 1TD.
Kit	Bioactivity Translator
Price	£27.35
Complexity	B
Circuit Diagram	1
Contents	3
Instruction Manual	2
Finish	3
Fault-Finding Guide	0

This instrument has been getting a lot of publicity recently in the national Press and on radio. It works on the principle that plants generate minute electrical potentials which the translator can amplify and use to control a synthesiser. The sound output follows the signals from the plant in pitch, rhythm and volume.

In practice, however, the device responds more to movement of the plant. I suspect this has something to do with the design of electrodes used — based loosely around a common or garden hairclip and conductive foam pads. However, the principle is sound and the system works.

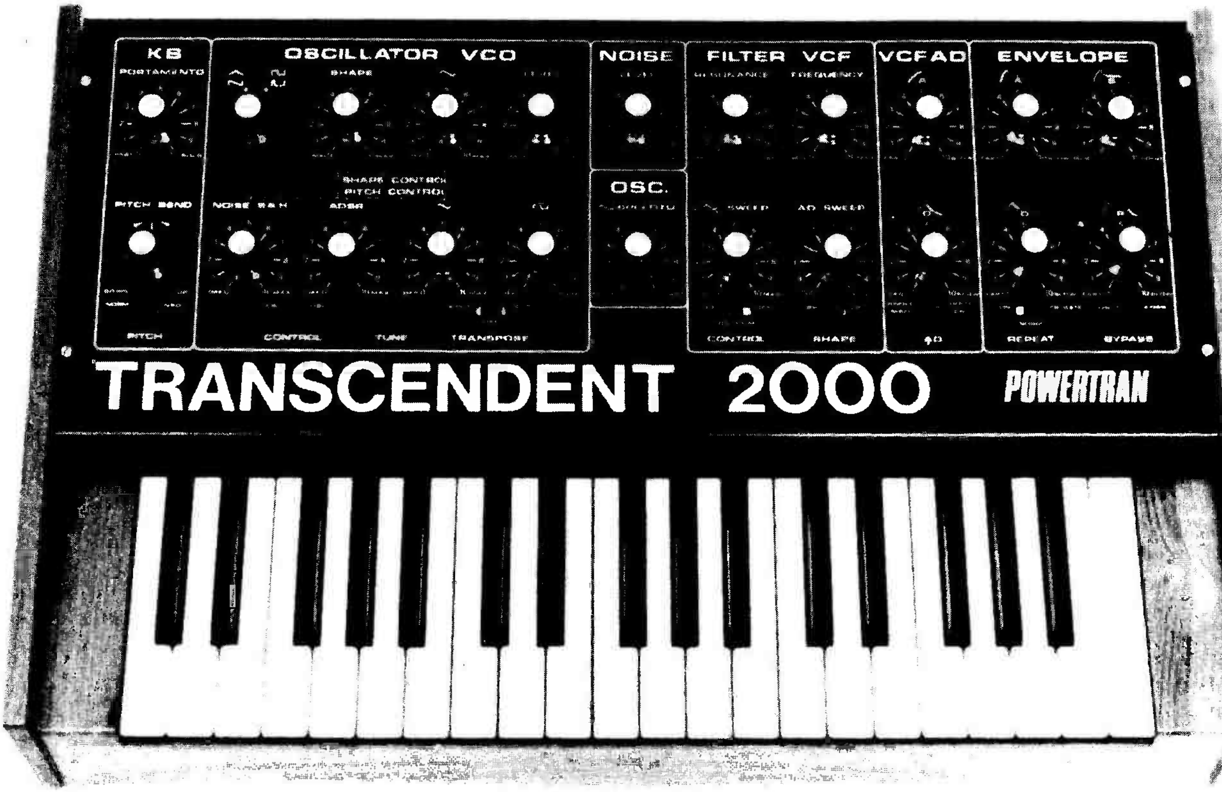
What's it like to build? Construction posed no problems. The PCB fits neatly into the smart teak finish case and a self-adhesive plastic sheet gives the front panel a professional appearance. It's a self-contained unit — you don't have to plug it into your amplifier. Synthesiser, amplifier, controls, batteries and loudspeaker are all housed in a single box.
ETI INDEX 9B

NIC

Company	NIC, 61 Broad Lane, London N15.
Kit	Pinball Wizard
Price	£39.30
Complexity	B
Circuit Diagram	1
Contents	3
Instruction Manual	3
Finish	2
Fault-Finding Guide	0

The Pinball Wizard black and white TV game was featured exclusively in the November 1979 issue of ETI. NIC purchased 500 of the games chip used in this kit. As Pinball Wizard has been selling well, I should get in touch with NIC as soon as possible, to avoid disappointment.

The chip does most of the work, so there are few extra components on the board, simplifying construction. You can buy everything you need from NIC for £39.30, or you could invest in just the basic kit of PCB and components for £28.90. The box and controls are £6.50 extra and the mains adaptor another £3.90.



POWERTRAN ELECTRONICS

Company	Powertran Electronics, Portway Industrial Estate, Andover, Hants SP10 3NM.		
Kit	Transcendent 2000		
Price	£168.50 + VAT		
Complexity	C	Instruction Manual	3
Circuit Diagram	1	Finish	3
Contents	3	Fault-Finding Guide	0

Powertran Electronics sent us a Transcendent 2000 single board synthesiser to have a look at. It's a 3 octave instrument transposable 2 octaves up or down giving an effective 7 octave range. Features include portamento, pitch blending, a VCO with shape and pitch modulation, a VCF with both low and high pass outputs and a separate dynamic sweep control, amongst many, many others.

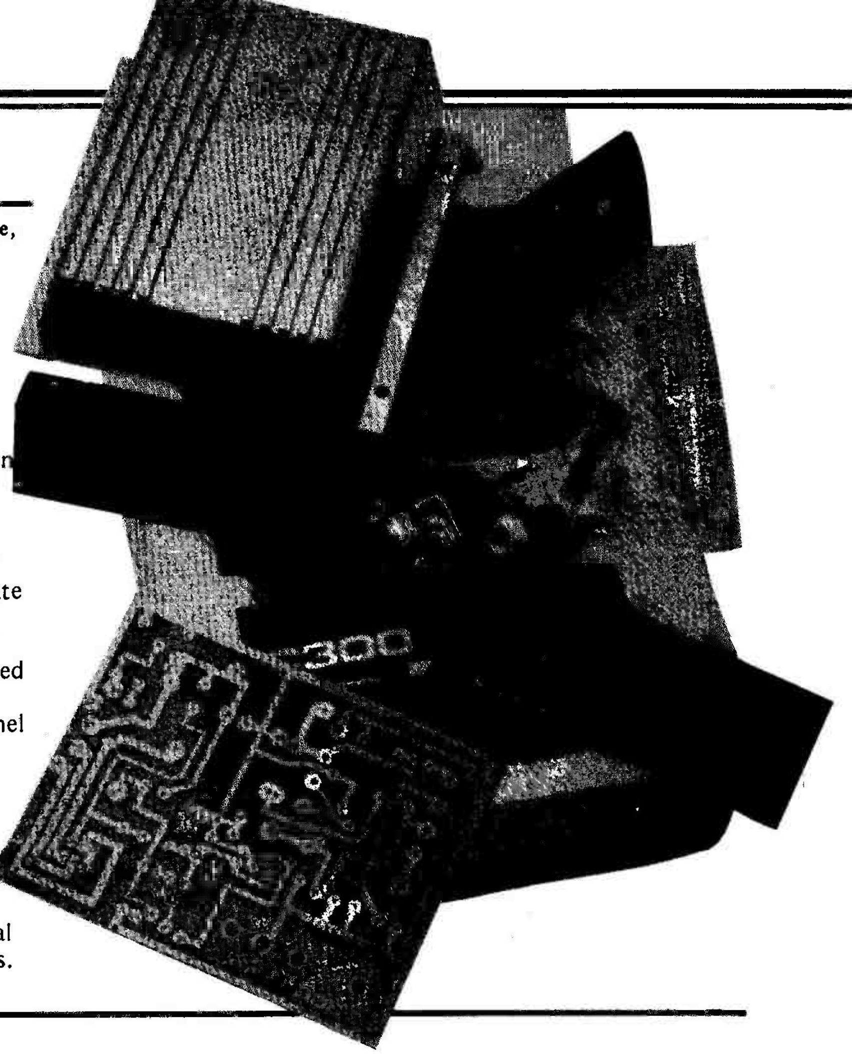
It's definitely not a beginners' kit, although we can't give you a full account of any constructional difficulties, because Powertran wouldn't let us build it. However, I can tell you that the kit comes absolutely complete, right down to the mains plug. The components are separated into 16 packs, each with a separate component listing, greatly facilitating component checking.

ETI INDEX 10C

The game includes pinball, basketball and breakout options, selected by push button. The star was undoubtedly breakout. Everyone here at ETI who borrowed the game became hopelessly addicted to breakout. You find that you have to have just one more game to try to get the maximum score of 864 by demolishing two walls of bricks with seven balls . . . . and then just one more game . . . . and then . . . .

NICs shop is packed with goodies, from a car alarm kit to computer kits (Nascom 2 and the UK101) including the Heathkit H14 Line Printer. Why not pop round for a browse.

ETI INDEX 9B



SURETRON SYSTEMS

Company	Suretron Systems (UK) Ltd, Piccadilly Place, London Road, Bath BA1 6PW.
Kit	Surefire C3000 Electronic Ignition
Price	£17.95
Complexity	A
Circuit Diagram	1
Contents	3
Instruction Manual	2
Finish	3
Fault-Finding Guide	1

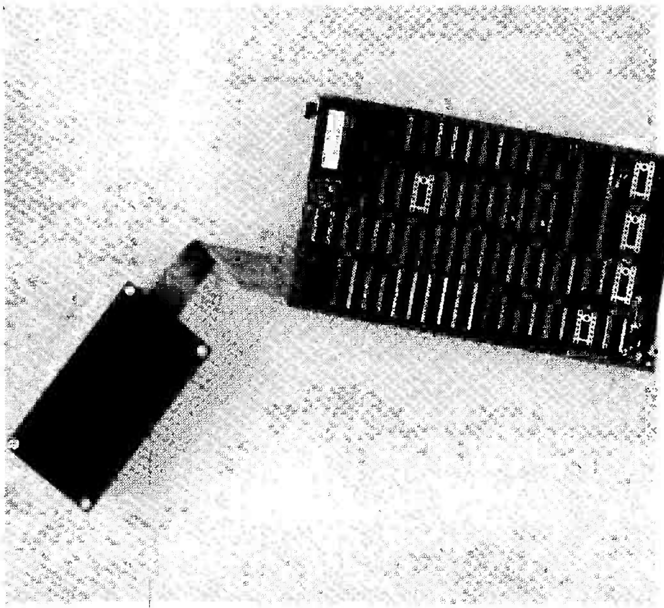
Construction is straightforward — just work your way down the list of assembly instructions. Copious diagrams show how components should be mounted. One group of components must be mounted very close to the PCB as a choke is mounted above them. Be careful how you hold the board when you're trying to persuade the choke pins to locate properly in the holes. When they snap into position, I can assure you that the pointed pins go through fingertips like a hot soldering iron through butter. Although the kit is designed for negative earth vehicles, atlerations are given for positive earth vehicles. When construction is complete Suretron's panel stickers give the kit a professional finish.

Fitting your new space-age electronic ignition system involves drilling a few holes in your precious auto-not-so-mobile. If you follow all the instructions, but the little box still suffers rejection problems from your motor, a flick of a switch returns the engine to conventional ignition operation until you can sort out the trouble.

If problems persist Suretron operate a telephone technical service or you can return the unit to them for fault diagnosis.
ETI INDEX 10A

TANGERINE COMPUTERS

Company	Tangerine Computers, Forehill, Ely, Cambs.
Kit	Microtan 65
Price	£69 + VAT
Complexity	C
Circuit Diagram	0
Contents	3
Instruction Manual	3
Finish	3
Fault-Finding Guide	0



The arrival of this kit on my cluttered desk made a little bit of history at ETI. It kindled in my well-thumbed grey cells something approaching enthusiasm for computing — something which I had previously thought impossible. I grasped Microtan in both hands and made for the wilds of Staines. The kit is presented in the form of a ring binder. Open the first page and there is your basic kit. Free the PCB from its cling-film and underneath it you find the components, neatly laid out on double sided tape, making component checking as easy as falling off a soldering iron. Construction shouldn't pose any problems, as it's just a matter of identifying the component and plugging it into the position marked on the PCB. I reckon if I, with no past experience of computing, or computer kits, can build this kit and have it working in an evening of not very arduous soldering, then anyone can. Mind you, before I started, I equipped myself with a fine tipped iron and very fine solder.

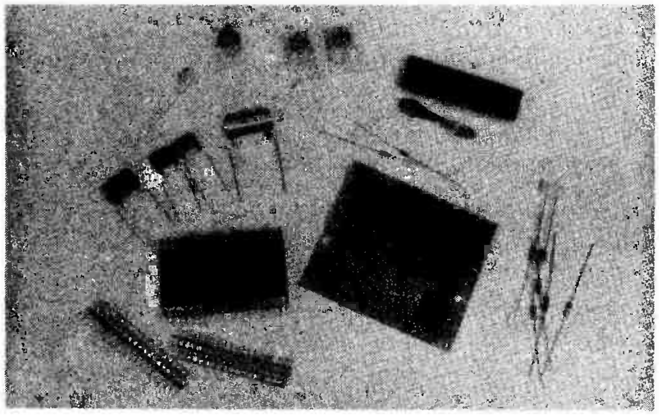
Once it's working you can plug in extra ICs to give lower case and graphics options. If you find hexadecimal machine code as baffling as I do, you can add an expansion unit (TANEX) and a BASIC interpreter, so that you can talk to the machine through an ASCII keyboard in something resembling English. The excellent manual, also included in the ring binder, gives a few sample programs. Within hours of getting my hands on this kit, I was blissfully blasting marauding aircraft out of the sky with my telly-bound missile.

I've quite arbitrarily given this kit a bonus of five on the ETI INDEX for getting just about everything right and providing excellent value for money. I'd recommend Microtan 65 to anyone with a modicum of soldering experience and an interest in computing.
ETI INDEX 14C

TK ELECTRONICS

Company	TK Electronics, 106 Studley Grange Road, London W7 2LX.		
Kit	DVM/Thermometer		
Price	£20.75 + VAT		
Complexity	B	Instruction Manual	2
Circuit Diagram	1	Finish	2
Contents	3	Fault-Finding Guide	0

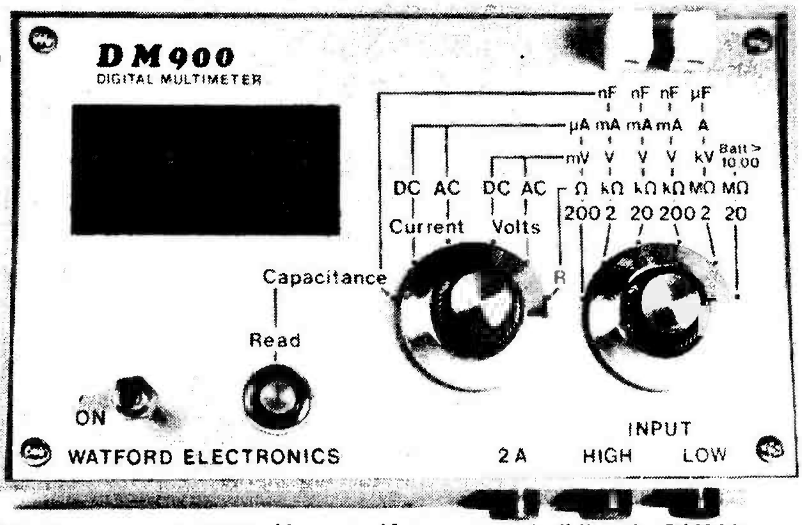
This kit was featured as a Kit Review subject in Hobby Electronics (October 1979). HE built the digital thermometer version. When you've decided which version of the kit you want to construct you have to build a decimal point driver. Three circuits are suggested — two give a fixed DP and the third a floating point. The thermometer uses a fixed DP. No provision is made for the DP driver on the board and its components are not included with the kit, but this shouldn't cause any problems, especially if you have the typical constructors' junk box of components.



The diode sensor proved to be reliable and the thermometer appeared to be sensitive to temperature changes
ETI INDEX 8B

WATFORD ELECTRONICS

Company	Watford Electronics, 33–35 Cardiff Road, Watford, Herts.		
Kit	DM 900 Digital Multimeter		
Price	£60 + VAT		
Complexity	C	Instruction Manual	2
Circuit Diagram	1	Finish	3
Contents	2	Fault-Finding Guide	1



I hope you know your colour code for resistor tolerances. Watford's DM 900 kit uses 1, 2 and 5 per cent resistors and there's no explanation of the coding in the instructions. The only minor irritation to mar this otherwise well presented kit was that the complement of 64 single-ended Vero pins was about thirty short. The PCB, although double-sided, does not have plated through holes. So, links between the top and under side of the board are made by Vero pins,

Construction is fairly straightforward, being a matter of finding a component on the parts list and soldering it into the correct position marked on the PCB. You'll have to drill the plastic case to take the three test sockets, although the front control panel comes ready drilled and with the meter scales marked.

You can buy the kit assembly instructions separately for £1.00 (free with kit) if you have an alternative supply of components. However, if you are not building the DM900 from Watford's kit, don't skimp on components to save a few pence. Get the best. You can't expect to make an accurate meter if you use, for instance 10% or even 5% resistors throughout.
ETI INDEX 9C

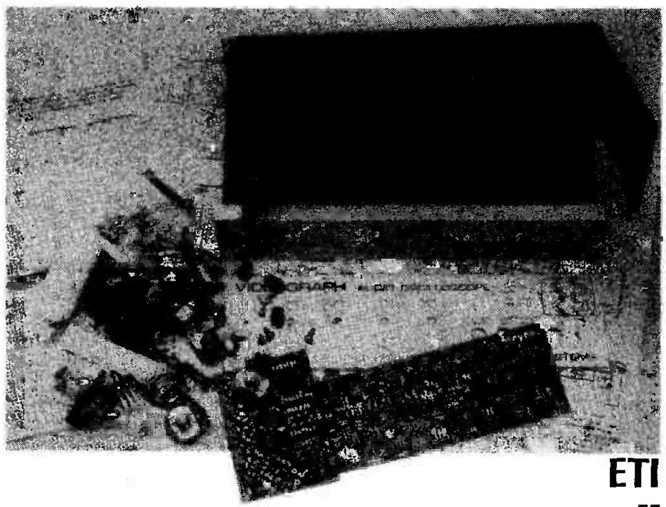
WILLIAM STUART SYSTEMS

Company	William Stuart Systems, 137 Billericay Road, Herongate, Brentwood, Essex.		
Kit	Videograph		
Price	£26.95 + cabinet and controls £12.95		
Complexity	B	Instruction Manual	3
Circuit Diagram	1	Finish	3
Contents	3	Fault-Finding Guide	1

If you want to buy a Christmas present for your hi-fi system, this luxury box of tricks is a bit out of the ordinary. It actually displays sound waves in colour on any normal television set. Left and right hand channels are shown in contrasting colours. Press a button to invert one channel. Peak signals make the background cycle through eight colours.

The Videograph also has a test signal generator. You can record the clean square wave on your cassette recorder, playback the signal through Videograph and actually see the distortion introduced by your system. You can actually see the flutter, wow, low frequency and transient response of your recorder, amplifier, etc.

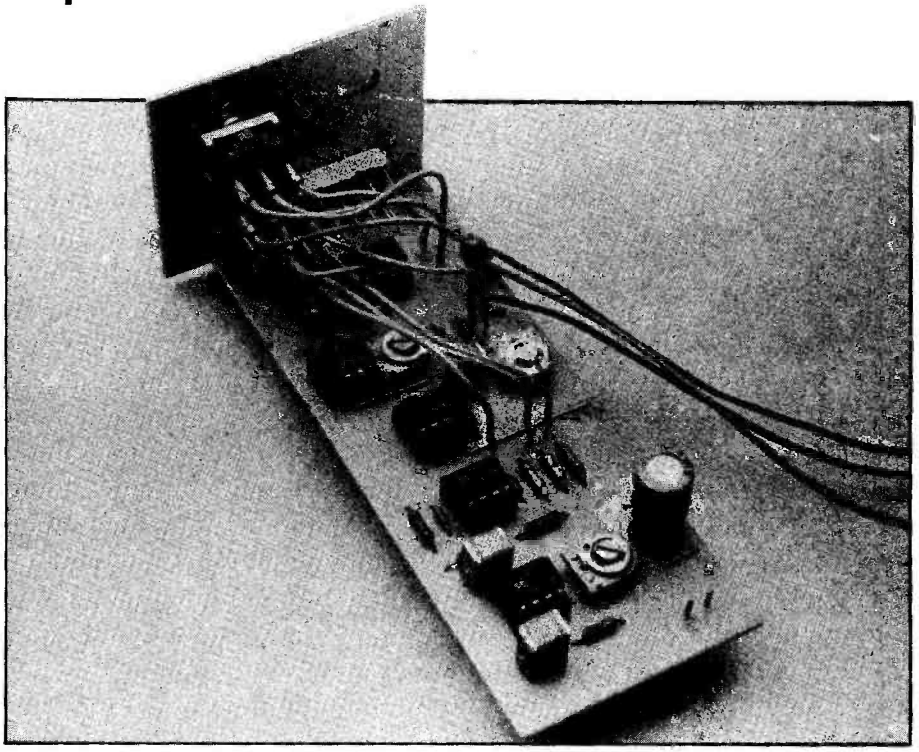
Construction is a matter of plugging components into two well-marked PCBs according to the clear instruction sheets. The chassis is pre-drilled with an attractive front panel. William Stuart Systems offer a repair service if things go drastically wrong.
ETI INDEX 11B



LED VU METER

An excellent way to watch what goes on in those secretive screened leads. Can be adapted to various levels of operation.

This unit will not replace the conventional VU or PPM meter; no LED display could fulfill the spec. However, with an output in 3 dB steps and a choice of a dot or bar display, it will make a useful and attractive addition to any audio system.



5 Into 1 = 10

With the log function achieved directly inside IC5, the use of four separate opamps to condition the signal may seem extravagant. However, the circuit design precludes the use of a conventional quad op amp package like the 324 and the final circuit exploits the good, all-round, economical performance of the 741s and the extremely high input impedance of the 3140s. The display consists of ten LEDs and these can be illuminated in a dot or bar format. Selection is by a SPDT switch, or a wire link may be permanently connected. Sensitivity of the unit is high. The gain of the first amplifier stage is adjustable and a full scale reading can be obtained with an output of just a few millivolts.

To keep down cost and avoid complex circuitry, a half-wave rectifier has been used. The meter has switchable resistors giving a peak programme response with fast attack and slow decay and a volume unit reponse with slower approximately equal respnse times. The response characteristics for each mode may easily be changed by selection of a few resistors and have little interaction with each other.

Construction And Setting Up

Use of our PCB makes construction simplicity itself and results in quite a compact and attractive unit. The PCB has been designed to accommodate stackable rectangular LEDs as shown in our photos. However, any type and colour of LEDs may be used. There are only four wire links to be inserted and the remaining components may be inserted as they come to hand. It is good practice to leave the semiconductors until last and use of sockets for the ICs makes substitution for fault-finding easy. Although ICs 3 and 4 feature FET input stages, these are well protected and no special handling precautions are required.

When completed, the unit may be set up by short-circuiting the input and, with a DC-coupled 'scope or sensitive voltmeter connected to the output (pin 6) of IC4, adjusting RV2 until the output reaches 0 V. Then apply the maximum signal you wish to indicate and with the unit set to VU adjust RV1 for a full scale reading. Now switch to PPM and adjust RV3 until a full scale reading is just obtained. The unit will cover a wide range of input levels, though for very high input signal levels you may have to attenuate the driving signal. A simple resistive divider will easily accomplish this. Do yourself a favour and have a peak at better VU today.

BUYLINES

The 3915 is available from Technomatic. Stackable rectangular LEDs are available from Watford Electronics. The other components should be readily obtainable.

PARTS LIST

RESISTORS All ¼W, 5%	
R1,10	100k
R2,3,4	10k
R5	2k2
R6	10M
R7,9	2M
R8	47k
R11	1k0
POTENTIOMETERS	
RV1	10k min horiz. preset
RV2,3	100k min horiz. preset
CAPACITORS	
C1,2	470n polycarbonate
C3	100u electrolytic
C4	100n polycarbonate
C5,6	10u tantalum
SEMICONDUCTORS	
IC1,2	741
IC3,4	3140
IC5	LM3915
D1,2	1N4148
LEDs	any LED
MISCELLANEOUS	
PCB, DPDT switch, SPDT switch, connectors, etc.	

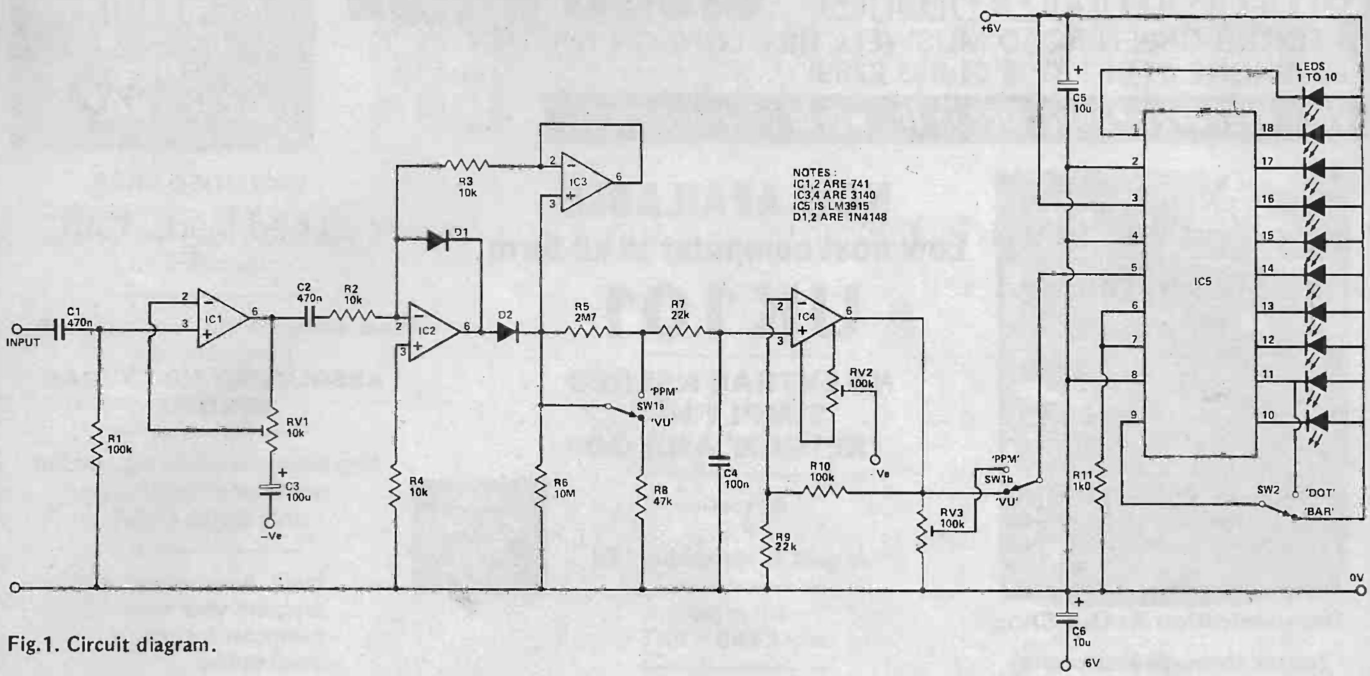


Fig.1. Circuit diagram.

HOW IT WORKS

The circuit consists of an AC amplifier driving a half-wave rectifier whose output charges a capacitor via a switched resistor network. The charge on the capacitor is then amplified and drives the bargraph chip either directly or via a potentiometer.

The signal is input via C1 to the non-inverting input of IC1. Resistor R1 provides DC bias for IC1, which is connected as a variable gain AC-coupled amplifier. This arrangement avoids offset problems when the gain is increased which would severely limit the usefulness of the stage.

The output of IC1 drives the half-wave rectifier built around IC2. The circuitry here follows fairly conventional lines except for the inclusion of IC3 in the feedback loop. Use of this BIFET chip with its negigible input current enables high values of resistance and a low value (100n) of storage capacitance to be used with the consequent advantage of a relatively low current drive producing a high rate of voltage change. Without IC3 in circuit and with SW1a in the 'PPM' position, C4 would charge quickly via R7 but would discharge almost as fast through R7 and R3. In the final circuit, the charge path is via R7, but the discharge path is via R7 and R6, giving a fast attack and slow decay time. Diode D1 acts as a clamp for a positive input and prevents IC2 from going into saturation. In the 'VU' mode, C4 charges via R5 and R7 and discharges through R5, 7, 6, 8. The ratios of these resistors produce almost equal attack and decay times.

As any load on C4 would interfere with the time constant of the RC network, another BIFET op-amp is used as a non-inverting amplifier with a gain of about five. Offset adjustment is provided for this stage with RV2, enabling the output to be accurately zeroed. Owing to the greater insertion loss of the RC network in the 'VU' mode, RV3 is included so that a full scale reading can be obtained for the same overall input level in both modes.

The bargraph chip IC5 handles the display. The input signal from SW1b is applied to pin 5, about 1V2 gives a full scale reading. The internal resistor chain gives an output in 3 dB steps; the ten LEDs providing a 30 dB range, a ratio of 32:1. No attempt has been made to 'tailor' the response of this chip as the LM3916 with an internally set VU response should be available in the future. It will probably be a pin for pin, plug-in replacement. Current through the LEDs is set at about 10 mA by R11 and capacitors C5, 6 provide decoupling.

A power supply of plus and minus six volts is recommended. A lower voltage may restrict the output swing of IC4 making a full scale reading unobtainable in the 'PPM' mode. Too high a positive supply may result in destruction of IC5 through excessive dissipation. Absolute maximum dissipation for this chip is 660 mW. If you use a positive supply greater than 6 V then the LEDs should be returned to the positive supply via a dropper resistor or a zener diode. IC5 produces either a 'dot' or 'bar' display depending on the connection of pin 9 to pin 11 or to the positive supply. Although SW2 is shown on the circuit diagram, the connection may be made permanently with a wire link.

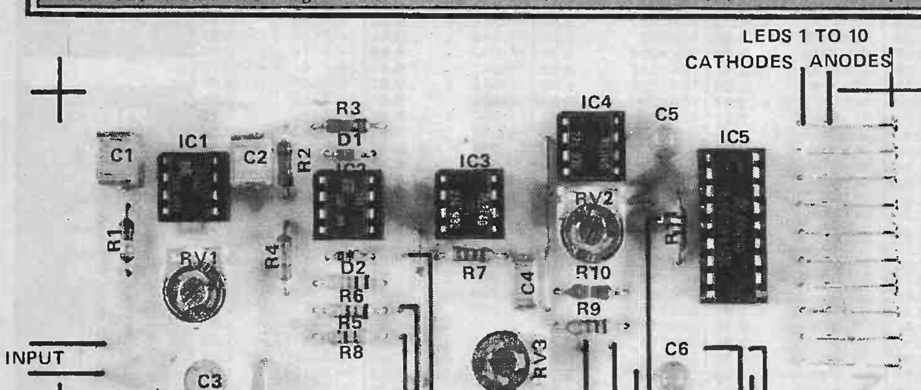
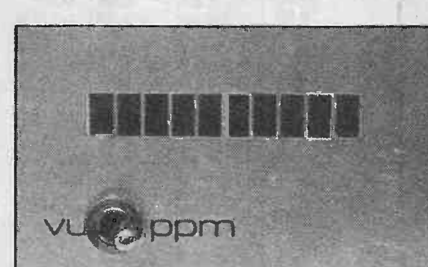


Fig.2. Component overlay. The rectangular LEDs are all mounted along the right edge of the board.



Use of stackable LEDs makes for an attractive panel layout.

ETI

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74LS28	0.18
74LS30	0.18
74LS32	0.26
74LS33	0.26
74LS37	0.23
74LS38	0.23
74LS40	0.18
74LS42	0.65
74LS47	0.81
74LS48	0.81
74LS49	0.81
74LS51	0.18
74LS54	0.18
74LS55	0.18
74LS73	0.33
74LS74	0.30
74LS75	0.40
74LS76	0.27
74LS78	0.27
74LS83	0.78
74LS85	0.81
74LS86	0.27
74LS90	0.57
74LS91	0.97
74LS92	0.69
74LS93	0.60
74LS95	0.81
74LS96	1.16
74LS107	0.32
74LS109	0.32
74LS112	0.32
74LS113	0.32
74LS114	0.32
74LS122	0.69
74LS123	0.72
74LS124	1.39
74LS125	0.36
74LS126	0.36
74LS132	0.60
74LS133	0.39
74LS136	0.36
74LS138	0.65
74LS139	0.65
74LS145	0.97
74LS151	0.81
74LS153	0.52
74LS154	1.30
74LS155	0.72
74LS156	0.72
74LS157	0.57
74LS158	0.57
74LS160	1.09
74LS161	0.69
74LS162	1.16
74LS163	0.69
74LS164	1.06
74LS165	0.72
74LS166	1.65
74LS168	1.71
74LS169	1.71
74LS170	1.72
74LS173	0.81
74LS174	0.97
74LS175	0.97
74LS181	2.77
74LS188	0.44
74LS189	2.08
74LS190	0.86
74LS191	0.86
74LS192	1.04
74LS193	1.04
74LS194	0.86
74LS195	0.97
74LS196	0.97
74LS197	0.97
74LS221	0.92
74LS240	2.08
74LS241	2.08
74LS242	2.08
74LS243	2.08
74LS245	2.50
74LS247	1.09
74LS248	1.09
74LS249	1.09
74LS251	0.96
74LS253	0.92
74LS257	0.92
74LS258	0.92
74LS259	1.39
74LS261	4.50
74LS266	0.37
74LS273	1.70
74LS279	0.57
74LS283	1.09
74LS289	4.50
74LS290	0.91
74LS293	0.91
74LS295	1.30
74LS298	1.16
74LS348	1.39
74LS352	1.04
74LS353	0.92
74LS362	4.21
74LS365	0.47
74LS366	0.47
74LS367	0.47
74LS368	0.47
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74LS393	0.84
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74LS670	1.71

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DESIGNER'S NOTEBOOK

Ray Marston devotes this month's 'Notebook' to an in-depth look at the Siemens IR60 system that forms the basis of the infra-red remote control system described in this issue.

The infra-red remote control project is based on the Siemens IR60 system that is copiously described in Siemens data books and applications notes. Now, the uninitiated amongst you might think that the ETI design team deserves absolutely no credit for merely converting an application note into a real-life project. Those professional design engineers amongst you who are familiar with so-called 'Applications Notes' may, however, well feel otherwise. Let me explain.

Application Notes

One of the most important lessons that the aspiring design engineer must learn is that manufacturer's data and application notes must **never** be regarded as sources of pure facts. In reality, they are simply propaganda sheets that are designed, within legal constraints, to help boost the sales of the manufacturer's products. They are designed to emphasise the good feratures of the product byt play down or ignore its deficiencies.

Data/application sheets vary considerably in quality from one manufacturer to another. One of the major American companies, for example, produces notes with excellent descriptive texts, but 30% of their application circuits don't (and could never) work. Japanese notes come in pidgin English interspersed with Croatian technical terms.

The upshot of all this is that when we tried to use the Siemens IR60 system we first had to spend three days decyphering the text and then spent another six days (literally) debugging the system. Still, enough of this waffle: The IR60 system is very good, so let's look at it.

The IR60 System

IR60 is a sophisticated infra-red remote control system that is capable of handling sixty code instructions (in practice 30 of these instructions are not decoded by the system's receiver but are read out on a serial interface, from which they can be fed to auxilliary decoder circuitry). The system is designed around two 18-pin P-MOS LSI packages and has exceptionally high immunity to false operation through noise, etc. The manufacturer claims system operating ranges of 30 - 40 metres. The receiver has three analogue outputs, one 4-bit (16 channel) binary output, three single-bit outputs and a serial interface for additional versatility.

The system is specifically designed to give remote control of modern TV sets but can in practice be used to control a whole range of domestic and industrial devices. The infra-red remote control system featured in this month's issue of ETI is based on the IR60 system, but uses only 16 of the 60 available instructions and has an effective range of only (!) 15 metres.

INST NO.	KEY CODE	SERIAL CODE FED CBA	FUNCTION	RECEIVER OUTPUT ACTION
0	1a	000 000	NORMAL POSITION/ON.	Volume sets to 1/3, Analogue 1 and 2 set to ½. RLA on.
1	1b	001	QUICKTONE	Volume reduces rapidly to zero.
2	1c	010	STANDBY	Turns RLA off.
3	1d	011	RESERVE 1	Switches RSV1 output between high and low states on alternate operations.
4	2a	100	PROGRAM STEP +/ON	Increments binary channel-select output by one step per operation: Turns RLA on.
5	2b	101	PROGRAM STEP –/ON	Decrements binary channel-select output by one step per operation: turns RLA on.
6	2c	110	ON	Turns RLA on.
7	2d	111	RESERVE 2 / ON	Switches RSV2 output between high and low states on alternate operations: Turns RLA on.
8	3a	001 000	—	Not evaluated by SAB3209 receiver, but read out at serial interface.
9	3b	001	—	
10	3c	010	—	
11	3d	011	—	
12	4a	100	—	
13	4b	101	—	
14	4c	110	—	
15	4d	111	—	
16	5a	010 000	CHANNEL 1 / ON	Sets binary output to 0000: Turns RLA on.
17	5b	001	CHANNEL 2 / ON	Sets binary output to 0001: Turns RLA on.
18	5c	010	CHANNEL 3 / ON	Sets binary output to 0010: Turns RLA on.
19	5d	011	CHANNEL 4 / ON	Sets binary output to 0011: Turns RLA on.
20	6a	100	CHANNEL 5 / ON	Sets binary output to 0100: Turns RLA on.
21	6b	101	CHANNEL 6 / ON	Sets binary output to 0101: Turns RLA on.
22	6c	110	CHANNEL 7 / ON	Sets binary output to 0110: Turns RLA on.
23	6d	111	CHANNEL 8 / ON	Sets binary output to 0111: Turns RLA on.
24	7a	011 000	CHANNEL 9 / ON	Sets binary output to 1000: Turns RLA on.
25	7b	001	CHANNEL 10 / ON	Sets binary output to 1001: Turns RLA on.
26	7c	010	CHANNEL 11 / ON	Sets binary output to 1010: Turns RLA on.
27	7d	011	CHANNEL 12 / ON	Sets binary output to 1011: Turns RLA on.
28	8a	100	CHANNEL 13 / ON	Sets binary output to 1100: Turns RLA on.
29	8b	101	CHANNEL 14 / ON	Sets binary output to 1101: Turns RLA on.
30	8c	110	CHANNEL 15 / ON	Sets binary output to 1110: Turns RLA on.
31	8d	111	CHANNEL 16 / ON	Sets binary output to 1111: Turns RLA on.

Table 1. Relationships between transmitter key codes and receiver actions on basic instructions.

The essence of the action is that the SAB 3210 transmitter chip receives input 'instructions' via an 8-row (1 to 8) by 4-column (a to d) matrix that can be activated by key switches. Each key can thus be allocated an instruction number, which in turn is related to a key code number (2d, 8a, etc). Whenever a key is operated the IC detects the action and generates a start-bit plus 6-bit serial code word which is transmitted to the receiver via the infra-red link, where the word may or may not be decoded may or may not cause some useful action to be performed.

The transmitter can produce 32 basic code words using 1-row/1-column key combinations, plus another 32 extension words

INST NO.	KEY CODE	SERIAL CODE FED CBA	FUNCTION	RECEIVER OUTPUT ACTION
32	81a	100 000	–	
33	81b	001		
34	81c	010	–	
35	81d	011	–	Not evaluated by SAB3209 receiver, but
36	82a	100	–	read at serial interface.
37	82b	101	–	
38	82c	110		
39	82d	111	–	
40	83a	101 000	VOLUME +	Increases volume output level.
41	83b	001	VOLUME –	Decreases volume output level.
42	83c	010	ANALOGUE 1 +	Increases analogue 1 output level.
43	83d	011	ANALOGUE 1 –	Decreases analogue 1 output level.
44	84a	100	ANALOGUE 2 +	Increases analogue 2 output level.
45	84b	101	ANALOGUE 2 –	Decreases analogue 2 output level.
46	84c	110	ANALOGUE 3 +	Not evaluated by SAB3209 receiver,
47	84d	111	ANALOGUE 3 –	but available on SAB4209 receiver.
48	85a	110 000		
49	85b	001	–	
50	85c	010		
51	85d	011		
52	86a	100	–	
53	86b	101	–	Not evaluated by SAB3209 receiver, but
54	86c	110	–	read out at serial interface.
55	86d	111	–	
56	87a	111 000	–	
57	87b	001	–	
58	87c	010	–	
59	87d	011	–	
60	–	100	–	Not used.
61	–	101	–	Not used.
62	–	110	–	END instruction.
63	–	111	–	Not permitted, due to ambiguity in biphase code.

Table 2. Relationships between transmitter key codes and receiver actions on Extension instructions.

when using a 2-row/1-column key combinations in which '8' always forms one of the two rows. For the benefit of those readers who may wish to modify the ETI system, the relationships between instruction numbers, key codes, transmitter codes and receiver output functions are shown in Table 1 for the basic codes and in Table 2 for the Extension codes.

Transmitter Connections

The method of connecting keys to the SAB 3210 for the 32 basic codes is quite straightforward, as shown in the manufacturer's basic application circuit of Fig. 1. Use of the extension instructions calls for a slightly more complex approach, with pairs of diodes connecting row-8 and one other row to one ofthe four columns so that actuation of a key connects two rows to one column. Fig. 2 shows the manufacturer's diagram for making a 60 key matrix, using both basic and extension connections.

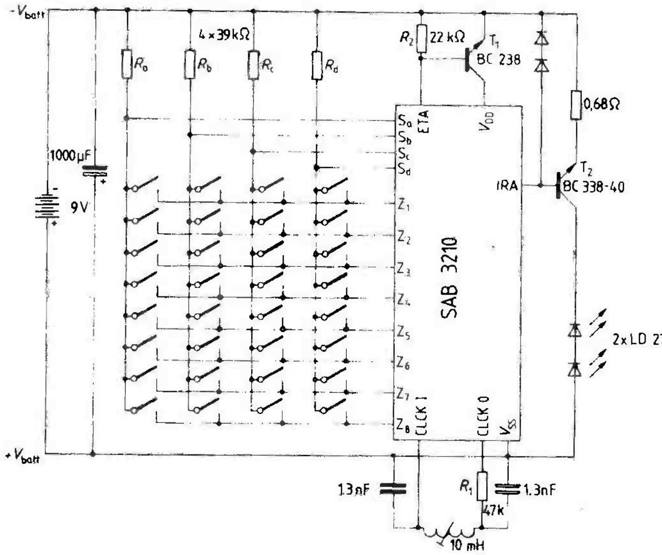

Fig.1. Manufacturer's application circuit, showing method of connecting keys for the 32 basic codes.

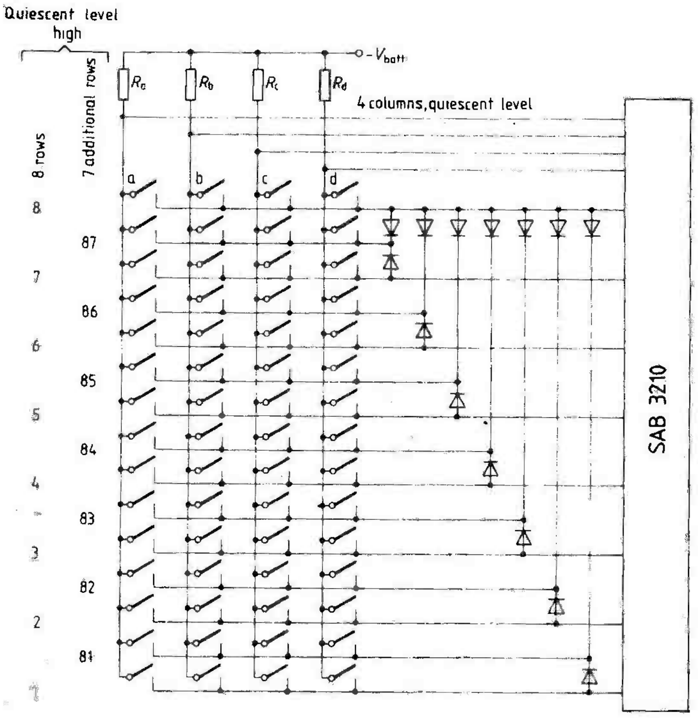

Fig.2. Manufacturer's diagram showing connections for a 60-key matrix using both basic and extension instructions.

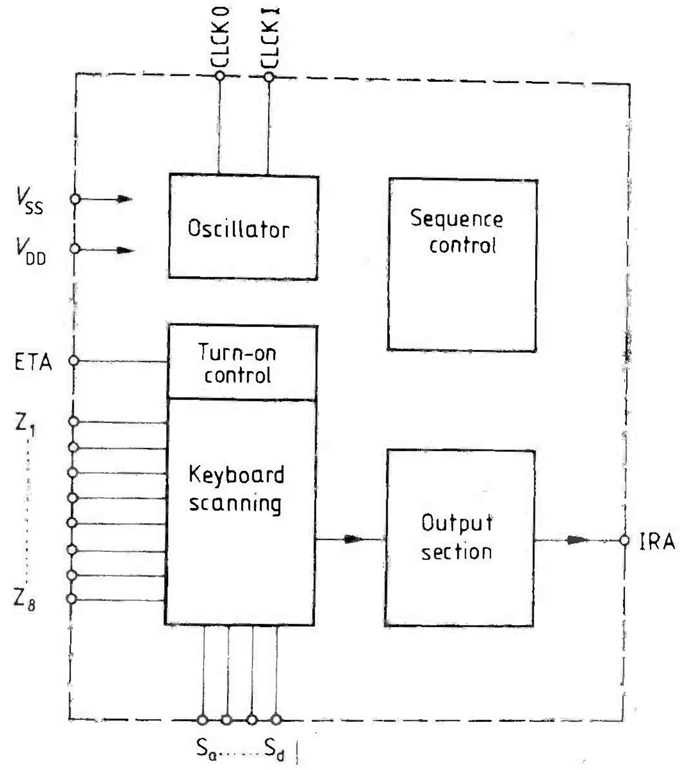

Fig.3. Block diagram (left) and pin notations (right) of the SAB3210 transmitter IC.

Fig. 3 shows the pin connections and the simplified block diagram of the SAB 3210 IC, which incorporates (amongst other things) a keyboard scanner circuit. When we were developing our prototype unit on Microdeck we found that the deck's intercapacitance between pin 16 (the '8' row) and ground caused the scanner to 'see' the '8' row as a closed switch whenever the transmitter was activated, thus causing the incorrect code to be transmitted when basic operation was required (it took us two days to discover the cause of the incorrect operation). We overcame this bug by trying pin 16 of the IC high with a 220k resistor: for good measure, we tied pins 11 and 12 (rows 3and 4) high as well.

One reason it took us so long to trace this fault was, because of the unusual nature of the Biphase serial code sent out by the transmitter. Fig. 4 is a reproduction of the manufacturer's timing/waveform diagram. What happens here is that the transmitted signal carries 'imaginary' markers: a pulse immediately following the marker is regarded as a '1'. Thus, the biphase signal shown in Fig. 4 is, reading from F to A, equal to 100 110.

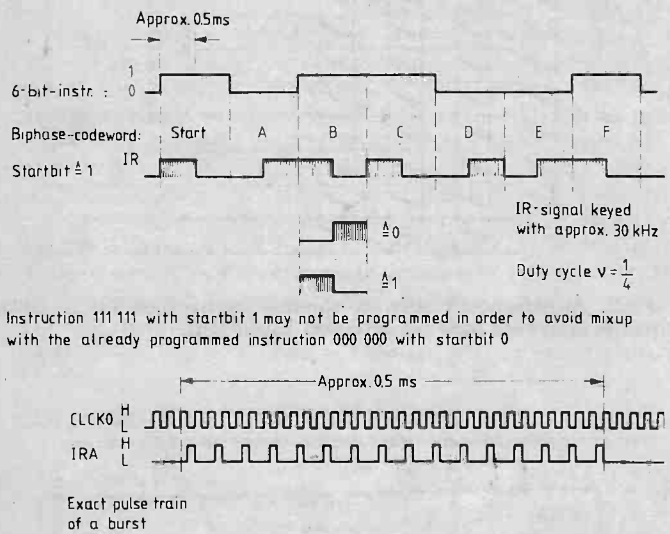

Fig.4. Reproduction of the manufacturer's transmitter timing/waveform diagram.

The Receiver Pre-Amplifier

The manufacturer produces a special pre-amplifier chip, the TDA 4050, for use with the IR60 system. Using this chip, they claim control ranges of up to 30 - 40 metres. We played with his chip for a couple of days but never managed to stop the damn thing oscillating. We then noticed the small print in the application data that said that the pre-amplifier 'should advantageously be mounted in a double-screened case', at which point we gave up and designed our own pre-amp.

One of the problems involved in IR pre-amp design is that the circuit must not only provide very high gain for long-range operation, but also must not saturate when the transmitter is placed only a few inches from the receiver. Our unit works well in both respects.

As a matter of general interest, we've reproduced the manufacturer's TDA 4050 pre-amp applications circuits in Fig. 5. The TDA 4050 IC should be available from Electrovalue.

Receiver/Decoder Circuits

The basic IR60 system is designed for use with the highly sophisticated SAB 3209 receiver IC. This chip checks the incoming code signal for 'sense' (number of bits, bit duration, etc), processes it and then both 'dumps' the resulting code signal at the serial interface and simultaneously passes it on to a register, from which it is then used to control the binary and analogue outputs. The processing action gives a very high immunity against noise and against signals of the wrong carrier frequency.

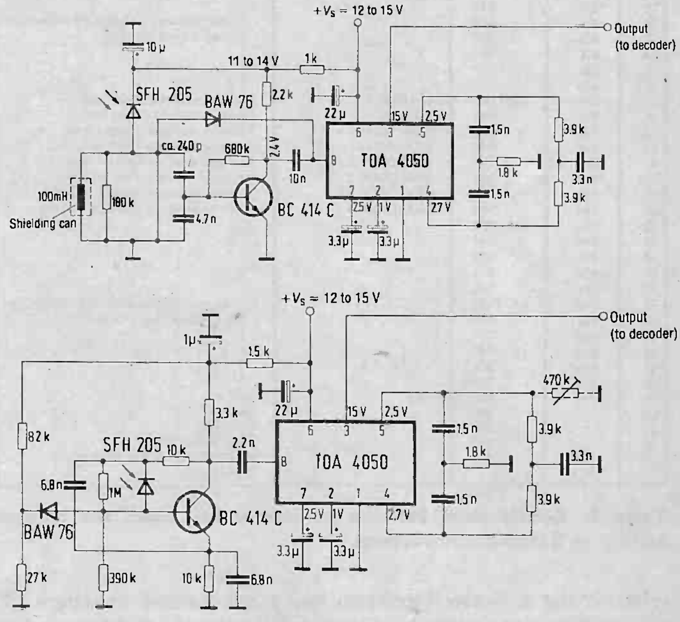

Fig.5. Two Siemens applications circuits showing methods of using the TDA4050 IR preamplifier IC.

Fig. 6 shows the pin designations of the SAB 3209 receiver IC, which provides three analogue, one 4-bit binary and three single-bit outputs. Siemens make a similar receiver chip, the SAB 4209, which has four analogue outputs: this chip is unlikely to be available through amateur electronics dealers, but could be of interest to those of our readers who are professional design engineers.

Pin connection

Pin No.	Pin designations
1	V_{SS}, supply voltage +12 V
2	CLCKO, clock output
3	CLCKI, clock input
4	PRGD, program control output
5	PRGC, program control output
6	PRGB, program control output
7	PRGA, program control output
8	PC, program change strobe input/output
9	RSV2, spare output
10	RSV1, spare output
11	VOLU, volume control output
12	ONOFF, standby output
13	BRIG, brightness output
14	COLO, color contrast output
15	RSIG, signal input, remote control
16	DLEN, I-bus input/output
17	V_{DD}, supply voltage 0 V
18	DATA, I-bus input/output

Fig.6. Pin designations of the SAB3209 receiver IC.

Siemens produce a number of 'special' (professional) support chips for use with the IR60 system. Fig 7, for example, shows the standard receiver application circuit, which also illustrates the use of the SAB 3211 display decoder/driver chip, which gives a visual readout of the selected binary-coded 'channel' number on a multi-segment LED display.

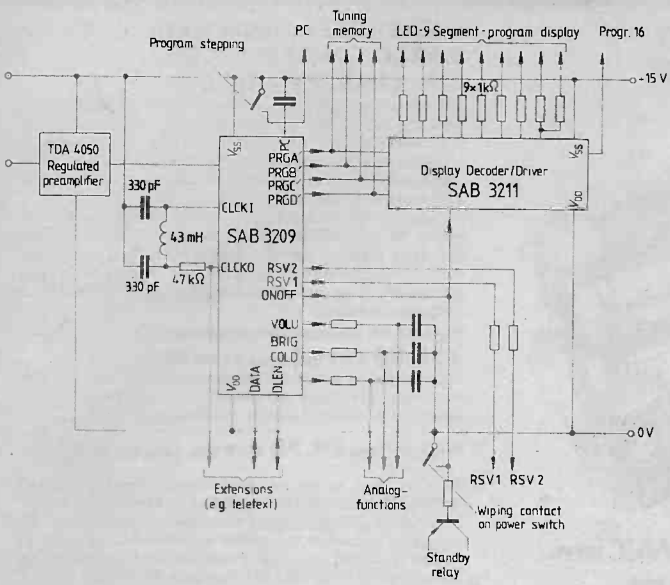

Fig.7. Siemens SAB3209 receiver application circuit, which also shows the use of the 'special' SAB3211 chip.

Another 'special' IC is the SAB 3271 receiver chip, which specifically decodes the transmitted 6-bit serial instruction code signal into the form of six parallel outputs, which can be decoded by additional circuitry to make all 60 'instructions' available for external use.

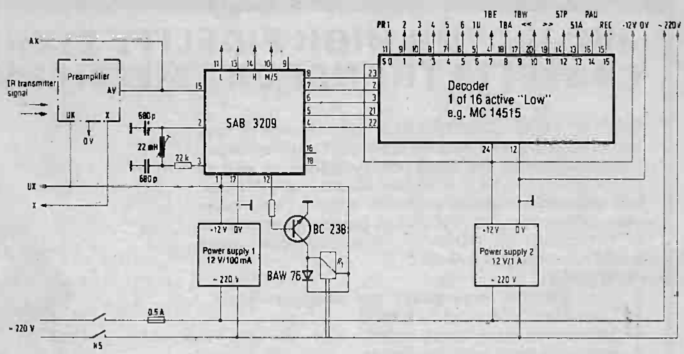

Fig.8. Siemens circuit showing the method of decoding the 4-bit binary output to give 16 output channels.

Interface Circuits

Interfacing the outputs of the SAB 3209 receiver to external circuitry calls for a certain amount of individual ingenuity. The signal-bit outputs can each be used to drive a relay via a transistor buffer, as already shown in the ETI remote control system elsewhere in this issue. The 4-bit binary output can be decoded into sixteen 'selector' channels by using the Siemens circuit as shown in Fig. 8. ICs such as the CD4066 can be used as on/off signal switches, driven from the outputs of the above channel selector.

The three analogue output channels can be used to control voltage-controlled attenuators or amplifiers (for volume control) and filters (for tone control, etc) by using some of the many circuits shown in previous issues of ETI. The VCA article shown in the March '80 issue gives some useful circuits.

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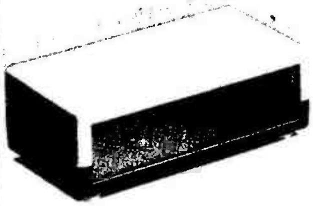

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K115	18 SP1218 (2N3702) transistors
K116	10 MPSL01 NPN 140V TO92
K117	10 BF450 PNP TV IF amp transistor
K118	16 ME4101 NPN 60V AF low noise
K119	10 2N5401 NPN 160V TO92
K120	6 prs 2SD96/2SB496 AF O/P sim to AC128/176
K121	20 7V5 400mW zeners
K122	10 VR525 5.25V 2.2W zener
K123	10 56V 1W zener
K124	50 .02µF disc ceramic
K125	200 1k 5A ¼W carbon film resistors
K126	100 3000pF 63V polystyrene preformed caps
K127	25 47µF 25V axial lead caps
K128	25 15µF 40V do
K129	8 AA113 diodes
K131	10 VA1086 thermistor
K133	20 3 way 5A term blocks
K134	50 unmarked untested OC71 type transistors
K135	30 4.7µF 10V radial elecs
K136	4 AC187k transistors
K137	5 18µF 100V non-polarised caps
K138	30 ¼" coil former with slug
K139	40 .025µF 50V mylar caps
K140	30 .05 do
K141	40 0.01µF 400V axial caps (C296)
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K143	200 squares mica insulation 25mm sq.
K144	30 1R5 3W wirewound resistors
K146	25 330µF 4V axial caps
K148	30 transformer former type X228
K149	12 Ferrite rod type XO36
K150	10 switches type W430
K151	12 0.125" red LED's
K152	10 0.2" red LED's
K154	15 5 pin 180° Din socket, clip fix

BULK BUYERS CORNER

All new full spec. devices. Prices are for a minimum of 100 of any one device and exclude VAT, which must be added at 15%. Minimum order value from this section is £10 + VAT + post. VAT receipt on request.

AC187K	.20	BC485B	.06	BF355	.18	PN109	.055
AD161/2	.45	BC486A	.06	BF394	.055	TIP32	.22
BC107	.07	BC546B	.06	BF414	.065	TIP 41A	.28
BC108	.06	BC547C	.055	BF450	.095	TIP42A	.29
BC109	.07	BC548B	.05	BF451	.09	TIP2955	.46
BC114	.06	BC556A	.06	BF757	.27	TIP3055	.45
BC117	.07	BC556B	.06	BFR40	.17	TIS91	.12
BC118	.05	BC557A	.06	BFW43	.32	ZTX107	.06
BC119	.14	BC737	.07	BFY17	.19	ZTX212	.06
BC125	.06	BCX32	.05	BYF50	.13	ZTX214	.06
BC139	.14	BCX33	.05	BFY51	.13	ZTX303	.07
BC147	.05	BCY32	.12	BFY52	.13	ZTX311	.07
BC148	.05	BCY71	.11	BFY56A	.16	ZTX313	.06
BC148B	.05	BCY72	.10	BFY56A	.16	ZTX341	.07
BC149	.05	BD112	.64	BFY64	.15	ZTX450	.06
BC159	.05	BD131	.18	BR101	.28	ZTX501	.96
BC168C	.055	BD132	.18	BRX48	.095	ZTX503	.07
BC169C	.055	BD133	.18	BRY46	.17	ZTX550	.06
BC172C	.05	BD137	.20	BSX20	.075	2N1021	.94
BC177	.07	BD138	.20	BSY38	.12	2N1132	.16
BC182B	.045	BD181	.40	BSY56	.10	2N1377	.62
BC183B	.045	BD184	.45	BSY82	.19	2N1711	.18
BC184L(TO5)	.045	BD246	.30	BSY85	.23	2N1893	.15
BC212	.045	BD278A	.32	BSY95A	.065	2N2369	.12
BC212B	.045	BD433	.32	BT121	.90	2N2646	.34
BC213L	.045	BD525	.24	BU205	.60	2N2894	.12
BC214L (TO5)	.045	BD526	.24	BU206	.60	2N2926Y	.045
BC237	.05	BD543A	.30	BU407	.60	2N2926R	.045
BC237B	.05	BD695A	.45	CV7001	.23	2N3053	.13
BC237C	.055	BD696A	.45	CV7493	.19	2N3054	.36
BC238B	.05	BF173	.13	CV7588	.18	2N3055	.30
BC239B	.055	BF181	.15	ME0475	.055	2N3442	.78
BC252	.07	BF195	.055	MJE340	.22	2N3583	.42
BC256A	.06	BF196	.055	MPS2369	.06	2N3618	.60
BC308	.05	BF197	.055	MPS3638A	.06	2N3702-10	.045
BC308B	.055	BF198	.055	MPS6515	.06	2N4124	.08
BC320	.07	BF241	.055	MPSA66	.24	2N4400	.06
BC328	.07	BF255	.075	OC44	.19	2N4401	.06
BC337	.07	BF257	.19	OC45	.17	2N4403	.06
BC348	.07	BF258	.20	OC139	.26	2N4410	.06
BC351	.14	BF324	.13	OCP71	.63	2N5193	.20
BC413	.05	BF337	.19	PBC108	.055	2N5195	.22

2N5401	.17
2N5447	.06
2N5831	.08
2N6121	.16
2SC536	.05
2SC1617	.62
2SC206B	.43
2SC2073	.45

TTL IC's

7401	.08
7404	.10
7405	.09
7417	.18
7420	.10
7430	.09
7442	.47
7445	.47
7460	.09
7472	.14
7474	.17
7493	.24
74107	.18
74121	.18
74190	.52
74913	.48

Linear IC's

555	.19
723	.28
741	.12

JUST ARRIVED
400 mW Zeners: These values only at **.030**: 3V6, 4V7, 5V1, 5V6, 6V2, 8V2.

Send SAE for latest bulk buyers list.

Diodes

1N4148	.02
per 1000	.016
1N4002	.032
per 1000	.025
per 10,000	.021
1N4004	.038
per 1000	.032
1N4006	.046
per 1000	.034

Zener diodes
400mW BZY88 or similar 5% All voltages from 2V7 to 36V. **.042**
1N4741 11V 1W **.06**
1N4742A 12V 1W **.06**
ZPY12 12V 1.6W **.075**
1S4020A 20V 1.5W "top hat" **.045**

Polystyrene Caps
22pF 125V 5% **£8**/1000
27pF 125V5% **£8**/1000
1500pF 125V 10% **£14**/1000
8200pF 125V 10% **£18**/1000

SCR's

2N5060	.15
C106D (2P4M)	.26

MINIATURE CERAMIC CAPS

Thompson/CSF miniature type in the following values:
3.9pF, 4.7pF, 22pF, 33pF, 47pF, 68pF, 82pF, 100pF, 560pF*, 2700pF#, .01µF#. All 5% except *10%, #20%.

Prices:	
up tp 82pF	**£7**/1000
100pF	**£9**/1000
560pF	**£5**/1000
2700pF	**£9**/1000
.01µF	**£10**/1000

Samples on request.

Mullard min ceramics:

33pF 5% 100V	**£7**/1000
330pF 2% 100V	**£8**/1000
3300pF 10% 100V	**£13**/1000

Stettner min ceramics:

330pF 5% 63V	**£7**/1000
.022µF 63V	**£14**/1000

Lemco: .047µF 63V **£16**/1000

Resistors
Min ¼W 5% carbon film 1R-10M (10% over 1M), all **£6.00**/1000
The following values only at **£3.50**/1000: 18R, 220R, 1k, 4k7, 33k, 39k, 47k, 220k.

Min presets
0.1W miniature type, open construction. All values from 100R to 1M, vertical or horizontal mntg. All at **.042**
The following values only at **.03** 470RV, 470RH, 500RH, 1kH, 1k5H, 2kV, 2k2H, 2k5H, 4k7H.
Also some Piher enclosed type at **.042**: 150RV, 200RH, 2kV.

Electrolytic Caps

2.2/25 R	.028
2.2/63 A	.032
4.7/10 R	.022
4.7/25 R	.028
4.7/25 A	.030
4.7/35 R	.030
4.7/50 R	.034
4.7/63 R	.038
10/16 R	.030
10/25 R	.032
10/25 R PC	.022
10/25 A	.035
10/50 A	.040
10/100 R	.042
15/40 A	.030
22/10 R	.021
22/25 A	.028
22/25 R	.027
22/63 A	.040
33/16 A	.022
47/6 A	.015
47/16 A	.025
47/25 A	.032
47/35 R	.038
47/40 A	.045
47/63 R	.045
100/6.3 A	.020
100/16 R	.035
100/63 A	.065
220/10 A	.045
220/16 A	.055
220/63 A	.075
220/70 A	.075
330/50 A	.075
330/100 A	.085
470/16 R	.080
470/40 R	.120
470/40 A	.150
470/100 RC	.150

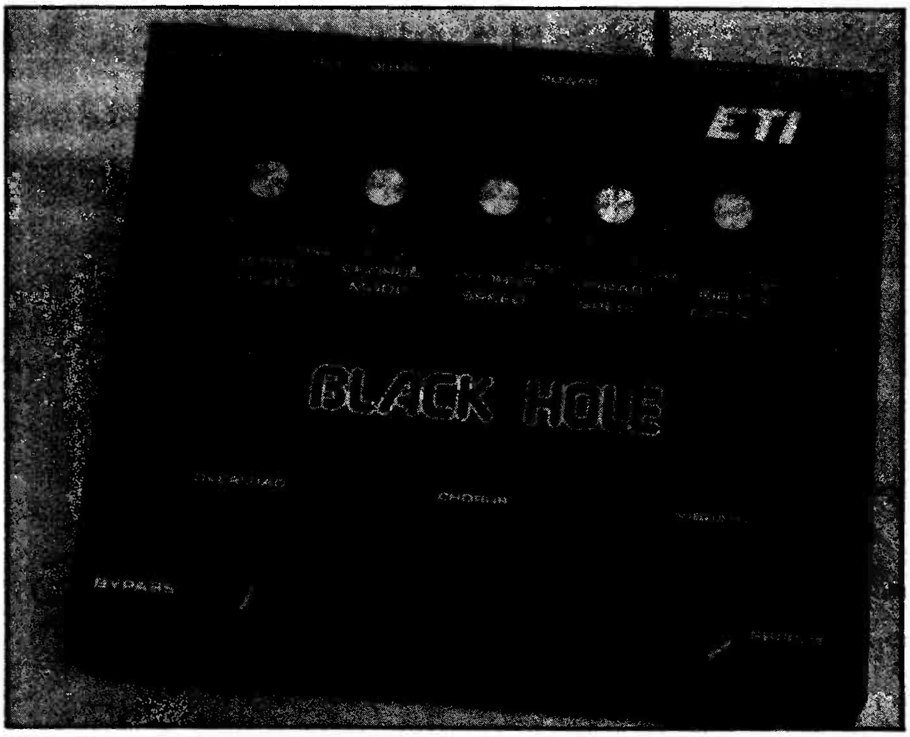
THE BLACK HOLE

Tim Orr, the prolific producer of music machines, presents the Black Hole Chorus Machine. Choose chorus effect or vibrato and control it all by footswitch.

The black hole is a musical effects device for processing natural and synthetic sounds. It has two modes of operation, chorus and vibrato. In the chorus mode the input signal is delayed (12 mS) by an analogue delay line. It is then mixed back with the original signal. This delay time is not long enough for a distinct second image to be heard, but it is noticeable, particularly as the time delay is slowly modulated. The sound produced by this process has a sort of 'spacey' feel to it as though the input signal was being accompanied by a faint chorus. What is, in fact, happening is that a comb filter has been produced (Fig. 1) with notches spaced at about every 90 Hz. As the delay time is modulated these notches move up and down in frequency producing a colouration of the sound similar to phasing. This, coupled with the short time delay, produces the 'spacey' colouration known as a chorus effect. A manual speed control allows the user to vary the modulation speed. A slow modulation is best suited for guitar and keyboard instruments, whereas a faster speed, which introduces a noticeable pitch modulation, works well on vocals. Another chorus mode is available to switch in a second delay line modulated in antiphase.

The vibrato mode is essentially the same as the chorus; the only things that change are the modulation waveform (triangular sweeps for the chorus sinusoidal sweeps for the vibrato) and the frequency range. As this is 2 to 13 Hz, a definite pitch modulation is produced. The controls that effect the vibrato are speed and modulation depth. The vibrato is not just pure frequency modulation, there is also amplitude modulation which produces a slightly more interesting effect.

The vibrato/chorus selection is made with a footswitch. Two LEDs indicate which effect has been selected and also the modulation speed. The input amplifier has a manual level control plus a high impedance-high level/low impedance-low level selector switch, thus enabling a wide range of input levels to be accommodated. The largest input level is 4V5 rms, and the smallest level for overload is 5 mV rms; a range of nearly 60 dB. An overload LED indicates the onset of distortion.



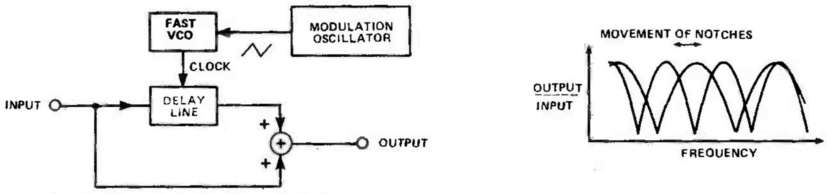


Fig.1. Block diagram of a comb filter.

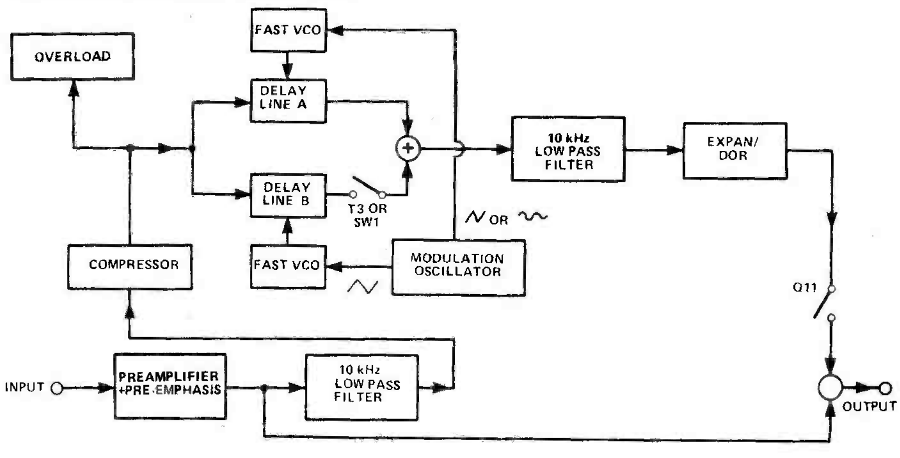


Fig.2. Block diagram of the Black Hole choraliser system.

	LOW	HIGH
MAXIMUM INPUT LEVEL	1.25Vpp	13Vpp
MAXIMUM INPUT LEVEL SENSITIVITY	15mVpp	150mVpp
INPUT IMPEDANCE	10k	110k
SIGNAL TO NOISE RATIO	68dB	74dB

MAXIMUM OUTPUT LEVEL	1Vpp
OUTPUT IMPEDANCE	600ohms
VIBRATO SPEED	2 – 13 Hz
CHORUS SPEED	0.3 – 3.3 Hz

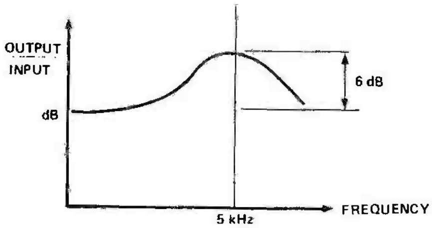


Fig.3. (top) Performance specification.

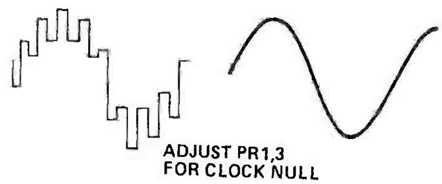
Fig.4. (above) Frequency response of pre-emphasis, IC11 pins 5, 6, 7.

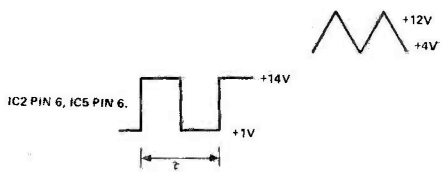
* REMOVE ALL ICs
TEST FOR ±15V AT IC9,10.
THE UNREGULATED RAILS WILL BE APPROXIMATELY ±22V
REPLACE ALL ICs AND RECHECK PSU.

* IC11 PIN 1,7 AND IC12 PIN 1,7, WILL HAVE THE AUDIO INPUT SIGNAL WITHOUT ANY DC BIAS.

* COMPRESSOR OUTPUT. IC13 PIN 10, HAS A DC BIAS OF APPROX. +7V PLUS THE AUDIO INPUT SIGNAL.

* FAST VCO. IC1 PIN 6 AND IC4 PIN 6





* POST FILTER. IC15 PIN 7. RECOVERED AUDIO SIGNAL WITH NO DC BIAS.

* EXPANDER. IC13 PIN 7. RECOVERED AUDIO SIGNAL WITH +5V DC BIAS.

* OUTPUT SIGNAL. IC15 PIN 1. INJECT A 500 Hz SINEWAVE INTO THE UNIT. A MODULATED OUTPUT SIGNAL WILL BE SEEN.

τ VARIES FROM ABOUT 22uS TO 28uS, IT BEING SWEPT BY THE MODULATION OSCILLATOR IC7.

* DELAY LINE OUTPUT

VIEW PR1 WIPER

INJECT A 1 kHz SINEWAVE. VARY ITS AMPLITUDE SO THAT IT IS 2Vpp AT THE VIEWING POINT.
ADJUST PR2 SO THAT THE WAVEFORM IS SYMMETRICALLY BIASED BETWEEN THE TWO CLIPPING LEVELS.
NEXT ADJUST PR1 SO THAT THE CLOCK SIGNAL IS NULLED.
REPEAT FOR DELAY LINE B, USING PR3,4, VIEWING PR3 WIPER.

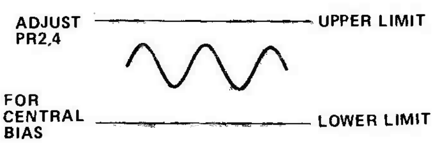
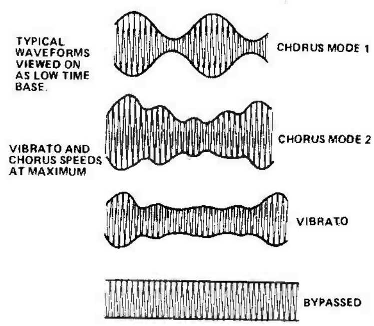
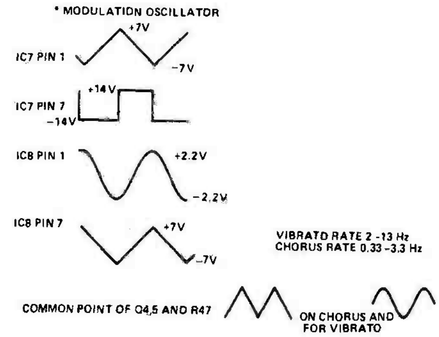


Fig.5. (above and above left) Alignment notes.





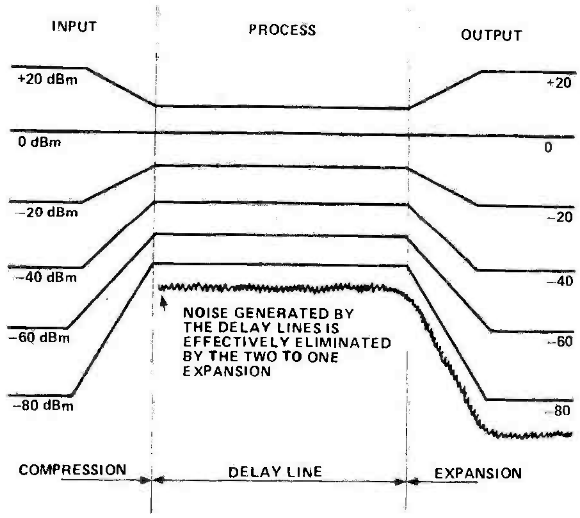
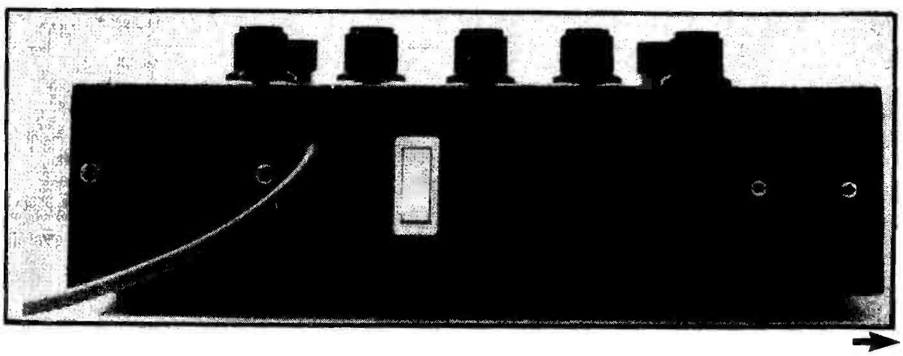


Fig.6. (left) Using a compander system to remove delay line noise.



You don't want to have to fumble for a lot of controls on the rear panel, so it's plain and simple — power on/off. No chance of accidentally hitting the power switch when you're operating Black Hole by footswitch.

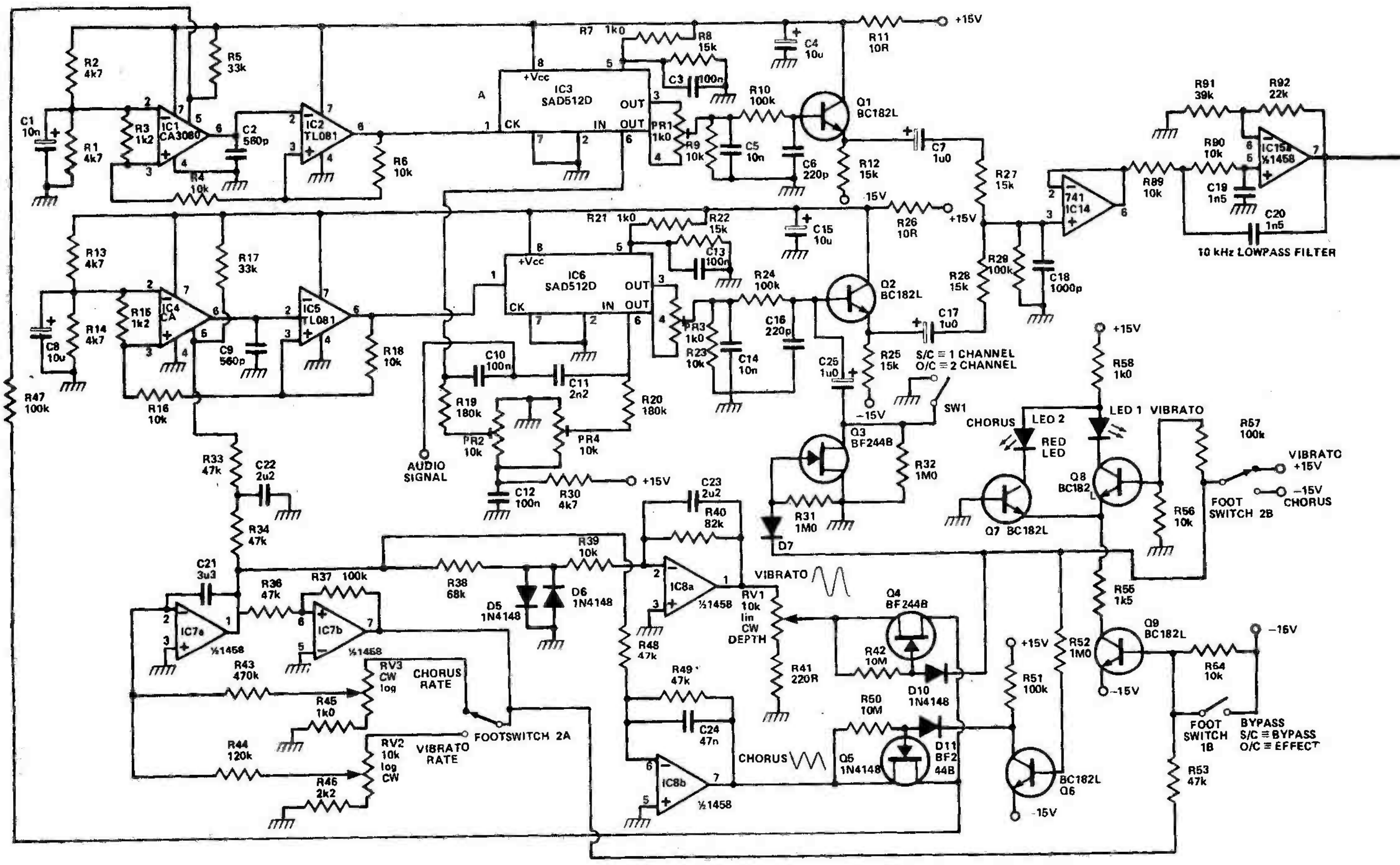


Fig.7. Circuit diagram. This circuit includes the footswitch controls for bypass, chorus, vibrato and chorus and vibrato rate.

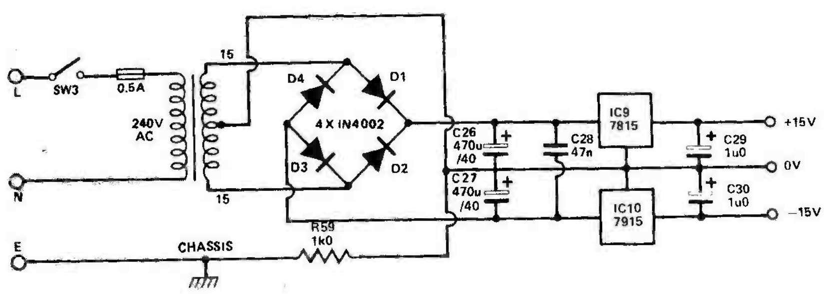


Fig.8. (left) Circuit diagram of the Black Hole's power supply.

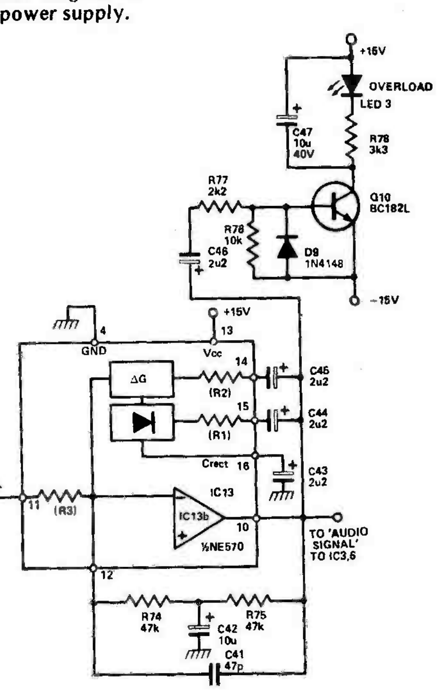
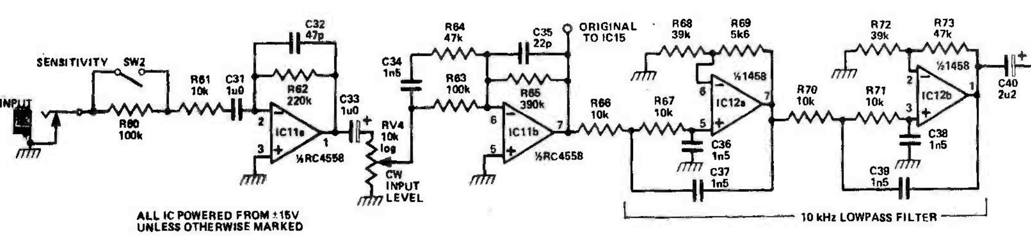
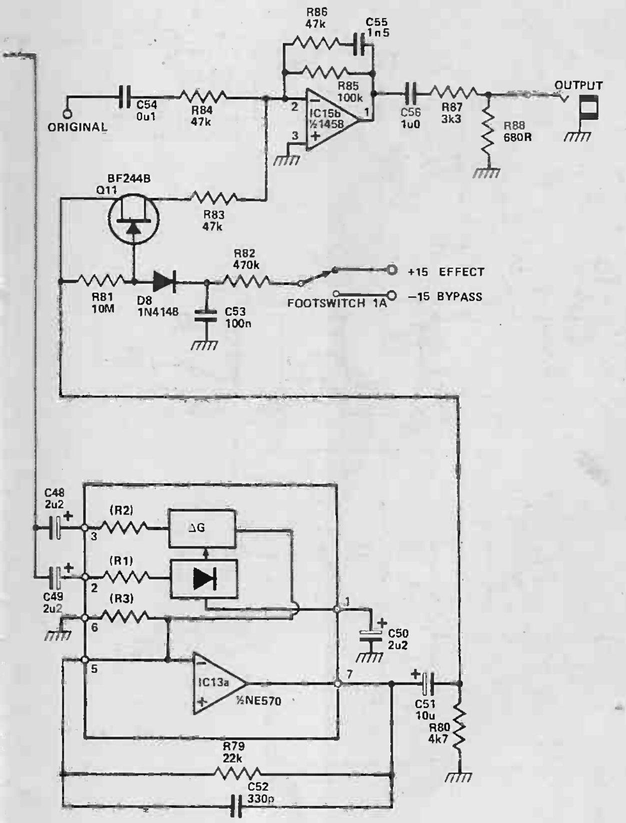
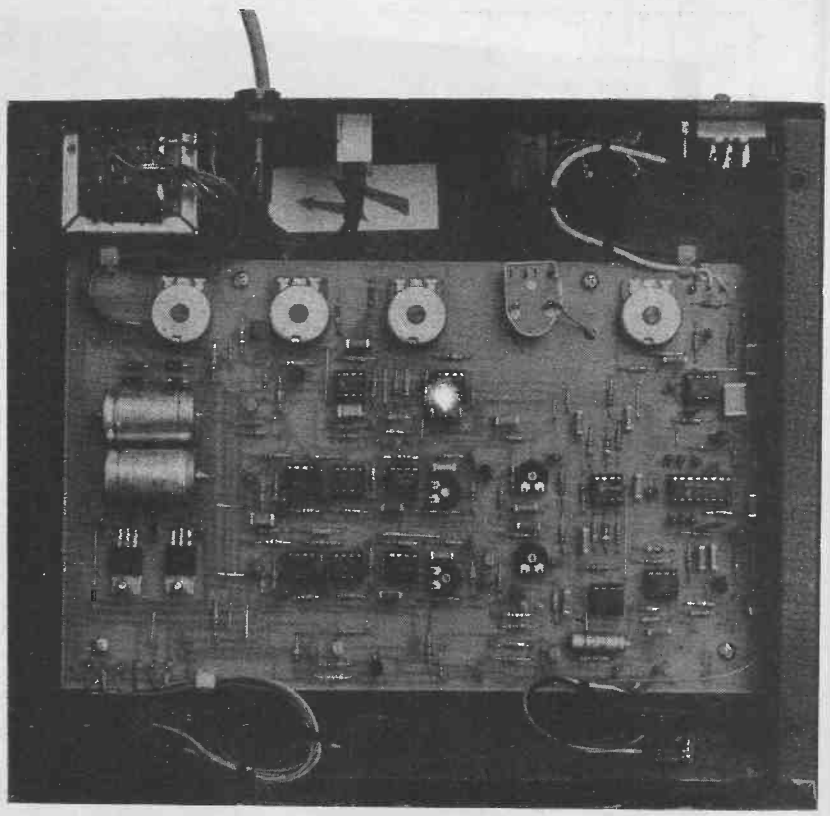


Fig.9. (below) This part of the circuit, the input amplifier, includes a 10 kHz low pass filter section built around IC12.







The inside story. Here the PCB has been built and installed in the case with the power supply. Just screw on the baseplate and it's ready to go.

HOW IT WORKS

The input amplifier (Fig.9) is a low noise Op Amp device, the RC4558 (IC11, pins 1,2,3). With SW2 closed the input impedance is 10 k and the first stage gain is +26 dB. With SW2 open circuit, the input impedance is 110 k and the gain is +6 dB. IC11, pins 5,6,7 forms a pre-emphasis circuit that is used to enhance the higher frequencies of the input signal (Fig.4). A de-emphasis circuit (IC15, pins 1,2,3) corrects the frequency response at the output and in doing so attenuates unwanted high frequency noise generated by the delay line and the compander. After pre-emphasis the signal is filtered by a 10 kHz 4 pole lowpass filter (IC12) to eliminate aliasing effects that can be caused by the delay line. A compander (compressor /expander) system has been employed to improve the overall noise performance (Fig.5). This ensures that the delay lines are always driven with a relatively large signal and that when there is no input signal, the output noise from the delay lines is expanded downwards thus rendering it inaudible. A simple overload detector circuit (Q10) is used to indicate the onset of distortion.

The delay lines are clocked by high frequency VCOs, IC1,2 and IC4,5. The VCO is a simple triangle/square wave relaxation oscillator running at about 45 kHz. The current into pin 5 of the CA3080 determines the oscillation frequency and this current is modulated by the slow oscillator IC7. Audio signals are fed into the analogue delay lines (IC3,6), the delay time being determined by the relationship,

Delay time = 512/clock frequency,

which in this case is about 12 mS. The outputs of the two delay lines are prefiltered by R10,C6 and R24,C16; then mixed together and filtered by a 10 kHz lowpass filter, IC15, pins 5,6,7. The signal is then expanded by the NE570 chip after which it is mixed with the original signal at IC15, pins 1,2,3, having first passed through a 'silent' analogue switch (Q11) which is ON when the effect is selected and OFF when bypassed. The modulation oscillator operates over two frequency ranges, one selected by the chorus speed control, the other by the vibrato speed control. IC7 is a low frequency triangle/squarewave relaxation oscillator. When the chorus mode has been selected the modulation waveform is a sinewave, being generated by IC8, pins 1,2,3. This signal is routed via switch Q4 to the high frequency VCO driving delay line A, whilst delay line B is disabled by Q3 which shunts the audio signal to ground. A simple LED control circuit Q7,8,9 indicates whether the unit is bypassed or in either the chorus or vibrato mode as well as indicating the modulation speed.

A standard two rail power supply provides a regulated +15 V at 70 mA and −15 V at 30 mA from two voltage regulators IC9,10.

BUYLINES

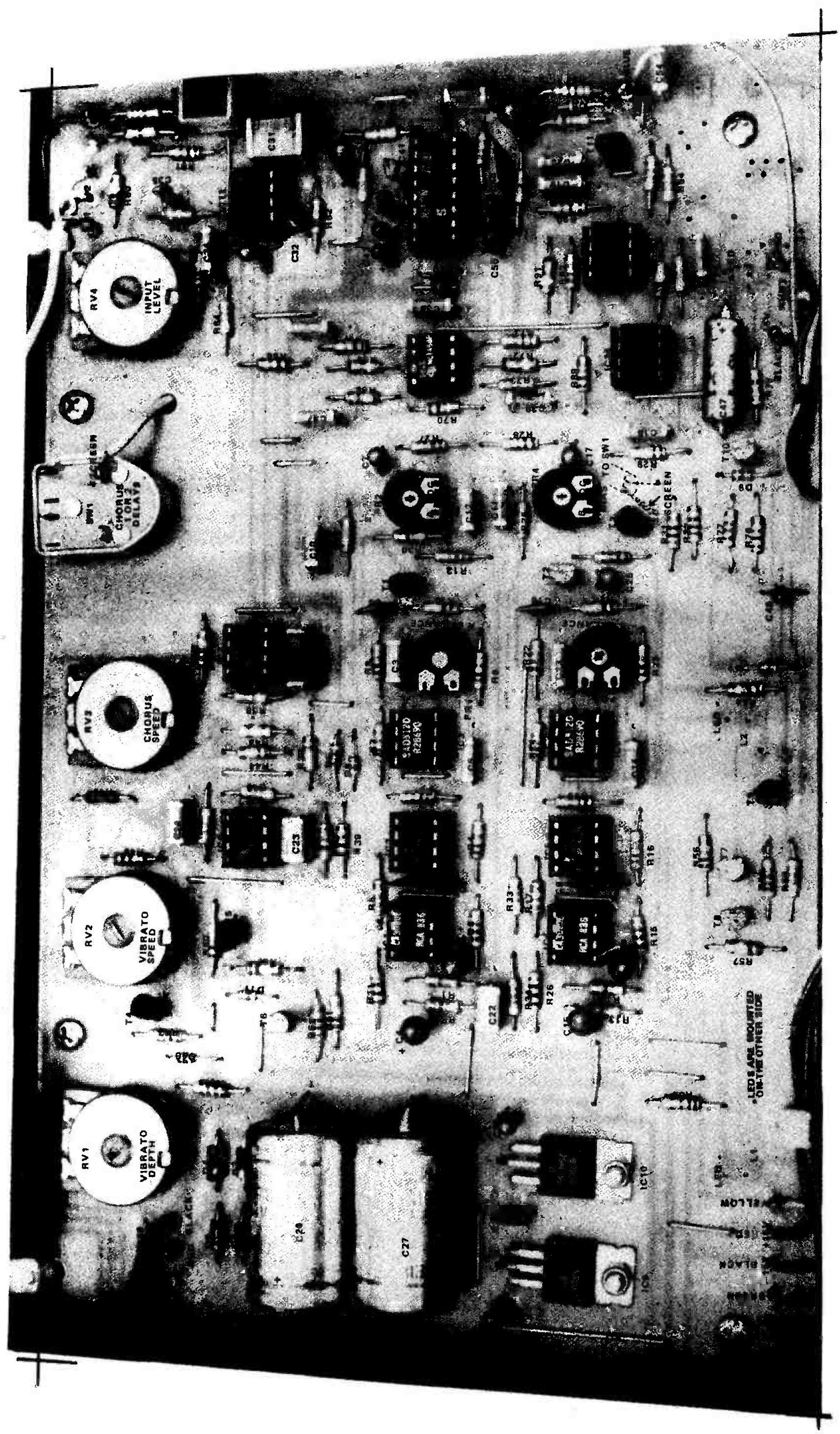


Fig.10. Component overlay. Double check the orientation of ICs, diodes and electrolytic capacitors.

PARTS LIST

RESISTORS All ¼W, 5%

R1,2,13,14, 30,80	4R7
R3,15,21	1k2
R4,6,9,16, 18,23,39,54, 56,61,66,67, 70,71,76,80, 90	10k
R5,17	33k
R7,45,58,59	1k0
R8,12,22,25, 27,28	15k
R10,24,29, 37,47,51,57, 60,63,85	100k
R11,26	10R
R19,20	180k
R31,32,52	1M0
R33,34,36, 48,49,53,64, 73,74,75,83, 84,86	47k
R38	68k
R40	82k
R41	220R
R42,50,81	10M
R43,82	470k
R44	20k
R46,77	2k2
R55	1k5
R62	220k
R65	390k
R68,72,91	39k
R69	5k6
R78,87	3k3
R88	680R

POTENTIOMETERS

RV1	10k lin PC mounting
RV2,3,4	10k log
PR1,3	1k0 horiz preset
PR2,4	10k horiz preset

CAPACITORS

C1,4,8,15, 42,51	10u 16V tantalum bead
C2,9	560p ceramic
C3,10,12,13, 53,54	100n
C5,14	10n
C6,16	220p ceramic
C7,17,25,29, 30,33	1u0 16V tantalum bead
C11	2n2
C18	1n0
C19,20,34, 36,37,38,39, 55	1n5
C21	330n
C22,23	220n
C24	47n
C26,27	470u 40V electrolytic
C28	47n 63V ceramic
C31,56	1u0
C32,41	47p ceramic
C35	22p ceramic
C40,43,44, 45,46,48,49, 50	2u2 16V tantalum bead
C47	10u 40V electrolytic
C52	330p

SEMICONDUCTORS

IC1,2	[illegible]
IC3,4	TL081CP
IC5	SAD512D
IC7,8,12,13	[illegible]
IC9	78M15
IC10	79M15
IC11	RC4558NB
IC16	NE570N
IC14	741CP
Q1,2,6,7,8, 9,10	BC182L
Q3,4,5,11	BF244B
D1–4	1N4002
D5–11	1N4148
LED 1–3	0.2" red LED

MISCELLANEOUS

8 pin low profile DIL socket (x12), 16 pin low profile DIL socket, SPDT slide switch, DPST rotary switch, mains switch, DPDT footswitch and cap (x2), ¼" jack socket (x2), 20 mm OAS fuse and holder, 15-0-15 V mains transformer, PCB, case to suit, ½" 6BA tapped pillar (x4).

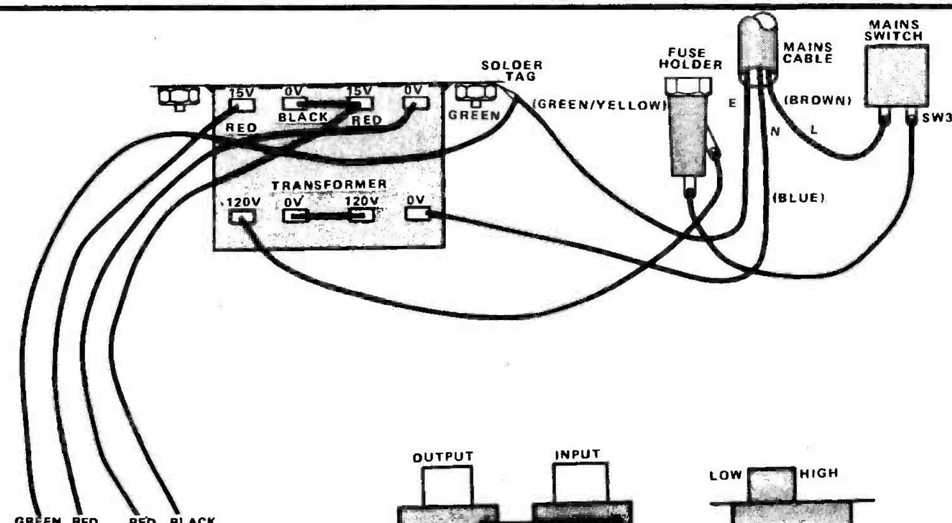


Fig.11. Power connection details.

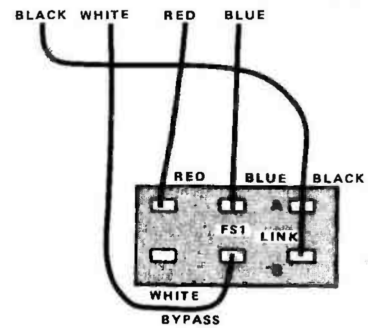


Fig.12. Wiring plan for Footswitch 1.

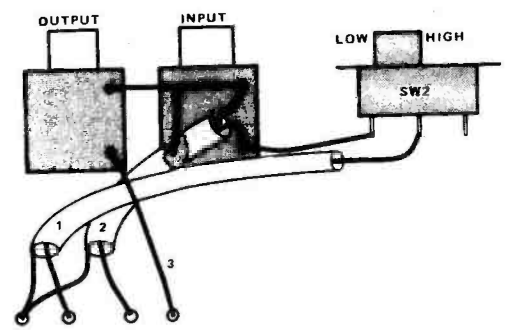


Fig.13. Input and output connections to PCB.

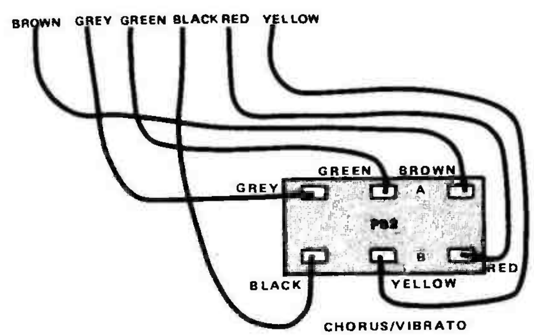


Fig.14. Connections from Footswitch 2 to the PCB.

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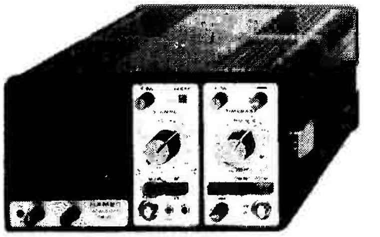

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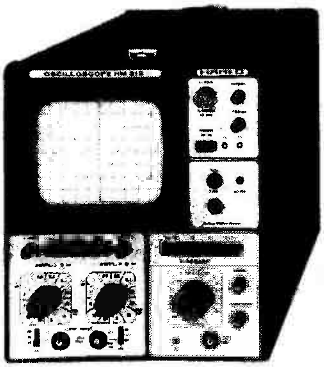

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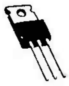

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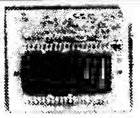

Based on the ICL7106. This kit contains a PCB, resistors, presets, capacitors, diodes, IC and 0.5" liquid crystal display. Components are also included to enable the basic DVM kit to be modified to a Digital Thermometer, using a single diode as the sensor. Requires a 3mA 9V supply (PP3 battery) £20.75

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LEDS	
0.1" Red	9p
0.1" Green	12p
0.1" Yellow	12p
0.2" Red	9p
0.2" Green	12p
0.2" Yellow	12p
0.2" clips	3p
Rectangular Red	18p
Rectangular Green	20p
Rectangular Yellow	21p

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DL304 Red 0.3" c.c. pin compatible with DL704	70p
DL307 Red 0.3" c.a. pin comp DL707	70p
DL847 Red 0.8" (pin comp DL747) c.c.	£1.80
DL850 Red 0.8" c.c. (pin comp DL750)	£1.80
DL727 Dual 0.5" c.a. Red	£1.50

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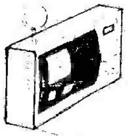
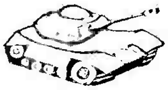



If you've got the ideas, we've got the hardware. Hundreds of uses in the home, shop, business or industry. Our range of ICs and components for Infra-Red remote control enable you to build controllers for applications ranging from heating to Hi-Fi to toys to garage door openers.

Up to 16 channels with three analogue outputs, low component counts and large tolerance of clock frequency eliminate the need for crystals or coils. The systems offer high noise immunity, reliability and low cost.




LD271 IR Emitting Diode	.36
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SL490 Keyboard Controlled Encoder/Transmitter	2.40
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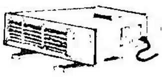
Data sheets (per device)	.05

These ICs can also be used with ultrasonic or radio links, depending on range, cost and speed of operation. For more details why not give us a ring

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LD300K - LIGHTDIMMER KIT	£2.90

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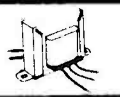

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9-0-9V	85p
12-0-12V	90p

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Soldercon Pins 50p / 100

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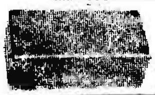

B2 95 × 71 × 35mm	65p
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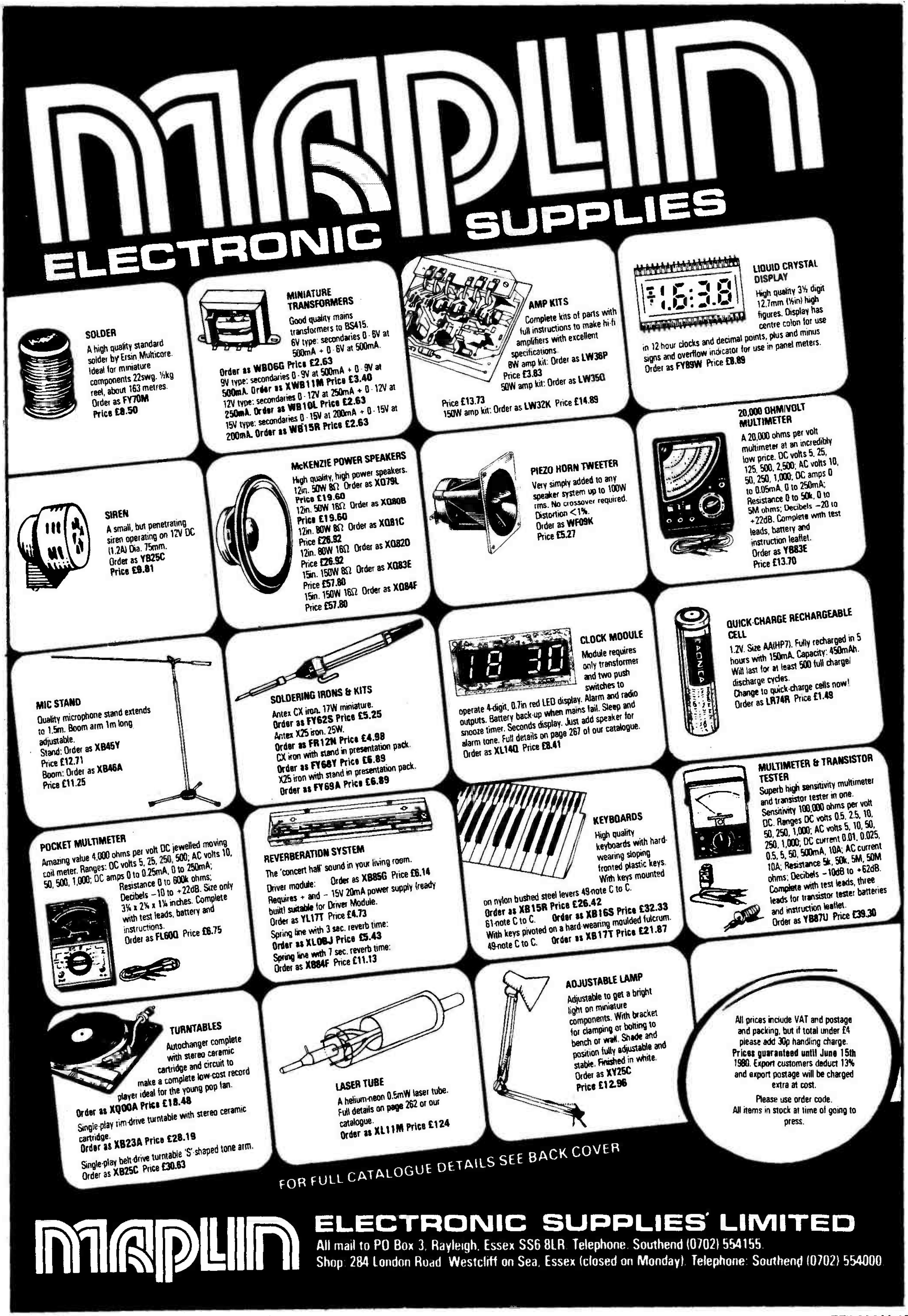
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RAVEN ON

As the chip industry experiences problems in maintaining it's rate of growth Dave Raven explains why and casts a glance at bubble memories.

In complete contrast to most manufactured goods integrated circuit pricing has remained on a steady, decreasing spiral. There is, however, a school of thought which sees this rapidly coming to an end.

With the ever increasing effects of inflation, which is not of course exclusive to the UK, the end of the manufacturers experience learning curve is in sight. The cost of producing linear devices is already said to be rising in the States and signals indicate that digitals will soon follow. This stems from a theory which says that every time accumulated experience doubles, costs and, therefore, prices go down by about 25 per cent. With the pressure from increasing demand for ICs, manufacturers have more than doubled accumulated experience every year, which pushed prices downwards. This theory has apparently proved valid in the industry for many years.

In effect, what is being suggested is that if, from the inception of the IC industry, 10 million devices have been sold by the end of a given year, it would have to sell 10 million devices the following year in order to lower prices by as much as 25 per cent. The following year 20 million devices must be sold to achieve another 25 per cent reduction. Clearly a point must be reached where this rate of growth could not be maintained. The suggestion is that the time has now arrived.

Accumulated shipments of Integrated Circuits reached 11.4 billion units in 1978. During 1979 the total sales of ICs was expected to reach about 5 billion units. If it is assumed that the United States IC industry ships 6.5 billion devices in 1980, it will have taken two years to double accumulated shipments. Therefore, if the theory holds true the price of ICs will have dropped by an average of 25 per cent. Inflation, however, over the two year period is going to more than off set the 25 percent price declines and could even exceed this. Technically, the digital integrated circuits have a more favourable price outlook than linear, since it is still possible to shrink more circuitry into a silicon slice. Designers are, however, experiencing increasing difficulties with the physical limitations posed by one millionth of a metre gate lengths and the effects of stray capacitance and in addition the demands being made on chip manufacturers for a host of new consumer products which appear each year.

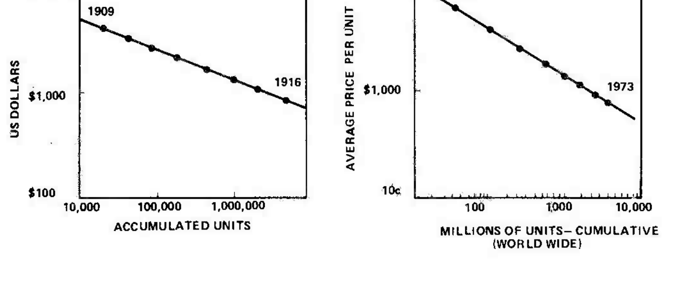

Fig.1. Similarities between price trends for the Model-T Ford and integrated circuits.

To illustrate some of the technical difficulties that have to be overcome in producing 1 micron lines, it is best to explain the techniques that can be used to produce these. The cheapest method is to use photolithography, which is well established for device fabrication. Using a procedure called 'float off' it is possible to define very narrow channels which are chemically etched and a metal is evaporated through the channel producing a very narrow line. The problems that can arise, however, are shown in the photographs and are not easily overcome even with the very sophisticated manufacturing techniques in use today.

PHOTO 1: an etched channel before deposition of metal to complete the gate.

The first photograph shows the etched channel before metal is deposited. Distance between the overhang is approximately two microns. The second photograph illustrates the metal deposited through the channel. Photograph three is an example of what can go wrong when the edges of the overhang break down, causing an electrical short. Each ledge is approximately 1.5 microns. This example is somewhat crude in present day technology. However, it serves to show quite clearly the mechanical effects of fabricating devices using these very tiny dimensions.

Electron beam lithography is improving the yield of integrated circuits plus increasing the chip density, thus overcoming many of the earlier problems. Once again, however, this equipment is not cheap and will further increase the already heavy capital investment required. The author of a recent article in an American device technology magazine produced comparisons between the product-