An Argus Specialist Publication

electronics today

INTERNATIONAL JANUARY 1984 90p

JOIN THE PLOT!

Experimenter's project for a vector graphic display.

Audio power amplifiers – the how and the why.

Behind the screen with Sinclair's new pocket TV

Bring your music playing to life with our Chorus/ Flanger project by Tim Orr

AUDIO....COMPUTING....MUSIC....RADI ROBOTICS.

Star sounds ** Star quality ** Star features **

Free SECURICOR DELIVERY on all orders over £100 (UK mainland only) Add just £2.50 on lower price orders

BIG NEWS ABOUT OUR LATEST ADVANCES IN ROBOTICS SEE INSIDE BACK COVER

DJ90 Stereo Mixer — this is a really versatile new mixer that enables the constructor DJ to produce a professional performance every time. There are two stereo inputs for magnetic cartridges, a stereo auxiliary input and mike input. Other 'plus' features are auto-panning for fast or slow slider controls, multi-mixing, ducking, interrupt, input modulation, in short everything . . . the whole works — AND — under £100 complete! Complete kit **£97.50** + VAT

TRANSCENDENT 2000 — Although only a 3 octave keyboard the '2000' features the same design ingenuity, careful engineering and quality components of its larger brethren. The kit is well within the scope of the first time builder — buy it, build it — play it! You will know you have made the right choice.
Complete kit **£165.00** + VAT

SALES COUNTER Collect your order from the factory. Open 9-12/1-4.30 Mon- Fri. Easy parking, no waiting

This versatile modular mixer, featured as a constructional article in Practical Electronics can be built up to a maximum of 24 inputs, 4 outputs and an auxiliary channel. Each input channel has Mic and Line inputs, variable gain, bass and treble controls and a parametric middle frequency equalizer. There are send and return jacks, auxiliary, pan and fader controls and output and group switching. The output channels have PPM displays and record and studio outputs. The auxiliary channel also has a PPM display and there is a headphone monitor jack and a built-in talk-back microphone. The mixer modules plug into base units each of which takes up to 6 channels. To eliminate hum, the power supply is in a separate cabinet.

KIT PRICES

Input channel	£19.90	Base unit and wooden front	£27.50
Output channel	£18.50	Pair of mahogany end cheeks	£12.50
Auxiliary channel	£22.50	Power Supply and cabinet	£19.50
Blank Panel	£3.00		

All prices are VAT exclusive

Digital Delay Line — With its ability to give delay times from 1.6 mSecs to up to 1.6 secs. Many powerful effects including phasing, flangine, A.D.T., chorus, echo &

vibrato are obtained. The basic kit is extended in 400 mS steps up to 1.6 secs. Simply by adding more parts to the PCB. Compare with units costing over £1,000!
Complete kit (400 mS delay)
£130 + VAT
Parts for extra 400 mS delay
£9.50 + VAT

TRANSCENDENT POLYSYNTH — A four octave polyphonic synthesiser with outstanding design characteristics and versatility and performance to match.
Complete kit **£230.00** plus VAT (single voice)
Extra voice (up to three more) **£35.60** plus VAT

Free Soldering Practise Kit on request with your first kit — useful tips, well illustrated.

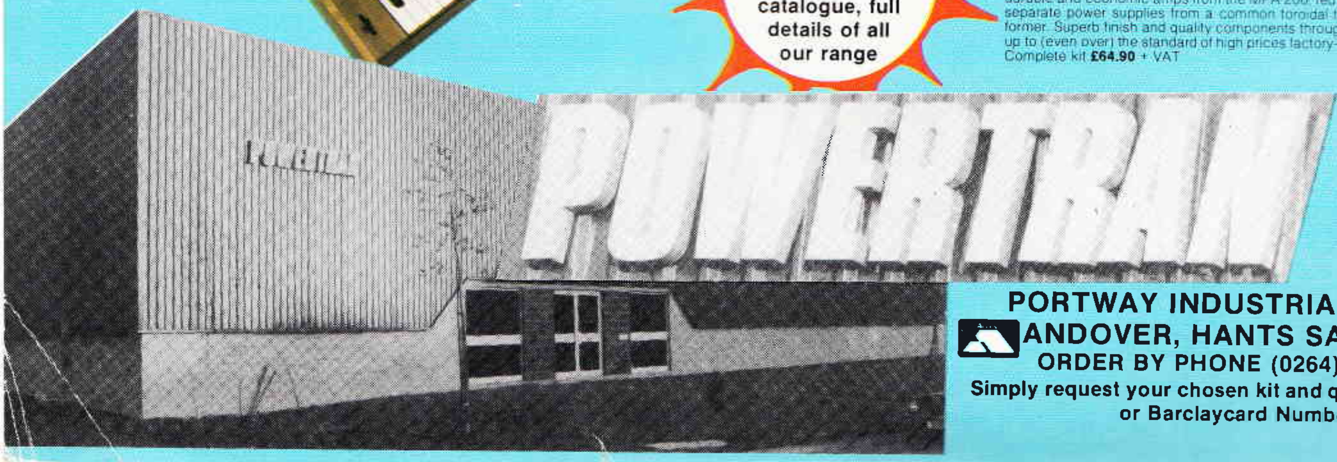
MPA 200 — is a low price, high power 100W amplifier, its smart styling, professional appearance and performance, make it one of our most popular designs. With adaptable inputs the mixer accepts a variety of sources yet straightforward construction makes it ideal for the first time builder. Complete kit **£49.90** + VAT

Chromatheque 5000 — a 5 channel lighting system powerful enough for professional discos yet controllable for home-effects. Sound to light, strobe to music level, random or sequential effects — each channel can handle up to 500W yet minimal wiring is needed with our unique single board design. Complete kit **£49.50** + VAT

ETI VOCODER — 14 channels each with independent level control, for maximum versatility and intelligibility. Two input amplifiers — for speech/excitation — each with level control and tone control. The Vocoder is a powerful yet flexible machine that is interesting to build and thanks to our easy to follow construction manual, is within the capability of most enthusiasts. Complete kit **£175.00** + VAT

SP2 200 twice the power with two of the reliable, durable and economic amps from the MPA 200, fed by separate power supplies from a common toroidal transformer. Superb finish and quality components throughout — up to (even over) the standard of high prices factory-built units! Complete kit **£64.90** + VAT

Component packs for most kits are available See our great free catalogue, full details of all our range

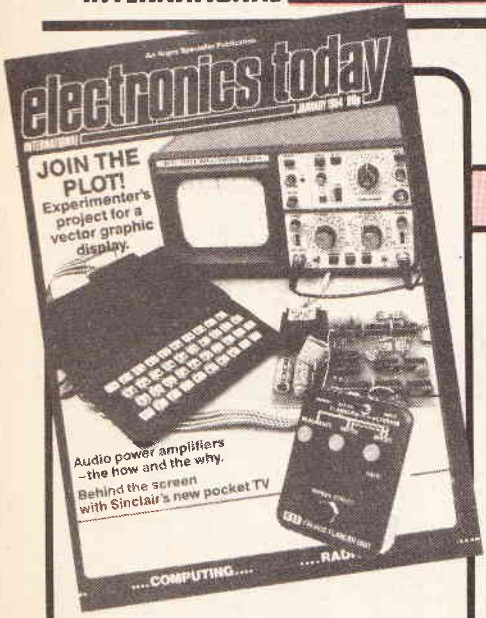


WORLD LEADERS IN ELECTRONIC KIT DESIGN AND SUPPLY

PORTWAY INDUSTRIAL ESTATE
ANDOVER, HANTS SA10 3NM.
ORDER BY PHONE (0264) 64455
Simply request your chosen kit and quote your Access or Barclaycard Number.

electronics today

INTERNATIONAL JANUARY 1984 VOL 13 NO 1



Dave Bradshaw: Editor
Phil Walker: Project Editor
Ian Pitt: Editorial Assistant
Jerry Fowler: Technical Illustrator
Paul Stanyer: Ad. Manager
Lynn Collis: Copy Control
Ron Harris B.Sc: Managing Editor
T.J. Connell: Chief Executive

PUBLISHED BY:
Argus Specialist Publications Ltd.,
1 Golden Square, London W1R 3AB.
DISTRIBUTED BY:
Argus Press Sales & Distribution Ltd.,
12-18 Paul Street, London EC2A 4JS
(British Isles)
PRINTED BY:
The Garden City Press Ltd.
COVERS PRINTED BY:
Alabaster Passmore.

OVERSEAS EDITIONS and their EDITORS
AUSTRALIA — Roger Harrison
CANADA — Halvor Moorshead
GERMANY — Udo Wittig
HOLLAND — Anton Kriegsman

ABC **Member of the Audit Bureau of Circulation**

☐ Subscription Rates. UK £13.75 including postage. For further details and Airmail rates etc, see the Readers' Services page.

EDITORIAL AND ADVERTISEMENT OFFICE
1 Golden Square, London W1R 3AB. Telephone 01-437 0626. Telex 8811896.

FEATURES

Due to lack of space, the fourth part of Bob Bennett's series on Machine Code Programming has been held over until next month.

PROJECTS

INFORMATION

WATFORD ELECTRONICS

33, CARDIFF ROAD, WATFORD, HERTS WD1 8ED, ENGLAND
Tel. Watford (0923) 40588. Telex: 8956095 WAELEC
ORDERS NORMALLY DESPATCHED BY RETURN OF POST

ALL DEVICES BRAND NEW. FULL SPEC. AND FULLY GUARANTEED. SEND CASH, P.O.'s OR CHEQUE WITH ORDER. GOVERNMENT AND EDUCATIONAL INSTITUTIONS OFFICIAL ORDERS ACCEPTED (ACCESS ORDERS BY TELEPHONE 0923-50234). TRADE AND EXPORT INQUIRY WELCOME. P & P ADD 60p TO ALL CASH ORDERS. OVERSEAS POSTAGE AT COST. PRICES SUBJECT TO CHANGE.

VAT Export orders no VAT. U.K. customers please add 15% VAT to total cost incl. p&p. We stock thousands more items. It pays to visit us. We are situated behind Watford Football Ground. Open Monday to Saturday, 9.00am to 6.00pm. Ample FREE Car parking.

POLYESTER RADIAL LEAD CAPACITORS: 250V; 10n, 20n, 15n, 22n, 27n **6p;** 33n, 47n, 68n, 100n **8p;** 150n, 220n **10p;** 330n, 470n **15p;** 680n **19p;** 1µ **23p;** 1µ5 **40p;** 2µ2 **46p.**

ELECTROLYTIC CAPACITORS (Values in µF). **500V:** 10µF **52p;** 47 **78p;** **63V:** 0.47, 1.0, 1.5, 2.2, 3.3, **8p;** 4.7 **9p;** 10 **10p;** 15, 22 **12p;** 33 **15p;** 47 **12p;** 68 **16p;** 100 **19p;** 220 **26p;** 1000 **70p;** 2200 **99p;** **50V:** 68 **20p;** 100 **17p;** 220 **24p;** **40V:** 6.8 **15p;** 22 **9p;** 33 **12p;** 330, 470 **32p;** 1000 **45p;** 2200 **90p;** **25V:** 4.7, 10, 22, 47 **8p;** 100 **11p;** 150 **12p;** 220 **15p;** 330 **22p;** 470 **25p;** 680, 1000 **34p;** 1500 **42p;** 2200 **50p;** 3300 **76p;** 4700 **92p;** **16V:** 2.5, 40 **8p;** 47, 68, 100 **9p;** 125 **12p;** 220 **13p;** 330 **16p;** 470 **20p;** 680 **34p;** 1000 **27p;** 1500 **31p;** 2200 **36p;** 4700 **79p.**

TAG-END TYPE: 64V: 4700 **245p;** 3300 **198p;** 2200 **139p;** **50V:** 3300 **154p;** 2200 **110p;** **40V:** 4700 **160p;** **25V:** 4700 **98p;** 10,000 **320p;** 15,000 **345p.**

POTENTIOMETERS: Carbon Track, 0.25W Log & Linear Values.

500Ω, 1K & 2K (LIN ONLY) Single	34p
5KΩ-2MΩ single gang	34p
5KΩ-2MΩ single gang D/P switch	80p
5KΩ-2MΩ dual gang stereo	90p

TANTALUM BEAD CAPACITORS: **35V:** 0.1µ, 0.22, 0.33 **15p;** 0.47, 0.68, 1.0, 1.5 **16p;** 2.2, 3.3 **18p;** 4.7, 6.8 **22p;** 10 **28p;** **16V:** 2.2, 3.3, **16p;** 4.7, 6.8, 10 **18p;** 15 **36p;** 22 **36p;** 33, 47 **50p;** 100 **95p;** 220 **100p;** **10V:** 15, 22 **26p;** 33, 47 **50p;** 100 **75p.**

SLIDER POTENTIOMETERS 0.25W log and linear values 60mm track 5KΩ-500KΩ Single gang **70p**

SILVER MICA (pf) 2, 3.3, 4.7, 6.8, 8.2, 10, 12, 18, 22, 27, 33, 39, 47, 50, 56, 68, 75, 82, 85, 100, 120, 150, 180 **15p.** 220, 250, 270, 330, 360, 390, 470, 600, 800 & 820pF **21p.** 1000, 1200, 1800 **30p each** 3300, 4700 **60p each**

SIEMENS multilayer miniature capacitors. **250V:** 1nF, 1n5, 2n2, 3n3, 4n7, 6n8, 8n2, 10n, 15n, 22n **7p;** 18n, 27n, 33n, 47n **8p;** 39n, 56n, 68n **9p,** 100nF **11p.** 100V: 100n, 120n, **10p;** 150n **11p;** 220n **13p;** 330n **18p;** 470n **23p;** 680n **30p;** 1µF **34p;** 2µ2 **50p.**

PRESET POTENTIOMETERS
0.1W 50Ω-2.2M Mini Vert. & Horiz. **8p**
0.25W 220Ω-4M7 Vert. & Horiz. **12p**

RESISTORS Hi-stab, Miniature, 5% Carbon.

	RANGE	Val	1-99	100+
0.25W	2Ω2-4M7	E24	3p	1p
0.5W	2Ω2-4M7	E12	3p	1p
1W	2Ω2-10M	E12	6p	4p
1% Metal Film 51Ω-1M		E24	8p	6p

CERAMIC Capacitors: 50V Range 1pF to 6800pF **4p;** 10nF, 15n, 33n, 47nF **5p;** 100nF/30V **7p.**

POLYSTYRENE Caps: 10pF to 1nF **8p**; 1n5 to 12nF **10p**

RESISTORS S.I.L. Package: 7 Commoned, 100Ω, 680Ω, 1K, 2K2, 4K7, 10K, 47K, 100K **24p.** 8 Commoned: (9 pins) 150Ω, 180Ω, 270Ω, 330Ω, 1K, 2K2, 4K7, 6K8, 10K, 22K, 47K, 100K **26p.**

TRANSISTORS

AC127/8	35
AC176	28
AC187/8	32
AD142	120
AD149	79
AD161/2	42
AF118	95
AF139	40
AF239	55
BC107/8	10
BC107B	14
BC108B	14
BC108C	14
BC109	10
BC109B	14
BC109C	14
BC147/8	9
BC147B	10
BC148C	10
BC149	9
BC149C	12
BC157/8	10
BC159	11
BC167A	10
BC168C	10
BC169C	10
BC171/2	11
BC173	11
BC177/8	16
BC179/81	20
BC182/3	10
BC184	10
BC182L	10
BC183L	10
BC184L	10
BC186/7	26
BC212/3	10
BC212L	10
BC213L	10
BC214	10
BC214L	10
BC237/8	14
BC307B	14
BC308B	16
BC327/8	15
BC337/8	15

BC441	34
BC461	34
BC477/8	40
BC516/7	40
BC547/8	12
BC549C	14
BC556/7	15
BC558/9	15
BCY70	16
BCY71/2	20
BD131/2	48
BD133	60
BD135	45
BD136/7	40
BD138/9	40
BD140	40
BD245	45
BD695A	150
BD696A	150
BF194/5	12
BF198/9	18
BF200	30
BF224	25
BF244A	28
BF244B	29
BF256B	35
BF257/8	32
BF259	35
BF594/5	23
BFR39/40	23
BFR41/79	23
BFR80/81	25
BFR98	105
BFX29/84	28
BFX85/86	28
BFX87/88	28
BFY50/51	23
BFY52	23
BFY56	32
BFY90	80
BRY39	40
BSX20	20
BSX29	34
BU105	170
BU205	190
BU206	200

BU208	200
MJ2955	70
MJE340	54
MJE371	100
MJE2955	99
MJE3055	70
MPF102	40
MPF103/4	30
MPF105	30
MPSA05	25
MPSA06	25
MPSA12	32
MPSA55	30
MPSA56	30
MPSA70	30
MPSU02	58
MPSU05	55
MPSU06	55
MPSU52	65
MPSU55	60
MPSU56	60
OC23	170
OC28/36	220
OC41/42	75
OC70	40
OC76	50
OC81/82	50
OC83/84	40
TIP29A	32
TIP29C	38
TIP30A	35
TIP30C	37
TIP31A	38
TIP31C	37
TIP32A	38
TIP32C	42
TIP33A	65
TIP33C	78
TIP34A	74
TIP34C	88
TIP35A	110
TIP35C	128
TIP36A	130
TIP36C	140
TIP41A	50
TIP41B	52
TIP42A	55
TIP42B	58
TIP120	70
TIP121	73

TIP141	105
TIP142	105
TIP147	120
TIP2955	60
TIP3055	60
TIS43	32
TIS44	45
TIS88A	50
TIS90	30
TIS91/93	32
VK1010	99
VN10KM	70
VN46AF	95
VN66AF	110
VN88AF	99
VN89AF	120
ZTX107/8	11
ZTX109	12
ZTX212	28
ZTX300	13
ZTX301/2	16
ZTX303	25
ZTX304	17
ZTX320/26	30
ZTX500/1	14
ZTX502/3	18
ZTX504	25
ZTX531	25
ZTX550	25
2N696	30
2N697	23
2N698	40
2N699	48
2N706A	19
2N708	19
2N914/5	32
2N918	35
2N930	20
2N1131/2	24
2N1303/4/5	
2N1307/8	65
2N1613	30
2N1671B	160
2N2160	295
2N2219A/20A/21A/22A	25
2N2369A	18
2N2646	45
2N2846	80

2N2904A/05A/06A/07A	26
2N2926G	10
2N3053	25
2N3054	58
2N3055	40
2N3442	140
2N3615	199
2N3702/3	10
2N3704/5	10
2N3706/7	10
2N3708/9	10
2N3710	10
2N3771	179
2N3772	195
2N3773	210
2N3819	27
2N3820	38
2N3822/3	45
2N3866	90
2N3903/4	15
2N3905/6	15
2N4427	80
2N4959	78
2N5172	18
2N5190	45
2N5191	75
2N5194	80
2N5305	24
2N5457	30
2N5458/9	30
2N5485	36
2N5777	45
2N6027	32
2N6109	60
2N6290	70
2SA636	250
2SA671	250
2SA715	60
2SC495/6	70
2SC1061	250
2SC1096	85
2SC1162	30
2SC1172	125
2SC1173	125
2SC1306	100
2SC1307	150
2SC1449	85
2SC1679	190
2SC1678	140

2SC1923	50
2SC1945	225
2SC1953	90
2SC1957	90
2SC1969	140
2SC2028	85
2SC2029	200
2SC2078	170
2SC2091	85
2SC2166	165
2SC2314	85
2SC2465	125
2SC2547	30
2SD234	75
2SK45	90
2SK288	225
2SJ83	225
2SJ85	225
3N128	112
3N140	112
40251	150
40311	60
40313	130
40361/62	70
40408	76
40412	90
40467	130
40468	85
40594	105
40595	110
40603	110
40673	70
40871/2	90

JUST PHONE YOUR ORDER THROUGH, WE DO THE REST.
0923 50234

LINEAR IC's

555 CMOS	85	LM324	30	SAB4209	595
702	75	LM334Z	90	SG3402	295
709C 8 pin	35	LM335	128	SL490	350
710	48	LM339	47	SL6270	150
741	14	LM348	60	SN76013N	350
747C 14 pin	65	LM349	115	SN76023N	350
748C 8 pin	36	LM358	60	SN76033	350
753 8 pin	185	LM377	175	SN76477	420
810	159	LM379	475	SN76488	480
9400CJ	350	LM380	75	SP8629	350
AY-1-1320	225	LM381N	145	SP0256AL	850
AY-1-5050	99	LM382	115	TA7120	125
AY-1-5051	160	LM384	160	TA7130	125
AY-1-6720	210	LM386	90	TA7204	150
AY-3-1270	730	LM387	120	TA7205	175
AY-3-8910	420	LM389	95	TA7222	150
AY-3-8912	625	LM393	45	TAA900	395
AY-5-1230	450	LM394CH	290	TAA621	296
AY-5-1317A	630	LM725CN	325	TAA661	190
CA3011	130	LM1889	325	TAA700	275
CA3012	175	LM733	70	TAD100	159
CA3014	275	LM1871	325	TBA120S	70
CA3018	86	LM2917	195	TBA540	275
CA3019	80	LM3302	75	TBA550Q	330
CA3020	210	LM3900	50	TBA641	290
CA3023	210	LM3909	85	TBA651	190
CA3028A	95	LM3911	125	TBA800	80
CA3035	255	LM3914	200	TBA810S	95
CA3036	270	LM3915	200	TBA820	80
CA3043	275	LM3916	250	TBA920Q	200
CA3045	365	LS7220	280	TBA950	300
CA3046	70	M51513L	230	TBA990	350
CA3048	220	M51515L	320	TC9109	750
CA3059	285	M51516L	475	TCA270	350
CA3075	213	M706B1	125	TCA280A	220
CA3080E	70	MB3712	220	TCA940	175
CA3081	190	MB3756	440	TCA965	145
CA3086	48	MC1204	250	TDA1004	290
CA3089E	200	MC1303	98	TDA1008	310
CA3090AQ	375	MC1304P	260	TDA1010	198
CA3123	165	MC1310P	150	TDA1022	499
CA3130	90	MC1445	250	TDA1024	115
CA3140	40	MC1455	50	TDA1034	350
CA3160	95	MC1458	35	TDA1490	350
CA3161E	160	MC1469	300	TDA2002	325
CA3162E	450	MC1494	694	TDA2003	250
CA3189	200	MC1495	350	TDA2004	495
CA3240	110	MC1496L	70	TDA2006	330
HA1366	175	MC1596	225	TDA2020	320
HA1388	255	MC1648	290	TDA2030	295
ICL7106	690	MC3302	90	TDB0791	420
ICL7107	975	MC3401	65	TL061CP	40
ICL7204	550	MC3403	75	TL062CP	60
ICL7611	99	MC3405	150	TL064CN	98
ICL7660	248	MC3432	00	TL071CP	25
ICL8038CC	300	MC3442	00	TL072CP	45
ICL8211	350	MC3423P	80	TL074CN	100
ICM7205	1150	MC4016	00	TL081CP	24
ICM7207	475	MF10	350	TL082CP	45
ICM7215	1050	MFC6040	275	TL083CP	75
ICM7216A	£22	ML924	275	TL084CP	90
ICM7217A	750	NE515	275	TL091CP	55
ICM7224	785	NE529	225	TL170	50
ICM7240	300	NE531	140	TL430C	90
ICM7555	85	NE534	150	TL507	110
ICM7556	150	NE543	225	TL509	110
LA3350	250	NE544	210	UA2240	120
LA4031P	340	NE555	18	UA78S40	230
LA4032	295	NE556DB	45	UAA170	180
LA4400	350	NE558	140	UAA180	180
LA4422	320	NE560	325	UGN3020T	160
LC7120	300	NE561	395	ULN2001	80
LC7130	340	NE562B	410	ULN2003	75
LC7137	395	NE564	420	ULN2004	75
LF347	150	NE565A	120	ULN2068	290
LF351	48	NE566	155	ULN2802	200
LF353	95	NE567	140	ULN2804	150
LF355	85	NE570	410	ULN2283	100
LF356	95	NE571	400	UPC575	275
LF357	110	NE5532	145	UPC1025H	375
LF398	475	NE5534	105	UPC1032	95
LM10	350	OM335	750	UPC1156H	270
LM301A	30	RC4136D	60	UPC1182	320
LM307	45	RC4558	45	UPC1366	195
LM308	95	S566B	225	XR2206	300
LM311	55	SAB3209	425	XR2207	375
LM318	150	SAB3210	325	XR2211	575
LM319	195	SAB3271	485	XR2216	675
				XR2266	360
				ZN414	80

ZN419CE	180
ZN423E	130
ZN424E	130
ZN425E-8	345
ZN426E-8	300
ZN427E-8	590
ZN428E	410
ZN429E-8	210
ZN459	325
ZN1034E	200
ZN1040E	665
ZNA234E	850

COMPUTER IC's

2102L	100	8088	£16	SFF96364E	800
2114L-200n	95	81LS95/96	120	SP0256AL2	850
2147-3	425	81LS97/98	120	TMS2716-3	725
2532-3	300	8118-10	250	TMS4047	100
25L32	450	8123	125	TMS4164-15	395
27L08	450	8154	£9	TMS4416-2	475
27L32	550	8155	350	TMS4500	£14
2716-5V	270	8156	350	TMS4532-3	350
2732	320	8202	£25	TMS5100	600
2764-250	425	8212	150	TMS6011	500
2813	200	8214	425	TMS9927	£14
26501	75	8216	100	TMS9928	£20
27128-4	£15	8224	150	TMS9929	£16
27128/250n	£16	8226	250	TMS9980	£20
3242	590	8228	220	TMS9995	£12
4027	95	8243	270	ULN2003	75
4116-150	100	8250	850	UPD7002	425
4118-250	325	8251A	250	WD1691	£14
4164-200	425	8253	400	WD1943	700
4334	00	8255	225	Z80CPU 2.5	299
4416-2	475	8256A	£35	Z80ACPU4M	300
4532-3	220	8257A	400	Z80ACTC	260
4816-100ns	250	8259	395	Z80B	875
5101	220	8271	£36	Z80DART	495
5514	250	8272	£17	Z80ADART	550
6116-150ns	340	8279	385	Z80ADMA	895
6116L-120ns	525	8282	450	Z80DMA	695
6117-100n	490	8283	450	Z80PIO	260
6167-6	795	8284	350	Z80APIO	275
6402	350	8T26A	99	Z80SIO-1	850
6502 CPU	325	8T27	150	Z80ASIO	900
6502A	450	8T28A	120		
6503	650	8T31	350		
6504	600	8T95N	90		
6505	650	8T97N	90		
6520	100	9364AP	550		
6522 VIA	285	9602	220		
6530 RRIOT	£11	AM26LS31C	125		
6532 RIOT	570	AM26LS32	100		
6545 CRTC	899	AM26LS32A	125		
6551 ACIA	650	AM26LS33	150		
6592	00	AM26LS33A	125		
68B54	780	AY-3-1015	300		
6800	780	AY-5-1013	300		
6802	220	AY-5-1350	388		
6803	250	AY-5-2376	600		
6805	670	AY-5-3600	750		
6808	520	COM8017	275		
6809	630	COM8116	700		
6810	115	DM8131	275		
6820	100	DP8304BN	250		
68B21	220	DS3647	00		
6821	100	DS3691N	320		
6840	375	DS8820	110		
6843	00	DS8830	110		
6845	750	DS8831	125		
6846	625	DS8832	250		
6847	650	DS88LS120N	275		
6850	110	E9364	00		
6852	250	E9365	£38		
6854	599	E9366	£38		
68B54	780	FD1691	£15		
6875	500	FD1771	£15		
68000 New msk	[illegible]	FD1791	£22		
8035	600	FD1793	£23		
8080A	250	FD1795	£28		
8085A	350	FD1797	£28		
		HA11235	200		
		HA17080	200		
		HA17083	200		
		HA80391	200		
		HD26501	75		
		IM6402	380		
		INS8060N	1050		
		MC1488	55		
		MC1489	55		
		MC14411	675		
		MC14412	725		
		MC3446	250		
		MC3447P	315		
		MC3486	175		
		MC3487	175		
		MM3886-2M	£7		
		MM5280D	695		
		MM5303	635		
		MM5307	1275		
		MM5387A	475		
		MM58174	700		
		RO-3-2513L	550		
		RO-3-2513U	650		

74S299	540
74S301	350
74S365	250
74S373	400
74S374	365
74S412	380
74S470	325
74S471	620
74S472	1150
74S474	400
74S475	800
74S571	620
74S573	950

75

75107/8/9	95
75110	90
75150	125
75154	195
75159	125
75182/3	99
75188/9	55
75322	140
75450	86
75451/2	52
75454	70
75491/2	65

74S

74S00	24
74S02	24
74S03	30
74S04	30
74S05	60
74S08	60
74S10	40
74S11	50
74S20	40
74S22	50
74S30	40
74S32	70
74S37	60
74S74	75
74S85	295
74S86	70
74S112	90
74S113	90
74S114	80
74S124	300
74S132	110
74S133	60
74S138	100
74S139	115
74S140	60
74S151	180
74S153	182
74S157	250
74S158	195
74S163	300
74S174	250
74S175	320
74S188	140
74S189	140
74S194	295
74S195	275
74S197	400
74S201	350
74S225	500
74S240	300
74S241	300
74S244	290
74S251	225
74S257	225
74S258	250
74S260	70
74S262	850
74S287	225
74S288	210
74S289	200

TTL 74

7400	18
7401	18
7402	18
7403	18
7404	20
74L04	00
7405	20
7406	50
7407	50
7408	20
7409	20
7410	20
7411	20
7412	20
7413	35
7414	45
7416	35
7417	35
7420	20
7421	20
7422	30
7423	30
7425	30
7426	45
7427	30
7428	30
7430	25
7432	25
7433	35
7437	30
7438	50
7440	25
7441	55
7442	40
7443	70
7444	65
7445	75
7446	55
7447	55
7448	60
7450	25
7451	25
7453	25
7454	25
7460	25
7470	35

7472	35
7473	35
7474	30
7475	60
7476	35
7480	50
7481	140
7482	80
7483	50
7484	90
7485	110
7486	35
7489	175
7490	30
7491	48
7492	30
7493	30
7494	60
7495	35
7496	50
7497	120
74100	90
74104	50
74105	50
74107	35
74109	40
74110	35
74111	60
74112	170
74116	80
74118	75
74119	85
74120	80
74121	32
74122	40
74123	55
74125	35
74126	40
74128	45
74132	40
74136	35
74141	60
74142	175
74143	190
74144	190
74145	60
74147	85
74148	70
74150	85
74151	40
74153	40
74154	85
74155	40
74156	40
74157	40
74159	100
74160	50
74161	50
74162	50
74163	55
74164	55
74165	55
74166	55
74167	200
74170	150
74172	280
74173	80
74174	100
74175	70
74176	50
74177	45
74178	60
74179	90
74180	50
74181	140
74182	50
74184	100
74185	100
74186	75
74188	75
74190	75
74191	75
74192	75
74193	60
74194	80
74195	60
74196	60
74197	60
74198	100
74199	100

74221	80
74246	100
74247	100
74248	130
74249	120
74251	60
74259	150
74265	75
74273	175
74276	135
74278	130
74279	45
74283	70
74284	200
74285	210
74290	85
74293	65
74297	900
74298	70
74351	120
74365	60
74366	60
74367	60
74368	60
74390	80
74393	100
74490	110

74C

C244	195
C245	195
C373	240
C374	245
C922	420
C923	500
C925	400

74LS

LS00	18
LS01	18
LS02	18
LS03	18
LS04	18
LS05	18
LS08	18
LS09	18
LS10	18
LS11	18
LS12	18
LS13	20
LS14	36
LS15	20
LS20	18
LS21	18
LS22	18
LS24	00
LS26	22
LS27	20
LS28	18
LS30	18
LS32	18
LS33	20
LS37	20
LS38	20
LS40	20
LS42	32
LS47	50
LS48	50
LS49	50
LS51	20
LS52	20
LS54	20
LS55	20
LS63	55
LS73	22
LS74	22
LS75	38

LS76	22
LS78	40
LS83	40
LS85	55
LS86	28
LS90	30
LS91	55
LS92	35
LS93	35
LS95	45
LS96	75
LS107	36
LS109	36
LS112	36
LS113	30
LS114	30
LS122	55
LS123	60
LS124	150
LS125	32
LS126	32
LS132	40
LS133	26
LS135	24
LS136	24
LS138	38
LS139	38
LS145	60
LS147	110
LS148	100
LS151	45
LS153	45
LS154	150
LS155	35
LS156	35
LS157	35
LS158	30
LS160	45
LS161	45
LS162	40
LS163	40
LS164	45
LS165	50
LS166	75
LS168	140
LS169	00
LS170	85
LS173	75
LS174	00
LS175	40
LS181	100
LS183	100
LS190	55
LS191	00
LS192	55
LS193	50
LS194	45
LS195	50
LS196	55
LS197	55
LS221	75
LS240	60
LS241	60
LS242	68
LS243	68
LS244	70
LS245	120
LS247	60
LS248	60
LS249	60
LS251	40
LS253	40
LS257	40
LS258	40
LS259	70
LS260	30
LS261	30
LS266	24
LS273	150
LS275	165
LS279	40
LS280	150
LS283	40
LS290	40
LS293	900
LS294	000
LS295	70
LS298	70
LS299	115

LS320	160
LS323	175
LS324	150
LS325	150
LS326	000
LS327	000
LS347	65
LS348	125
LS352	60
LS353	60
LS356	180
LS362	180
LS363	180
LS364	180
LS365	45
LS366	45
LS367	40
LS368	40
LS373	60
LS374	70
LS375	40
LS377	75
LS378	85
LS379	80
LS384	475
LS385	185
LS386	50
LS390	60
LS393	60
LS395	85
LS396	00
LS398	80
LS399	80
LS445	100
LS447	50
LS465	120
LS467	120
LS471	000
LS490	80
LS540	90
LS541	90
LS624	00
LS640	200
LS641	200
LS645	200
LS668	65
LS669	65
LS670	120
LS673	950
LS674	500

CMOS

4000	14
4001	14
4002	14
4006	50
4007	15
4008	32
4009	24
4010	24
4011	15
4012	18
4013	20
4014	46
4015	40
4016	20
4017	32
4018	45
4019	25
4020	42
4021	40
4022	40
4023	15
4024	32
4025	16
4026	90
4027	22
4028	45
4029	47
4030	20
4031	125
4032	70
4033	125

4034	140
4035	45
4036	275
4037	115
4038	110
4039	280
4040	40
4041	40
4042	40
4043	40
4044	40
4045	105
4046	46
4047	40
4048	40
4049	30
4050	30
4051	45
4052	60
4053	50
4054	85
4055	85
4056	85
4057	£10
4059	435
4060	45
4061	1195
4062	995
4063	85
4066	27
4067	245
4068	20
4069	20
4070	20
4071	22
4072	20
4073	22
4075	20
4076	55
4077	20
4078	20
4081	20
4082	20
4085	55
4086	60
4089	125
4093	20
4094	70
4095	95
4096	70
4097	275
4098	75
4099	75
4160	95
4161	99
4162	99
4163	99
4174	99
4175	105
4194	105
4408	790
4409	790
4410	725
4411	675
4412	790
4415	480
4419	280
4422	770
4433	770
4435	850
4440	999
4450	350
4451	350
4490	350
4500	675
4501	28
4502	60
4503	40
4504	75
4505	185
4506	35
4507	35
4508	130
4510	46
4511	46
4512	45
4513	199
4514	115
4515	125
4516	65

4517	275
4518	40
4519	30
4520	50
4521	90
4522	125
4526	60
4527	65
4528	50
4529	150
4530	90
4531	130
4532	50
4534	400
4536	275
4538	80
4539	90
4541	140
4543	70
4544	150
4548	40
4549	375
4553	245
4554	180
4555	35
4556	35
4557	320
4558	120
4559	395
4560	160
4561	104
4562	495
4566	165
4568	250
4569	175
4572	36
4580	460
4581	250
4582	99
4583	90
4584	48
4585	70
4597	330
4599	290
40097	45
40098	42
40100	215
40101	130
40102	140
40103	175
40104	95
40105	105
40106	35
40107	60
40108	198
40109	100
40110	300
40114	240
40161	194
40163	50
40174	45
40175	50
40181	220
40192	75
40193	95
40194	90
40195	80
40244	195
40245	195
40257	198
40373	240
40374	245

SPEAKERS
8Ω, 0 3W, 2"; 2 25", 2 5", 3" **80p**
0 3W, 2 5" 40Ω; 64Ω or 80Ω **80p**

DIODES	
AA119	15
AA129	20
AAY30	15
BA100	15
BAX13	20
BY100	24
BY126	12
BY127	14
CRO33	250
OA9	40
OA47	12
OA70	12
OA79	15
OA81	20
OA85	15
OA90	8
OA91	8
OA95	8
OA200	8
OA202	8
1N914	4
1N916	5
1N4001/2	5
1N4003	6
1N4004/5	6
1N4006/7	7
1N4148	4
1N5401	15
1N5404	16
1N5406	17
1N5408	19
1S44	9
1S921	9
6A/100V	40
6A/400V	50
6A/800V	65

BRIDGE RECTIFIERS (plastic case)	
1A/50V	18
1A/100V	20
1A/400V	25
1A/600V	34
2A/50V	30
2A/200V	40
2A/400V	46
2A/600V	65
6A/100V	83
6A/600V	125
10A/200V	215
10A/600V	298
25A/200V	240
25A/600V	395
BY164	56
VM18	50

ZENERS
Range: 2V7 to 39V 400mW **8p each**
Range: 3V3 to 33V. 1 3W **15p each**

VARICAPS	
MVAM2	165
BA102	30
BB105B	40
BB106	40

SCR's Thyristors	
0 8A-100V	32
5A/300V	38
5A/400V	40
5A/600V	48
8A/300V	60
8A/600V	95
12A/100V	78
12A/400V	95
12A/800V	188
BT106	150
BT116	180
C106D	38
TIC44	24
TIC45	29
TIC47	35
2N5064	38
2N4444	130

TRIACS	
3A/100V	48
3A/400V	56
3A/800V	85
8A/100V	60
8A/400V	69
8A/800V	115
12A/100V	78
12A/400V	82
12A/800V	135
16A/100V	103
16A/400V	105
16A/800V	220
25A/400V	185
25A/800V	295
25A/1000V	480
30A/400V	525
T2800D	120

SOLDERCON PINS
100 **75p**
500 **370p**

DIAC
ST2 **25**

OPTO

LEDS price includes Clips

TIL209 Red 3mm	10
TIL211 Green 3mm	14
TIL212 Yellow	14
TIL220 2" Red	12
0 2" Yel, Grn, Amber	14
Rectangular LEDs with two part clip R, G & Y	45
Rectangl Stackable LEDS	18
Triangular LEDs R&G	18
0 2" Flashing LED Red	56
0 2" Bi colour LEDs Red/Green	65
Green/Yellow	80
0 2" Tri colour LEDs Red/Green/Yellow	85
0 2" Red High Bright	59
High Bright Green or Yellow	65
LD271 Infra Red (emit)	46
TIL32 Infra Red (emit)	52
SFH205 (detector)	118
TIL78 (detector)	55
TIL38	50
TIL81 **82**; TIL100	90

7 Segment Displays

TIL321 5" C An	120
TIL322 5" C th	120
DL704 3" C Cth	125
DL707 3" C Anod	125
FND357 or 500	130
3" Green C A	140
±1 3" Red or Green	150
Bargraph 10 seg. Red	250
Bargraph NSM3914	500

FERRIC CHLORIDE
Crystals 1lb
195p + 50p p&p

DALO ETCH RESIST
Pen plus spare tip **100p**

0·5" LIQUID CRYSTAL DISPLAYS

3½ digit	495
4 digit	530
6 digit	625

BPX25	250
BPW21	320
BPX65	320
IL74	65
ILD74	115
ILQ74	220
ILCT6 Darlington Isolator	135
TIL111	70
OCP71	120
ORP12	78
2N5777	50
4N33	135
Pin diode	610
Schmitt Receiver	610

OPTO SWITCH
Reflective TIL139 **225**
Slotted similar to RS **186**

ALUMBOXES	
4×2½×2"	85
4×2¾×2½"	103
4×4×2½"	120
5×4×2"	105
5×2¾×1½"	90
5×2¾×2½"	130
5×4×1½"	99
5×4×2½"	120
6×4×2"	120
6×4×3"	150
7×5×3"	180
8×6×3"	210
10×4½×3"	240
10×7×3"	275
12×5×3"	260
12×8×3"	295

COPPER CLAD BOARDS

Fibre Glass	Single-sided	Double-sided	SRBP 9 5"×8 5"
6"×6"	**100p**	**125p**	**110p**
6"×12"	**175p**	**225p**	

VEROBOARDS 0 1"

	Clad	Plain		
2½×3¾"	**85-95**	—	'VQ' Board	180
2½×5"	**100-110**	—	'DIP' Board	395
3¾×3¾"	**100-110**	—	Vero Strip	144
3¾×5"	**115-125**	**95p**	**PROTO-DECs**	
3¾×17"	**390-420**	**275p**	Veroblock	405
4¾×18"	**495p**	—	S-Dec	395
Pkt. of 100 pins	**55p**		Eurobreadboard	590
Spot Face Cutter	**150p**		Bimboard 1	695
Pin Insertion Tool	**185p**		Superstrip SS2	£13

VERO WIRING PEN and Spool **350p**
Spare Wire (Spool) **75p**; Combs **6p** ea.
Wire Wrapping Stakes 100 **250p**

VOLTAGE REGULATORS

1A T0220 Plastic Casing

	+ve		−ve	
5V	7805	**40p**	7905	**45p**
12V	7812	**40p**	7912	**45p**
15V	7815	**40p**	7915	**45p**
18V	7818	**40p**	7918	**45p**
24V	7824	**40p**		

100mA T092 Plastic Casing

5V	78L05	**30p**	79L05	**50p**
6V	78L62	**30p**	—	
8V	78L82	**30p**	—	
12V	78L12	**30p**	79L12	**50p**
15V	78L15	**30p**	79L15	**50p**

ICL7660	**248**	LM317K	**250**
78H05 5V/5A	**550**	LM317P	**99**
78H12 12V/5A	**640**	LM323K	**500**
78HG +5 to +24V 5A	**599**	LM337T	**175**
		LM723	**30**
79HG −2.25V to −24V 5A	**685**	TBA625B	**75**
		RC4194	**375**
LM309K	**120**	RC4195	**160**

SWITCHES

SLIDE 250V

1A DPDT	14
1A DPDT C/OFF	15
½A DP on/on/on	40

PUSH BUTTON
Spring loaded
Latching or Momentary 6A
SPDT c/over **110**
DPDT c/over **160**

MINIATURE
Non Locking
Push to make **15p**
Push break **25p**

TOGGLE 2A 250V

SPST	35
DPDT	48
4 pole on off	54

SUB-MIN TOGGLE 2 amp

SP changeover	60
SPST on off	54
SPDT c/off	85
SPDT Biased	105
DPDT 6 tags	75
DPDT C/OFF	88
DPDT on/on/on	185
DPDT Biased	145
3 pole c/over	205

ROTARY: (Adjustable Stop Type)
1 pole/2 to 12 way, 2p/2 to 6 way, 3 pole/2 to 4 way, 4 pole/2 to 3 way **48p**

ROTARY: Mains 250V AC, 4 Amp **64p**

DIP SWITCHES: (SPST) 4 way **65p**; 6 way **80p**; 8 way **87p**; 10 way **100p**; (SPDT) 4 way **190p.**

AMPHENOL PLUG

	IDC	Solder
24 way IEEE	**475p**	**450p**
36 way Centronics	**525p**	**485p**

ASTEC UHF MODULATORS
6MHz Standard **325p**
8MHz Wideband **450p**

Telephone orders by Access. Simply phone your order through 0923-50234 & we do the rest.

DIL SOCKETS	Low profile	Wire wrap
8 pin	**8p**	**25p**
14 pin	**10p**	**35p**
16 pin	**10p**	**42p**
18 pin	**16p**	**52p**
20 pin	**20p**	**60p**
22 pin	**22p**	**65p**
24 pin	**25p**	**70p**
28 pin	**28p**	**80p**
40 pin	**30p**	**99p**

ZIF DIL SOCKET
24 way **565p**
28 way **750p**
40 way **799p**

DIL PLUGS (Headers)

Pins	Solder	IDC
14	**38p**	**95p**
16	**42p**	**100p**
24	**88p**	**138p**
28	**185p**	**290p**
40	**195p**	**218p**

RIBBON CABLE (price per foot)

Ways	Grey	Colour
10	**15p**	**28p**
16	**25p**	**40p**
20	**30p**	**50p**
26	**40p**	**65p**
34	**60p**	**85p**
40	**70p**	**90p**
64	**100p**	**135p**

'D' CONNECTORS:

Pins	9 way	15 way	25 way	37 way
MALE				
Solder	**80p**	**110p**	**160p**	**240p**
Angle	**150p**	**210p**	**250p**	**355p**
Strait	**170p**	**160p**	**220p**	**310p**
FEMALE				
Solder	**105p**	**160p**	**200p**	**338p**
Angle	**165p**	**215p**	**290p**	**440p**
Strait	**175p**	**200p**	**300p**	**420p**
COVERS	**80p**	**75p**	**75p**	**90p**

IDC 25 way Plg. **385p**, Skt. **450p**

SIL Sockets 0.1"
20 way **65p**
32 way **95p**

EDGE CONNECTORS 1"

2×18 way	**180p**
2×22 way	**199p**
2×23 way	**170p**
2×25 way	**225p**
2×28 way	**210p**
2×30 way	**245p**
2×36 way	**295p**
2×40 way	**315p**
2×43 way	**395p**
2×75 way	**550p**

SPECTRUM FORTH I/O UNIT

12K off Fig – **FORTH IN ROM**

FULL RS232 and 24 bits of I/O for Centronics and control units can be used from **BASIC** or **FORTH.** Will work on 16K or 48K Spectrum. Many more features.

ONLY £59
(Send S.A.E. for full details)

IDC CONNECTORS (Speed block type)

2 rows	PCB Male with latch Strt. Pins	Angle Pins	Female Header Socket	Female Card-Edge Connector
10 way	**90p**	**99p**	**85p**	**120p**
16 way	**130p**	**150p**	**110p**	**195p**
20 way	**145p**	**166p**	**125p**	**240p**
26 way	**175p**	**200p**	**150p**	**320p**
34 way	**205p**	**236p**	**169p**	**340p**
40 way	**220p**	**250p**	**190p**	**420p**
50 way	**235p**	**270p**	**200p**	**470p**

EURO CONNECTORS

Gold flashed contacts	FEMALE SOCKETS Strt.	Angle	MALE PLUGS Strt.	Angle
DIN 41617 31 way	**170p**	—	—	**175p**
DIN 41612 2×32 way	**275p**	**320p**	**220p**	**285p**
DIN 41612 2-3×32 way	**295p**	**340p**	**240p**	**300p**
DIN 41612 3×32 way	**360p**	**385p**	**260p**	**395p**

TRANSFORMERS (mains Prim. 220-240V)
3-0-3V, 6-0-6V 100mA; 9-0-9V 75mA; 12-0-12V 75mA; 15-0-15V 75mA **98p**
6VA: 2x6V- 5A; 2x9V- 4A; 2x12V-0 3A; 2x15V- 25A **250p**
12VA: 2x4V5-1 3A, 2x6V-1 2A; 2x12V- 5A; 2x15V- 4A **345p** (35p p&p)
24VA: 6V-1 5A 6V-1 5A; 9V-1 2A 9V-1 2A; 12V-1A 12V-1A; 15- 8A 15- 8A; 20V- 6A 20V- 6A **385p** (60p p&p)
50VA: 2×6V-4A; 2×9V-2 5A; 2×12V-2A; 2×15V-1 5A; 2×20V-1 2A; 2×25V-2A; 2×30V-0 8A **480p** (60p p&p)
100VA: 2×12V-4A; 2×15V-3A; 2×20V-2 5A; 2×30V-1 5A; 2×40V-1 25A; 2×50V-1A **965p** (60p p&p)

JUMPER LEADS Ribbon Cable Assembly
DIL Plug (Headers)
Single Ended Lead. 24" long

Length	14pin	16pin	24 pin	40 pin
24"	**145p**	**165p**	**240p**	**325p**
Double Ended Leads				
6"	**185p**	**205p**	**300p**	**465p**
12"	**198p**	**215p**	**315p**	**490p**
24"	**210p**	**235p**	**345p**	**540p**
36"	**230p**	**250p**	**375p**	**595p**

IDC FEMALE RECEPTACLE Jumper Leads 36"

	20pin	26pin	34pin	40pin
1 end	**160p**	**200p**	**260p**	**300p**
2 ends	**290p**	**370p**	**480p**	**525p**

COMPUTER CORNER

- **SEIKOSHA GP100A** – Unihammer Printer, normal & double width characters, dot resolution graphics 10" Tractor feed, parallel interface standard. **FREE 500 Sheets** **£155**
- **SEIKOSHA GP 250X** Printer **£199**
- **EPSON FX80 PRINTER** 10" Tractor/Friction feed, 11×9 Dot matrix. 160 CPS, 137 colmns. Bidirectional, logic seeking, proportional spacing. Hi-res bit image. Normal, Italics & Elite Char. Underlining Superscript & Subscript. **£349**
- **EPSON RX80 100CPS,** 9×9 matrix Epson printer. Didirectional, logic seeking, etc. **£255**
- **RX80F/T EPSON PRINTER.** As above but has both Tractor and Friction feed facilities. **£279**
- **KAGA – RGB** 12 inch medium resolution colour monitors **£219**
  Connecting lead for KAGA monitors **£5**
- **ZENITH 12" Hi-RES,** Green Monitor 40/80 column select switch, value for money. **£73**
- **MICROVITEC 14"** colour monitor. RGB input. Lead incl. **£215**
- **TEX EPROM ERASER.** Erases up to 32 ICs in 15-30 min. **£33**
- **TEX EPROM ERASER** with the Solid-State 30 minute Electronic Timer. **£43**
- **SOLID STATE** 30 minute Electronic **TIMER** for above UV Erasors **£14**
- **Spare** 'UV lamp bulbs **£9**
- **MULTIRAIL PSU KIT.** Output: +5V/5A; +12V; +25V; −5V; −12V @ 1A. **£40**
- **4 ×4 matrix keypad** (reed switch assembly) **£4**
- **C12 COMPUTER Grade BASF Cassettes** in Library Cases **40p**
- **8½" & 9½" Fan fold paper** (1000 sheets) **(150p)** **£7**
- **Teleprinter Roll** (no VAT) **£3.50**

MANY MORE PRINTERS, MONITORS, INTERFACES, AVAILABLE. CALL IN AT OUR SHOP FOR DEMONSTRATION. BE SATISFIED BEFORE YOU BUY OR WRITE IN FOR OUR DESCRIPTIVE LEAFLET.

(P&P on some of the above items is extra)

BROTHER 8300 DAISEY WHEEL PRINTER/ TYPEWRITER

Provides very high quality type in any six interchangeable styles including Italics, Script and 4 conventional typefaces. Ideal for business use. Connects directly to a BBC Micro via standard centronics interface or can be used as a stand alone typewriter. As typewriter, has a built in timing function to measure the operator's speed making it ideal for teaching or invoicing jobs correctly. Friction feed; 11 CPS; 12" max width; 5 different colour ribbons. Hard top cover/carrying case. **Only: £399.**

SPECTRUM 32K UPGRADE

Upgrade your 16K Spectrum to full 48K with our RAM Upgrade Kit. Very simple to fit. Fitting instructions supplied.

£19.50

ANTEX Soldering Irons

C15W	**510**	**Spare bits**	**85**
G517W	**510**	**Elements**	**230**
G18W	**525**	**Iron stand**	**175**
XS25W	**530**	**Heat Shunt**	**30**

CRYSTALS	
32 768KHz	100
100KHz	235
200KHz	268
455KHz	370
1MHz	275
1 008M	275
1 28MHz	392
1 5MHz	420
1 6MHz	395
1 8MHz	395
1 8432M	200
2 0MHz	225
2 4576M	200
2 5MHz	225
2 56250M	220
3 2768M	150
3 57954M	98
3 6864M	300
4 0MHz	150
4 032MHz	290
4 194304M	200
4 433619M	100
4 608MHz	200
4 80MHz	200
5 0MHz	160
5 185MHz	300
5 24288M	390
6 0MHz	140
6 144MHz	150
6 5536MHz	200
7 0MHz	150
7 168MHz	250
7 68MHz	200
8 0MHz	150
8 08333M	395
8 867237M	175
9 00MHz	200
9 375MHz	350
10 0MHz	175
10 5MHz	250
10 7MHz	150
10 24MHz	200
12 0MHz	175
12 528MHz	300
14 31818M	170
14 7456M	175
14 765MHz	250
15 0MHz	200
16 0MHz	200
18 0MHz	180
18 432M	150
19 968MHz	150
20 0MHz	200
24 0MHz	170
24 930MHz	325
29 695MHz	150
26 670MHz	325
27 125MHz	295
27 145M	190
27 648MHz	300
38 66667M	175
48 0MHz	175
55 5MHz	400
100MHz	295
116 0MHz	300
145 8MHz	225

BBC MICROCOMPUTER

Model A **£299;** Model B **£399** (incl. VAT). We stock the full range of BBC Micro peripherals, Hardware & Software like, Disc Drives (Top quality Cumana & Mitsubishi), Diskettes, Printers, Printer Paper, Interface Cable, Dust Covers, Cassette Recorder & Cassettes, Monitors, Connectors (Ready made Cables, Plugs & Sockets), Plotter (Graphic Tablet) EPROM Programmer, Lightpen Kit, Joysticks, Sideways ROM Board, EPROM Eraser, Machinecode ROM, The highly sophisticated Watford's 16K BEEB DFS, WORDWISE, BEEBCALC, Software (Educational Application & Games), BOOKS, etc. etc. Please send SAE for our descriptive leaflet.

DISC DRIVES FOR BBC MICRO

- **CS50A – TEAC** Cased with own Power Supply, S/S, 40 track, 5¼", 100K **£175**
- **CD50A – TEAC** Twin Cased with own PSU, S/S, 40 track, 5¼", 200K **£340**
- **CS50E – TEAC** Single Cased with own PSU, S/S, 80 track, 5¼", 200K **£250**
- **CD50E – TEAC** Twin Cased with own PSU, S/S, 80 track, 5¼", 400K **£475**
- **SINGLE MITSUBISHI** Slim line – Cased with own PSU, DS/DD, 1 Megabytes (400K with BBC) **£275**
- **TWIN MITSUBISHI** Slim line – Cased with own PSU, DS/DD, 2 Megabytes (800K with BBC) **£535**
- Single Drive Cable for BBC Micro **£8**
- Twin Drive Cable for BBC Micro **£12**

(5 year warranty on VERBATIM Diskettes)

- 10 Verbatim Diskettes, 5¼", S/S **£20**
- 10 Verbatim Diskettes, 5¼", D/S **£30**

(2 year warranty on WABASH Diskettes)

- 10 WABASH Diskettes, 5¼", S/S **£15**
- 10 WABASH Diskettes, 5¼", D/S **£25**

Many more types available.
Please send SAE for our detailed leaflet.
N.B. Carriage is extra on drives.

WATFORD ELECTRONICS
Tel. (0923) 40588 **Telex. 8956095**

01-452 1500 TECHNOMATIC LTD 01-450 6597

BBC Micro Computer System
OFFICIAL DEALER
Please phone for availability

BBC Model B **£347**
+ carr £7/unit
Model A to Model B
Upgrade Kit **£60**
Installation **£15**

LANGUAGE ROMs
BCPL Rom + Disc + Manual £87
PASCAL-T Rom £45

WORD PROCESSOR ROMs
VIEW 16k Rom £52
WORDWISE 8k Rom £34

Software from ACORNSOFT/ PROGRAM POWER/GEMINI in stock

FLOPPY DISC INTERFACE
£95 & £15 installation

BBC COMPATIBLE DISC DRIVES
All drives are supplied with necessary cables
Single Drive without PSU: 100k **£150**; 200k **£215**; 400k **£265**
Single Drive with PSU: 100k **£185**; 200k **£260***; 400k **£330**
Dual Drives with PSU: 2x100k **£355**; 2x200k **£475***; 2x400k **£540**
*** These drives are switchable 40/80 drives.**
40/80 Switch Module for 1×400k and 2×400k Drive **£32**

DISKETTES
40 track SS **£15**; 80 track SSDD **£22**
80 track DSDD **£26**

BBC FLOPPICLENE DRIVE HEAD
Cleaning kit with 50 disposable discs **£17**

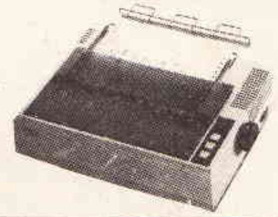
Phone or send for our BBC leaflet

CASSETTE RECORDER
SANYO Data Recorder DR101
A superior quality data recorder with dedicated computer output and monitoring facility on both record and play **£39.50 + £1.50 carr.**
SLIMLINE Cassette Recorder complete with counter and remote control **£24.50 + £1.50 carr.**
BBC Recorder **£27**
Computer Grade Cassettes
£0.50 each. **£4.50** for 10 + **£1** carr
Cassette lead **£3.50.**

MONITORS
MICROVITEC 14in RGB Monitors
1431 Std. Res Monitor **£215**
1451 Med Res Monitor **£345**
1441 Hi Res Monitor **£440**
12'' KAGA RGB I **£235** RGB III **£399**
12'' Hi Res Green SANYO **£99** KAGA **£106**

TORCH Z-80 PACK
Your B.B.C. computer can be converted into a business machine at a cost slightly higher than an 800k disc drive. The Torch pack with twin disc drive and a Z80A processor card greatly enhances the data storing and processing capability of the computer. (NOTE: In BBC mode the disc pack functions as a normal BBC drive.). Z80A card comes with 64k of RAM and a CP/M compatible operating system. The system is supplied complete with a BBC owner's user guide, a Systems/Demo disc, a PERFECT software package and COMANEX, a business management game. The PERFECT software package comprises of a DATABASE, CALC, WORDPROCESSOR and SPELLER commercially valued at over £1,000. The complete package for only **£730.** Installation **£20.** Carr. **£8.**

PRINTERS
EPSON RX80 FT **£305**
EPSON FX80 **£370**
EPSON FX100 **£565**
EPSON MX100 **£400**
Carriage/Printer **£7**



NEC PC 8023 BE-N **£320**
SEIKOSHA GP100A **£170**
SEIKOSHA GP250A **£210**
Parallel Printer Cable **£12**
Serial Printer Cable **£8**

Variety of Printer Interfaces in stock
2000 fanfold sheets **£13.50 + £3** p.&p.

SIDEWAYS ROM EXPANSION BOARD
SREB provides 8 additional sockets for expanding the computer's sideways ROM capacity by a further 128k (2764s consume 40mA on standby and in our opinion 8 ROMs will not overload the computer psu). The board is dimensioned ensuring clearance of components with adequate ventilation. Fully assembled and tested board with fitting instruction. With TI sockets **£25.** With turned pin sockets **£30.** P. & P. **£2.**

BBC EPROM PROGRAMMER
A fully self-contained Eprom Programmer with its own power supply, able to program 2516, 2716/32/32A/64/128 single rail Eproms.
★ Personality selection is simplified by a single rotary switch.
★ Programming voltage selector switch is provided with a safe position.
★ Warning indicator to show programming in progress.
★ Programmer can read, blank check, program and verify at any address/addresses on the EPROM.
★ Simple menu driven software supplied on cassette (transferable to disc).
★ Full editor with ASCII disassembler.
Programmer complete with cables, software and operating instructions: **£79.50 + £2** p. & p.

PRODUCTION PROGRAM: P8000
P8000 provides reliable gang programming of up to 8 EPROMS simultaneously with device sizes up to 16k x 8 bytes. Devices supported range from 2704 to 27128 in single and three rail versions. Simple menu driven operation ensure easy eprom selection and reliable programming in minimum programming times. **£695 + £6** carriage.

BOOKS (no VAT; p&p £1)
Assembly Lang Prog. for BBC	**£8.95**
Assembly Lang programming on BBC Micro by Ferguson and Shaw	**£7.95**
Basic Prog. for BBC	**£5.95**
BBC An Expert Guide	**£6.95**
Easy Programming on BBC	**£5.95**
Further Programming on BBC	**£5.95**
Introducing BBC Micro	**£5.95**
Programming the BBC	**£6.50**
30 Hour Basic	**£5.95**
35 Educational Programs	**£6.95**
BBC Sound & Graphics	**£7.95**
Creating Adventure Programs	**£6.95**
Discovering Machine Code	**£6.95**
Structured Programming	**£6.50**
The Friendly Computer Book BBC	**£4.50**
Beyond Basic BBC	**£7.25**

UV ERASERS
The following erasers are all fitted with safety interlocks and mains switches with indicators.
UV1B up to 6 Eproms **£47**
UV1T as above but with timer **£59**
UV140 up to 14 Eproms **£61**
UV141 as above but with timer **£79**

★ SPECIAL OFFER ★
2532	**£3.50**	27128-3	**£18**
2732	**£3.50**	4164-2	**£4.50**
2764-25	**£5**	6116P-3	**£3.50**

LIGHT PEN
(RH-1). A superior design, with a 'push tip', status indicator LED, and an interface box that plugs into the user port. Comes with manual, full software and four Basic demonstration programs **£39.50.**

SMARTMOUTH
The 'infinite vocabulary' self-contained speech synthesiser unit. Uses only 5-10 bytes per word – no ROMs required – simply plugs into the user port. (Has Aux. Audio output skt.). Supplied with Demo/Development programs and simple software instructions, **£37 + £2** p. & p.

NEW COMPREHENSIVE CATALOGUE AVAILABLE – PLEASE SEND FOR PRICE LIST

CONNECTOR SYSTEMS

I.D. CONNECTORS
(Speedblock Type)

No of ways	Header Plug	Receptacle	Edge Conn.
10	**90p**	**85p**	**120p**
20	**145p**	**125p**	**195p**
26	**175p**	**150p**	**240p**
34	**200p**	**160p**	**320p**
40	**220p**	**190p**	**340p**
50	**235p**	**200p**	**390p**

JUMPER LEADS
24'' Ribbon Cable with Headers

	14-pin	16-pin	24-pin	40-pin
1 end	**145p**	**165p**	**240p**	**350p**
2 ends	**210p**	**230p**	**345p**	**540p**

24'' Ribbon Cable with Sockets

	20-pin	26-pin	34-pin	40-pin
1 end	**160p**	**200p**	**280p**	**300p**
2 ends	**290p**	**370p**	**480p**	**525p**

Ribbon Cable with D. Conn.
25-way Male **500p** Female **550p**

AMPHENOL CONNECTORS
36-way plug Centronics Parallel Solder **£5.25** IDC **£4.95**
36-way socket Centronics Parallel Solder **£5.50** IDC **£5.20**
24-way plug IEEE Solder **£5** IDC **£4.75**
24-way socket IEEE Solder **£5**

RIBBON CABLE
(Grey/meter)

10-way	**40p**
16-way	**60p**
20-way	**85p**
26-way	**120p**
34-way	**160p**
40-way	**180p**
50-way	**200p**
64-way	**280p**

D CONNECTORS

	No. of ways 9	15	25	37
MALE				
Solder	**80p**	**105p**	**160p**	**250p**
Angled	**150p**	**210p**	**250p**	**365p**
FEMALE				
Solder	**105p**	**160p**	**200p**	**335p**
Angled	**165p**	**215p**	**290p**	**440p**
Hoods	**90p**	**85p**	**90p**	**100p**

IDC 25-way plug **385p.** Socket **450p**

RS 232 JUMPERS
(25-way D)
24'' Single end Male **£5.00**
24'' Single end Female **£5.25**
24'' Female-Female **£10.00**
24'' Male-Male **£9.50**
24'' Male-Female **£9.50**

EURO CONNECTORS

	Plug	Skt.
DIN 41617		
21-way	**160p**	**165p**
31-way	**170p**	**170p**
DIN 4161Z		
2×32-way St. Pin	**220p**	**275p**
2×32-way Ang. Pin	**275p**	**320p**
3×32-way St. Pin	**260p**	**300p**
3×32-way Ang. Pin	**375p**	**350p**

EDGE CONNECTORS

	0.1''	0.156''
2×18-way	–	**140p**
2×22-way	**190p**	**240p**
2×23-way	**175p**	–
2×25-way	**225p**	**220p**
2×28-way	**190p**	–
1×43-way	**260p**	–
2×43-way	**365p**	
1×77-way	**600p**	
5100 Conn		**600p**

TEXTOOL ZIF
SOCKETS
24-pin **£5.75**
28-pin **£8.00**
40-pin **£9.75**

DIL SWITCHES
4-way **70p**
6-way **85p**
8-way **90p**
10-way **140p**

DIL HEADERS

	Solder Type	IDC Type
14pin	**40p**	**100p**
16pin	**50p**	**110p**
24pin	**100p**	**150p**
40pin	**200p**	**225p**

TEST CLIPS
14-pin **275p** 16-pin **£3** 40-pin **£6**

NEXT MONTH

AN ARGUS SPECIALIST PUBLICATION
electronics today INTERNATIONAL

BENCH PSU

One of the necessities of any experimenter's life is that of having to supply power for projects. Here is a supply that could be purpose built for electronics enthusiasts — in fact, it *is* purpose built *by* electronics enthusiasts! Output voltages are adjustable, but are nominally 5V at 2.5A and + and − 15V at 0.5A. And what's more, a full kit will be available, so start saving your pennies now!

THE-MINI-MYNAH

In our long-standing tradition of first-rate projects with third-rate puns for titles, here's our project for a speech synthesiser board. Its long list of features includes unlimited vocabulary from the use of allophone speech synthesis; four levels of inflection (we don't know of any other published design that allows inflection); 2K of on-board memory dedicated to speech generation, which allows the board to store 100 or more words; speech reproduction words, phrases or sentences stored in the memory selectable by a single command from the host computer; and simple interfacing requirements. So don't even think about building another design until you've seen ours!

MORE MEMORY FOR Z80 COMPUTERS

Following on from the project for a 6502/6800 64K DRAM board published in September 1983, we look at ways of increasing the available memory capacity of some common-or-garden Z80 computers. There are basically two methods — upgrading the existing memory, by substituting higher capacity DRAMs, and building a separate card with a block of memory on it. This article will look at the first, with the second method looked at in a future issue.

DON'T RISK MISSING OUT ON THE FEBRUARY ISSUE OF ETI — ON SALE FRIDAY THE 6TH OF JANUARY

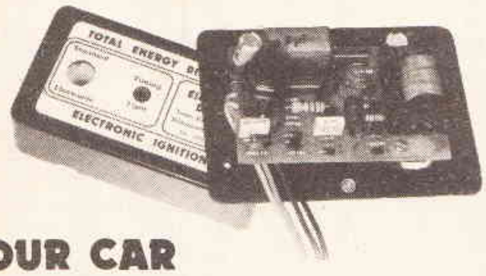
Articles described here are in an advanced state of preparation. However, circumstances may dictate changes to the final contents.

electronize

AUTO-ELECTRONIC PRODUCTS

KITS OR READY BUILT

TOTAL ENERGY DISCHARGE ELECTRONIC IGNITION



IS YOUR CAR AS GOOD AS IT COULD BE ?

★ Is it **EASY TO START** in the cold and the damp? Total Energy Discharge will give the most powerful spark and maintain full output even with a near flat battery.

★ Is it **ECONOMICAL** or does it "go off" between services as the ignition performance deteriorates? Total Energy Discharge gives much more output and maintains it from service to service.

★ Has it **PEAK PERFORMANCE** or is it flat at high and low revs. where the ignition output is marginal? Total Energy Discharge gives a more powerful spark from idle to the engines maximum (even with 8 cylinders).

★ Is the **PERFORMANCE SMOOTH**. The more powerful spark of Total Energy Discharge eliminates the "near misfires" whilst an electronic filter smoothes out the effects of contact bounce etc.

★ Do the **PLUGS and POINTS** always need changing to bring the engine back to its best? Total Energy Discharge eliminates contact arcing and erosion by removing the heavy electrical load. The timing stays "spot on" and the contact condition doesn't affect the performance either. Larger plug gaps can be used, even wet or badly fouled plugs can be fired with this system.

★ **TOTAL ENERGY DISCHARGE** is a unique system and the most powerful on the market - 3½ times the power of inductive systems - 3½ times the energy and 3 times the duration of ordinary capacitive systems. These are the facts:

Performance at only 6 volts (max. supply 16 volts)

SPARK POWER — 140W, SPARK ENERGY — 36mJ
SPARK DURATION — 500μS, STORED ENERGY — 135mJ
LOADED OUTPUT VOLTAGE
50pF load — 38kV, 50pF + 500k — 26kV

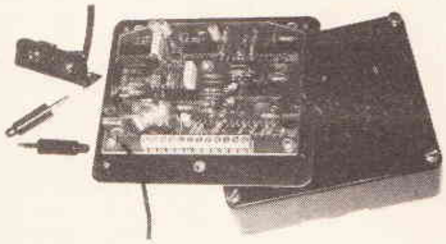
We challenge any manufacturer to publish better performance figures. Before you buy any other make, ask for the facts, its probably only an inductive system. But if an inductive system is what you really want, we'll still give you a good deal.

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

★ **IN KIT FORM** it provides a top performance system at less than half the price of comparable ready built units.The kit includes: pre-drilled fibreglass PCB, pre-wound and varnished ferrite transformer, high quality 2uF discharge capacitor, case, easy to follow instructions, solder and everything needed to build and fit to your car. All you need is a soldering iron and a few basic tools.

Most **NEW CARS** already have electronic ignition. Update **YOUR CAR**

ELECTRONIZE ELECTRONIC CAR ALARM



HOW SAFE IS YOUR CAR ?

More and more cars are stolen each week and even a steering lock seems little help. But a car thief will avoid a car that will cause him trouble and attract attention. If your car has a good alarm system – well there are plenty of other cars to choose from.

LOOK AT THE PROTECTION AN ELECTRONIZE ALARM CAN GIVE

★ **MINIATURE KEY PLUG** A miniature jack plug attaches to your key ring and is coded to your particular alarm.

★ **2025 INDIVIDUAL COMBINATIONS** The key plug contains two 1% tolerance resistors, both must be the correct value and together give 2025 different combinations.

★ **ATTRACTS MAXIMUM ATTENTION** This alarm system not only intermittently sounds the horn, but also flashes the headlight and prevents the engine being started.

★ **60 SECOND ALARM PERIOD** Once triggered the alarm will sound for 60 seconds, unless cancelled by the key plug, before resetting ready to be triggered again.

★ **30 SECOND EXIT DELAY** The system is armed by pressing a small button on a dashboard mounted control panel. This starts a 30 second delay period during which the owner can open and close doors without triggering the alarm.

★ **10 SECOND ENTRY DELAY** When a door is opened a 10 second delay operates to allow the owner to disarm the system with the coded key plug. Latching circuits are used and once triggered the alarm can only be cancelled by the key plug.

★ **L.E.D. FUNCTION INDICATOR** An LED is included in the dashboard unit and indicates the systems operating state. The LED lights continuously to show the system is armed and in the exit delay condition. A flashing LED indicates that the alarm has been triggered and is in the entry delay condition.

★ **ACCESSORY LOOP - BONNET/BOOT SWITCH - IGNITION TRIGGER** These operate three separate circuits and will trigger the alarm immediately, regardless of entry and exit delays.

★ **SAFETY INTERLOCK** The system cannot be armed by accident when the engine is running and the car is in motion.

★ **LOW SUPPLY CURRENT** CMOS IC's and low power operational amplifiers achieve a normal operating current of only 2.5 mA.

★ **IN KIT FORM** It provides a high level of protection at a really low cost. The kit includes everything needed, the case, fibreglass PCB, random selection resistors to set the code and full set of components etc. In fact everything down to the last washer plus easy to follow instructions.

fill in the coupon and send to: ☐ Please send more information

ELECTRONIZE DESIGN Dept D · Magnus Rd · Wilnecote · Tamworth · B77 5BY · tel 0827 281000

TOTAL ENERGY DISCHARGE (6 or 12 volt negative earth)

☐ Assembled ready to fit ~~£26.70~~ £19.95
☐ D.I.Y. parts kit ~~£15.90~~ £14.95

TWIN OUTPUT for cars and motor cycles with dual ignition

☐ Twin, Assembled ready to fit ~~£36.45~~ £29.95
☐ Twin, D.I.Y. parts kit ~~£24.55~~ £22.95

INDUCTIVE DISCHARGE (12 volt only)

☐ Assembled ready to fit ~~£15.95~~ £12.75

Prices Include VAT £1-00 PP(UK) per Unit. D

CAR ALARM (12 volt negative earth)

☐ Assembled ready to fit (All wires and connectors incl.) ~~£27.95~~ £29.95
☐ D.I.Y. parts kit ~~£24.95~~ £19.95

I enclose cheque/postal order OR debit my Access/Visa card

VISA

Name ____________________

Address ____________________

____

____________________ Code __________

COMTECH ELECTRONICS

TRANSISTORS

BC 107B	12p
BC 108C	12p
BC 109C	10p
BC 113/4	16p
BC 115/6	17p
BC 119	28p
BC 139	32p
BC 140	28p
BC 141	29p
BC 142	27p
BC 143	27p
BC 160	30p
BC 161	32p
BC 169C	8p
BC 171B	9p
BC 172C	9p
BC 173C	9p
BC 177B	15p
BC 178C	15p
BC 179	15p
BC 182	9p
BC 182B	9p
BC 183B	9p
BC 183C	9p
BC 184B	9p
BC 184C	9p
BC 212	9p
BC 212B	9p
BC 213B	9p
BC 213C	9p
BC 214B	9p
BC 214C	9p
BC 237	7p
BC 238	9p
BC 239	9p
BC 251	9p
BC 300	36p
BC 301	32p
BC 302	32p
BC 303	32p
BC 304	32p
BC 307	10p
BC 308	10p
BC 309	10p
BC 327	12p
BC 328	12p
BC 337	12p
BC 338	12p
BC 413C	10p
BC 414C	10p
BC 415C	10p
BC 416C	10p
BC 477	25p
BC 478	23p
BC 479	24p
BC 546	10p
BC 546B	10p
BC 547B	9p
BC 548B	9p
BC 548C	9p
BC 549C	9p
BC 550C	10p
BC 556	10p
BC 556B	10p
BC 557B	9p
BC 557C	9p
BC 558B	9p
BC 558C	9p
BC 559C	9p
BC 560C	10p
BC 637	20p
BC 638	20p
BC 639	22p
BC 640	24p
BCY 70	18p
BCY 71	18p
BCY 72	17p
BD 115	50p
BD 131	45p
BD 132	48p
BD 133	70p
BD 135	30p
BD 136	30p
BD 137	30p
BD 138	35p
BD 139	35p
BD 140	35p
BD 203	70p
BD 204	70p
BD 205	70p
BD 206	70p
BD 239A	40p
BD 239C	50p
BD 240A	42p
BD 240C	50p
BD 241A	42p
BD 241C	54p
BD 242A	42p
BD 242C	54p
BD 243A	55p
BD 243C	68p
BD 244A	64p
BD 244C	78p
BF 180	30p
BF 181	30p
BF 182	30p
BF 183	30p
BF 184	30p
BF 185	30p
BF 194	12p
BF 195	12p
BF 196	12p
BF 197	12p
BF 198	10p
BF 199	12p
BF 200	40p
BF 224	15p
BF 244C	22p
BF 245	25p
BF 256C	32p
BF 256LC	35p
BF 257	32p
BF 258	32p
BF 259	35p
BF 336	36p
BF 337	39p
BF 338	40p
BF 457	32p
BF 458	32p
BF 459	37p
BF 494	12p
BF 595	16p
BF 596	20p
BFX 29	28p
BFX 30	28p
BFX 84	28p
BFX 85	28p
BFX 87	27p
BFX 88	23p
BFY 50	23p
BFY 51	22p
BFY 52	22p
BSY 95A	23p
BU 205	140p
BU 206	150p
BU 208	140p
MJ 2500	230p
MJ 2501	245p
MJ 2955	90p
MJ 3000	210p
MJ 3001	225p
MJE 340	48p
MJE 350	70p
MJE 370	80p
MJE 371	84p
MJE 520	60p
MJE 521	68p
MJE 2955	80p
MJE 3055	68p
MPSA 05	20p
MPSA 06	20p
MPSA 12	22p
MPSA 13	22p
MPSA 42	23p
MPSA 43	23p
MPSA 55	20p
MPSA 56	20p
MPSA 63	22p
MPSA 64	22p
MPSA 92	24p
MPSA 93	24p
TIP 29A	30p
TIP 29B	33p
TIP 29C	33p
TIP 30A	30p
TIP 30B	33p
TIP 30C	36p
TIP 31A	33p
TIP 31B	35p
TIP 31C	37p
TIP 32A	33p
TIP 32B	35p
TIP 32C	37p
TIP 33A	55p
TIP 34A	60p
TIP 41A	46p
TIP 41C	60p
TIP 42A	46p
TIP 42C	60p
TIP 110	45p
TIP 115	45p
TIP 120	70p
TIP 121	70p
TIP 122	70p
TIP 126	70p
TIP 127	70p
TIP 2955	70p
TIP 3055	70p
TIS 44	20p
TIS 90	24p
TIS 92	20p
2N1613	30p
2N1711	30p
2N1893	30p
2N2218	24p
2N2218A	25p
2N2219	24p
2N2219A	25p
2N2221A	20p
2N2222	18p
2N2222A	20p
2N2368	23p
2N2369A	15p
2N2484	24p
2N2646	48p
2N2904	22p
2N2904A	23p
2N2905	23p
2N2906A	22p
2N2907	23p
2N2907A	25p
2N3053	23p
2N3054	56p
2N3055	50p
2N3055H	75p
2N3440	58p
2N3441	120p
2N3442	120p
2N3702	10p
2N3703	10p
2N3704	10p
2N3705	10p
2N3706	10p
2N3707	10p
2N3708	10p
2N3771	150p
2N3772	170p
2N3773	190p
2N3819	20p
2N3823	50p
2N3866	95p
2N3903	10p
2N3904	10p
2N3905	10p
2N3906	10p
2N4030	30p
2N4033	30p
2N4037	40p
2N4058	10p
2N4059	10p
2N4060	10p
2N4061	10p
2N4062	10p
2N4400	15p
2N4401	15p
2N4402	15p
2N4403	15p
2N5400	18p
2N5401	20p
2N5457	28p
2N5458	27p
2N5459	25p
2N5460	38p
2N5550	18p
2N5551	20p
2N6027	23p
2N6028	23p

ZENERS

400 mW	
2V7-36V	6p
1.3 W	
4V7-51 V	10p

THYRISTORS

C 106D	28p
C 116D	70p
C 126D	90p
C 126M	98p
MCR 101	30p
MCR 102	34p
T 2800D	110p
T 2800M	165p
2N4443	120p
2N4444	130p
2N5060	23p
2N5061	24p
2N5062	29p
2N5064	32p

TRIACS

C 206	55p
C 225D	60p
C 226D	70p
C 226M	90p
C 236	90p
C 236M	120p
C 246D	98p
C 246M	140p
BR 100	30p

BRIDGE RECTIFIERS

W 005	18p
W 01	20p
W 02	22p
W 04	24p
W 06	28p
W 08	32p
3A/50V	40p
3A/100V	42p
3A/200V	44p
3A/400V	46p
6A/50V	75p
6A/100V	80p
6A/200V	88p
6A/400V	94p
25A/100V	185p
25A/200V	198p
25A/400V	220p

LED's

3mm red	7p
5mm red	7p
3mm green	10p
5mm green	10p
3mm yellow	10p
5mm yellow	10p
clips	3p
rectangular	
Red	10p
Green	14p
Yellow	14p

CMOS

4000	14p
4001	14p
4002	14p
4006	50p
4007	16p
4008	50p
4011	14p
4012	15p
4013	24p
4014	54p
4015	46p
4016	24p
4017	42p
4018	47p
4019	30p
4020	46p
4021	42p
4022	46p
4023	14p
4024	38p
4025	14p
4026	84p
4027	29p
4028	42p
4029	48p
4030	18p
4035	56p
4040	48p
4041	48p
4042	42p
4043	44p
4044	44p
4046	55p
4048	30p
4049	25p
4050	25p
4051	52p
4052	52p
4053	54p
4066	28p
4068	15p
4069	15p
4070	15p
4071	15p
4072	15p
4073	15p
4074	15p
4075	15p
4077	15p
4078	15p
4081	15p
4082	15p
4093	32p
4098	78p
40161	52p
40162	52p
40163	52p
4501	16p
4502	55p
4503	34p
4504	98p
4506	70p
4508	145p
4510	50p
4511	52p
4512	48p
4513	98p
4514	110p
4516	55p
4517	180p
4518	52p
4520	55p
4522	65p
4526	64p
4528	56p
4529	72p
4530	92p
4531	70p
4532	88p
4541	70p
4544	120p
4551	88p
4553	180p
4554	148p
4555	48p
4556	48p
4557	160p
4558	110p
4559	390p
4560	170p
4566	120p
4568	270p
4569	140p
4572	42p
4573	198p
4574	198p
4575	198p
4580	280p
4584	38p
4585	74p
4599	178p

IC SOCKETS

8 pin	8p	22 pin	14p
14 pin	9p	24 pin	19p
16 pin	10p	28 pin	25p
18 pin	11p	40 pin	26p
20 pin	14p		

CPU IC's

6800	395p
6802	550p
6808	520p
6810	250p
6820	250p
6821	190p
6840	595p
6850	180p
6852	360p
6880	140p
6885	130p
6889	140p
68000	POA
8T26A	140p
8T28	120p
8T95	140p
8T97	140p
8T98	140p
8080A	400p
8085A	500p
8156C	600p
8212C	198p
8216C	140p
8224C	220p
8228C	450p
8251AC	495p
8253AC	800p
8257C	750p
8259C	900p
8288	£16
TMS9980A	£22
TMS9981N	£25
TMS9901N	590p
TMS9902N	550p
Z80A 4M	380p
Z80A PIO	350p
Z80A DMA	£5
2101-4A	350p
2114-4	120p
2147 70nS	600p
2147 45nS	700p
2716	400p
4164 150nS	£10
4016 200nS	£7
5101LC	340p
5101LC-1	395p

VOLTAGE REGULATORS

Positive	
100mA	
78L05	30p
78L12	30p
78L15	30p
78L18	45p
78L24	45p
1 A TO220	
7805	39p
7808	55p
7812	39p
7815	39p
7818	39p
7824	40p
5 A TO3	
78H05	500p
Negative	
100 mA	
79L05	50p
79L12	50p
79L15	50p
1 A TO220	
7905	45p
7906	65p
7908	65p
7912	55p
7915	55p
7924	65p
–Variable–	
LM 309K	120p
LM 317K	250p
LM 317T	98p
LM 337T	180p
LM 350T	395p
LM 723CN	35p
78H05	500p

OPTO

TIL 32	55p
TIL 38	40p
TIL 78	50p
TIL 100	100p
TIL 111	85p
2N5777	50p
4N25	80p
4N28	70p
4N33	128p
4N35	150p
4N37	100p
BPX 38	390p
BPX 43	340p
TIL 221 (high output clear red)	20p

LINEAR IC's

CA 3046	72p
CA 3065	190p
CA 3080	72p
CA 3086	56p
CA 3089	170p
CA 3090AQ	300p
CA 3130E	95p
CA 3140E	40p
CA 3160E	100p
CA 3161E	140p
CA 3240AE	165p
CA 3240E	110p
CA 3260E	100p
CA 810QM	250p
LF 347	160p
LF 351	45p
LF 353	80p
LF 355	85p
LF 356	88p
LF 357	110p
LM 301A	26p
LM 307	54p
LM 311	60p
LM 318	120p
LM 324	40p
LM 339	46p
LM 348	60p
LM 358	48p
LM 380	68p
LM 380-8	80p
LM 381	140p
LM 381	120p
LM 384	125p
LM 386	90p
LM 387	135p
LM 393	70p
LM 555	16p
LM 556	45p
LM 565	100p
LM 567	150p
LM 709	35p
LM 710	70p
LM 711	60p
LM 733	75p
LM 741	14p
LM 747	50p
LM 748	35p
LM 1458	36p
LM 3900	47p
MC 1455	16p
MC 1458	34p
MC 1496	70p
MC 1748	35p
MC 3302	72p
MC 3401	68p
MC 3403	65p
NE 529	220p
NE 531	160p
NE 532	56p
NE 544	200p
NE 550	160p
NE 555	16p
NE 556	45p
NE 558	170p
NE 565	140p
NE 560	150p
NE 567	110p
NE 570	350p
NE 571	320p
NE 644	POA
NE 645	270p
RC 4558	48p
SAA1027	590p
SAA1056	495p
SAA5000	350p
SAA5010	710p
SAA5020	550p
SAA5030	£10
SAA5040	£16.00
SAA5041	£25
SAA5050	£10
SAA5052	£10
SL490	300p
SN76115	98p
SN76660	90p
TBA120S	70p
TBA520Q	200p
TBA550	240p
TBA570Q	200p
TBA625	100p
TBA800	70p
TBA810AS	95p
TBA810S	95p
TBA820	75p
TBA820M	78p
TBA920	195p
TBA950	210p
TCA270	120p
TCA800	250p
TCA940	180p
TDA1022	550p
TDA1024	130p
TDA2002	130p
TDA2003	180p
TDA2004	295p
TDA2005M	440p
TDA2006	240p
TDA2020	250p
TDA2030	220p
TDA2040	450p
TDA2054M	130p
TL061	40p
TL062	80p
TL064	120p
ULN2001	80p
ULN2003	80p
ULN2004	80p

CAPACITORS

Electrolytic radial/axial.

Value/	V	price
0.47	25	5p
0.47	63	6p
1 µF	63*	6p
2.2	16	5p
2.2	63*	6p
4.7	25	6p
4.7	63*	6p
10 µF	10	5p
10 µF	16	6p
10 µF	25*	6p
10 µF	63*	7p
22 µF	16	6p
22 µF	25	6p
22 µF	63*	9p
47 µF	10	7p
47 µF	25	8p
47 µF	63	12p
100	10*	6p
100	16	8p
100	25	10p
100	63	18p
220	10*	8p
220	16	10p
220	25*	14p
220	63	24p
470	10	14p
470	25*	20p
1000	10	18p
1000	25*	28p
2200	10	32p
2200	25*	45p

* axials only available these values, radial available on all of above.

Tantalum bead.

Value/	V	price
0.1 µF	35	12p
0.22	35	12p
0.33	35	12p
0.47	35	12p
0.68	35	12p
1 µF	35	12p
2.2 µF	35	16p
3.3 µF	35	18p
4.7 µF	25	20p
6.8 µF	25	20p
10 µF	16	20p
15 µF	16	28p
22 µF	16	35p
33 µF	16	60p
33 µF	10	36p
47 µF	10	60p
68 µF	10	80p
60 µF	6.3	60p
100µF	6.3	70p
100µF	3	38p
150µF	6.3	90p

Ceramic Plate 63/100 V
3.3 pf to 4N7 6p

Polystyrene 5% 63 V: 10 pF to 1 nF **9p** each, 1n2 to 10 nF **12p** each.

Polyester C352 series 250 V 0.01, 0.015, 0.022, 0.033, 0.047 **6p**. 0.068, 0.1 **8p** 0.15, 0.22 **10p** 0.33, 0.47 13p 0.68 20p. 1 µ **22p**.

Disc Ceramic: 10 N **4p**

DIODES

AA 119	9p
BAX 13	5p
BAX 16	6p
OA 47	9p
OA 90	7p
OA 91	7p
OA 95	8p
OA 200	7p
OA 202	8p
1S44	6p
1S921	9p
1N914	3p
1N916	4p
1N4148	3p
1N4149	4p
1N4001	3p
1N4002	4p
1N4003	4p
1N4004	5p
1N4005	5p
1N4006	6p
1N4007	6p
1N5401	11p
1N5402	12p
1N5403	13p
1N5404	13p
1N5405	14p
1N5406	14p
1N5407	15p
1N5408	16p
6A/100V	25p
6A/200V	28p
6A/400V	30p

HEATSINKS

TO5 push on 6mm (80°C/W) **16p** each. 12mm (60°C/W) **28p** each. TO3 14°C/W **40p** each. TO3 10°C/W **110p** each. TO126/220 18°C/W **22p**. All in matt black finish.

RESISTORS

¼ Watt Carbon film 5% E24 series 4.7 R-2M2 **1p** each. ½ Watt Carbon film 5% E12 series 1R-10M **2p** each. ¼ Watt Metal film 1% E24 series 10R-1M **4p** each. **250p** per 100, one value only. **280p** per 100 mixed values. 2.5 Watt wire-wound 0R22 10 ohms E12 series **25p each**. **Presets:** miniature horizontal & vertical **9p** each 100R-500K. Multiturn cermet trimmers 100R-500K **88p** each. Potentiometers. Single gang 2K to 1M **43p** each. Single gang with DPST switch **78p** each. Dual gang **89p** each.

VEROBOARDS

2.5"x1"	25p
2.5"x3.75"	90p
2.5"x5"	110p
3.75"x3.75"	110p
3.75"x5"	115p
pak of 100 pins	55p
Spot Face cutter	150p

HARDWARE

each

4xTO3 mounting kits **23p** 64 mm Loudspeakers 8R **70p** 4xTO66 mounting kits **23p** 64R **78p** each. 300mW rating. 5 xTO126 bushes/washers **18p** PP3 battery snaps **6p** each. 10xTO220 bushes/washers **28p** 4xHP7 battery holder **22p** 5 xTO3P bushes/washers **18p** 6xHP7 battery holder **32p** 20mm panel fuseholder **32p** 20mm chassis fuseholder **7p** 4mm plugs **12p**. 4mm sockets **20p**. 4mm insulated terminals **30p**. 3.5mm jack socket **15p**. 3.5mm jack plug **15p** Phono sockets **15p**. Switches: miniature toggle, SPST **60p**, SPDT **68p**, DPDT **78p** each. Miniature push buttons 1A/250V push to make **16p** push to break **23p**. Midget rotary switches, pcb terminals 2P6W, 4P3W, 3P4W **39p** each. Slide switch 1A/250V DPDT (22 x 12 x 8 mm) **16p**.

BRAND NEW COMPONENT PACKS

CP100	60 IC sockets, 8, 14, and 16 pin 20 of each	440p
CP101	20 BC182/BC212 transistors, 10 of each	130p
CP102	20 BC183/BC213 transistors, 10 of each	100p
CP103	20 BC184/BC214 transistors, 10 of each	130p
CP104	20 BC549C/BC559C transistors, 10 of each	130p
CP105	20 BC550C/BC560C transistors, 10 of each	160p
CP106	100 1N914 switching diodes, 75-100V/75mA	240p
CP107	100 1N916 switching diodes, 75/100V/75mA	280p
CP108	100 1N4148 switching diodes, 75-100V/75mA	160p
CP109	500 1N4148 switching diodes, 75-100V/75mA	680p
CP110	30 1N4002 1A/400V rectifiers	100p
CP111	10 MC1458 Dual op amps (741 type)	320p
CP112	100 400mW zeners, 4 of each 2V7 to 33V	450p
CP113	100 1.3W zeners, 4 of each 4V7 to 51V	850p
CP114	4 LF351 JFET op amps, Low noise	170p
CP115	4 LF353 JFET op amps, dual low noise	300p
CP117	50 mixed LED's 3mm/5mm/rect/red/green/yellow	400p
CP119	100 1N4002 1A/100V rectifiers	270p
CP120	10 C106D 400V/4A thyristors	250p
CP121	10 NE556 dual timer IC's	400p
CP124	100 mixed electrolytic capacitors 10-63V/1-1000µF	£6
CP125	5 LM317T 1A/TO220 variable regulators	440p

SPECIAL BULK PURCHASE

C106D 400V 4A Thyristor **28p** each. 10 for **250p**, 25 for **475p**. 100 for **£20**. 300 for **£54**. 500 for **£85**. 1000 off POA. LM317T 1A/Adj. Regulator **98p** each. 10 for **880p**. 25 for **£21**, 100 for **£68** 300 for **£195** 500 for **£296** 1000 off POA. 1N4148 switching diodes **3p** each. 100 for **160p**. 500 for **£6.80**. 1000 for **£11.50**. Larger quantities please enquire. 1N914 switching diodes **3p** each. 100 for **240p**. 500 for **£11.00**. 1000 for **£17**. Larger quantities please enquire. Generous quantity discounts available on most lines.

ORDERING INFORMATION: Please add **40p** P&P to all orders under **£6**, then VAT to total order. Cheques or postal orders made payable to Comtech Electronics. Official orders welcome, trade please enquire. All items held in stock despatched same day. LARGE SAE brings full list.

COMTECH ELECTRONICS

205 STURDEE ROAD
LEICESTER
LE2 9FY
Telephone: (0533) 779578

★SAME DAY DESPATCH★

★COMPETITIVE & RELIABLE★

DIGEST

New HP Research Centre In UK

At a press launch attended by the Secretary of State for Trade and Industry, Norman Tebbit, TV cameras and your very own editor, Hewlett Packard announced that they will be opening a new research laboratory in Bristol, to serve as their European Research centre. The company's main laboratories are in Palo Alto, California, and the new laboratory will be the company's first R&D establishment outside the USA.

The company will be commencing recruiting in the very near future, and the lab will be open in the Spring of 1984 with around 50 research staff initally, rising to 200 by 1987.

According to HP's UK managing director, David Baldwin, the exact research objectives of the laboratory have yet to be decided, but will be in computing science. There will definitely be no semiconductor research.

David Baldwin and Norman Tebbit were very coy about the financial inducements that had been offered to make the company choose the UK (apparently, just about every country in the world had also been under consideration). However, they denied that the prospect of government grants had been a major factor in the choice sufficiently often to make all the cynical journalists present convinced that it must have been.

However, the company's line was that the availability of well qualified graduates (despite the cut-backs in the technological universities such as Salford) and the excellence of the UK's universities (despite the cut-backs in technological universities such as Salford) were amongst the reasons — as was the apparent presence, on the M4 corridor, of the world's highest concentration of technical expertise.

Mr Baldwin stated that, with a few tax rule changes here and there, the establishment of the laboratory could lead to a large amount of money going to the UK universities in the form of research and equipment grants. HP currently spends around $25m or more in this way in US Universities. The laboratory will also provide sufficient space for visiting researchers from Universities (and, presumably, Polys) to come and work on site.

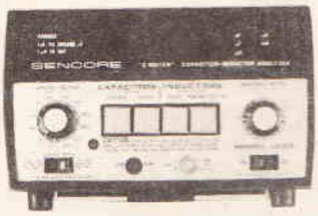
HP reckon that for every project researched, there will be 50 other people employed by the company elsewhere, such as in production, marketing, etc, and therefore one could expect the research centre to generate around an additional 10,000 jobs given time. Obviously, there is absolutely no guarantee that these jobs will be generated in the UK, although according to a company representative, it would be more likely than if the lab had been sited in W. Germany.

One interesting feature is that although the first head of the laboratory will be an American, Donald L. Hammond who is currently head of the physical research centre at Palo Alto, one of his tasks will be to appoint a British successor. All those interested should join the editor in writing to Hewlett Packard Ltd, Nine Mile Ride, Wokingham, Berkshire RG11 3LL.

World's Thinnest Transformer

The latest transformer in the OB range from Avel-Lindberg stakes a claim as the thinnest yet, because, at 0.8VA, it is less than 10.5mm high (0.413in.) and will fit inside the smallest card frames. Dual primaries for 240 or 120V AC 50/60Hz mains operation are complemented by twin centre-tapped secondaries which give output voltages from 10V at 80mA to 48V at 17mA in series and 5 to 24V in parallel. These miniature transformers are proof-tested at 5kV a.c. and have a maximum operating temperature of 120°C (Class 2). They conform to IEC 65 Class 2, B.S.415 class 2 and VDE 0550 Class 2.

The normal method of fixing to a printed circuit board would be to direct solder the connecting pins, but where extra mechanical strength is required, the transformer can be screwed to the board using four holes moulded into the resin-filled, flat thermoplastic cases. The non-concentric twin primary and secondary windings are wound on separate bobbins which gives maximum isolation and low inter-winding capacitance. The secondaries can be series, parallel or independently wired, but if they are isolated from each other the applied potential between them must not exceed 500 V DC. The transformer is also short-circuit proof. Avel-Lindberg Limited, South Ockendon, Essex RM15 5TD, tel 070 885 3444.



Prize Tester

Fieldtech Heathrow are so convinced of the market potential of their LC53 Z-meter that they are running a free entry Autumn Sweepstake to promote the product with the Z-meter itself, valued at well over £550, as the prize. The unit is unique because it will dynamically test capacitors, coils, SCR's and TRIAC's and, it is claimed, will find 75% of defective capacitors which value only meters will miss.

The LC53 tests capacitors for leakage current under full load with up to 600 volts applied, checks capacitor dielectric absorbtion, and has the capability to reform electrolytics. It will check for all coil defects in or out of circuit, and it automatically tests coils for effective Q using a US patent ringing test. It tests transmission lines for distance to open or short circuits within feet and it will also test dielectric strength to 600 volts.

For further details of the instrument and the sweepstake, contact Mike Dawson, Fieldtech Heathrow Limited, Huntavia House, 420 Bath Road, Longford, Middlesex UB7 0LL, tel 01-897 6446.

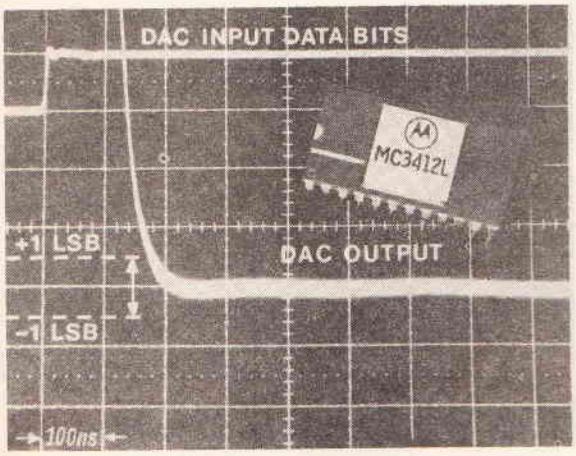
Plastic Shorts

Next time you investigate a defunct piece of electrical equipment and come across a resistor which appears to have gone short circuit, look again. That resistor may not be a resistor at all.

A system whcih is rapidly gaining acceptance within the electronics industry involves using wire links with plastic bodies to join tracks on printed circuit boards. The plastic body is usually about the same size as that of a small resistor or diode and may, therefore, depending upon its colour, give rise to confusion in the minds of the unsuspecting.

The idea behind the use of these links is quite simple. PCB designers often need to link tracks on a board in circumstances which do not justify the use of a double sided board. The usual solution is to use wire links, but these have to be cut and inserted by hand, an expensive procedure especially where automatic insertion equipment is being used to mount the other components. Pre-formed plastic-bodied links can be handled by the insertion equipment just as though they were conventional resistors, and even where boards are assembled by hand are quicker to insert than lengths of wire. The only restriction is that the pads on the PCB must be made the correct distance apart to accept the pre-formed leads, but since this already applies to just about every other component commonly used on PCBs there are no problems. Some companies use a number of standard lengths, eg 10, 15 and 20 mm, thus easing the task of the PCB designer.

In the past, companies have produced their own links or had them made to their own requirements. As the idea has caught on, however, a few companies have entered the market with pre-formed links. One of these is Nortronic, who call their products Zerohm Resistors. They are indeed about the size of a small resistor and have a brown body with yellow banding. Nortronic claim that they are chip resistant and have British Telecom approval. Nortronic Associates Limited, Gateway, Drew Industrial Estate, Crewe, Cheshire CW1 1YY, tel 0270 586161.



High-Speed 12-bit D to A

Motorola has introduced a high-speed 12-bit digital to analog converter, the MC3412/3512, which uses monolithic bipolar and thin film resistor technology to provide high stability and fast settling time, and which is designed to work with a minimum of external components.

Active laser trimming of thin film resistors at wafer level gives guaranteed limits of gain and offset errors of ± 0.25% FSR (full scale range) and ± 0.05% FSR respectively without external adjustment. Monotonicity is guaranteed over the full temperature range and an innovative bit switching scheme ensures that settling time will be no greater than 400 ns to ± ½ LSB.

The converter includes an internal precision 10 volt bandgap reference and span/bipolar offset resistors. With the addition of one external op-amp, the precision span and bipolar offset resistors provide calibrated unipolar or bipolar full scale output voltage ranges of 0 to 5.0, 0 to 10, ± 2.5, ± 5.0 and ± 10 volts. A CMOS/TTL threshold control pin permits selection of either CMOS or TTL logic levels at the data inputs.

Packaged in a 24-pin ceramic DIP, the MC3412/2512 is pin-compatible with the popular AD563 and AD565 digital to analog converters, and is available in commercial and military temperature ranges. For further information contact Motorola Ltd., European Literature Centre, 88 Tanners Drive, Blakelands, Milton Keynes MK14 5BP, tel 01-352 0041 ext 34.

32K Byte DRAM

Mostek Corporation have introduced a 256K DRAM which they claim is the first on the market with 32K x 8 organisation. The MK4856 is produced using scaled NMOS technology which allows access times down to 100 ns. The address system is not multiplexed and Mostek say that this will eliminate the need for system logic and thus simplify timing. The device also has an integral refresh counter, further reducing external logic count. The 28 pin DIP version has the standard pinout and is available in plastic (N suffix) or ceramic (P suffix) form and a leadless chip carrier version (E suffix) is also available. The MK4856 is available with access times of 100 ns, 120 ns, or 150 ns and further information can be obtained from Mostek UK Ltd, 1 Valley Drive, Kingsbury Road, London NW9, tel 01-204 9322.

Microwave Amplifiers

NEC have introduced two new ICs which are claimed to offer a constant 16 dB gain from DC to 1.2 GHz. The MM765 and MM766 have built in temperature compensation to ensure stable bias and have an input and output impedance of 50 ohm, allowing devices to be cascaded where higher levels of gain are required. The MM765 operates at 10V and can be supplied in 8-pin or TO-33 packages, while the MM766 operates at 5V and is available in DISK-mold, 8-pin MINI, 8-pin DIP, and TO-72 packages.

Also new from NEC are a series of silicon NPN epitaxial transistors which offer up to 9 dB of gain at 1 GHz and have a noise degradation figure of 1.1 dB. The NE-856 series have a high current capability and come in four package styles including TO-92 and SOT-23. NEC Electronics UK Ltd, 116 Stevenson Street, New Stevenson, Motherwell ML1 4LT, tel 0698 732221.

Single Chip Data Acquisition Controller

All the functions required for intelligent data acquisition and signal monitoring are contained in the CY600 Analog/ASCII Data Acquisition Controller which is being introduced by Weyfringe. The chip is designed to be placed between A/D converters and an 8-bit host computer system.

When programmed, each CY600 channel will scan one or more A/D signals and inform the host when specified conditions are met, freeing the host system from signal monitoring tasks. The minimum CY600 contains two channel buffers which can be programmed with the instructions and conditions to be monitored. Each channel is assigned six registers to hold user defined constants, A/D readings, or the results of arithmetic computations. Each channel can monitor its own signals or access any other channel's registers (cross channel correlation) so the device can test for several conditions by using different instructions in each channel. The maximum version of the CY600 is given up to four channels with larger program buffers and eleven registers per channel by adding an 8156 memory and I/O expansion chip.

The CY600 commands control the A/D converters, select channels and register and peform arithmetic operations (+, −, /) and conditional tests (<, =, >). Expressions combining all of the above provide comparisons of the signals and registers so that if a specified condition arises, the CY600 interrupts the host, and the host may then query the CY600 to determine the cause of the interrupt. For further information contact Mr Harry Gleghorn, Weyfringe Limited, Longbeck Road, Marske, Redcar, Cleveland TS11 6HQ, tel 0642 470121.

Dot-Matrix Displays

Nineteen new models of planar gas discharge (PGD) flat-panel, dot-matrix display subsystems have been introduced by Beckman Instruments. The displays, which complement the current one-line Beckman displays, enable large amounts of information to be presented where space is limited.

DC planar gas display technology produces high visibility yellow-orange light emission on a high-contrast black background. The height of the light emitting area is from 0.24 to 3.7 in and the width from 4.8 to 8.7 in. The full-controller versions interface using a standard 8-bit parallel microprocessor data bus. The alphanumeric units provide drivers, refresh RAM, a character generator and editing features, depending on model, allowing the user to display 5 x 7 dot matrix characters. The graphic units do not contain a character generator but allow each dot to be individually addressed so that characters and graphic patterns can be created with unlimited flexibility.

The driver-only versions provide cathode and anode drivers, the user having to supply external scanning and drive signals and design the controller with a data interface, character generator and refresh RAM.

The panels, fully garanteed by Beckman for one year, are available in the UK from Beckman Instruments Ltd, Milen House, 11 Wagon Lane, Sheldon, Birmingham B26 3DU, tel 021-742 7921.

Rapid Electronics

MAIL ORDERS:
Unit 1, Hill Farm Industrial Estate,
Boxted, Colchester, Essex CO4 5RD.
TELEPHONE ORDERS:
Colchester (0206) 36412.

ACCESS AND BARCLAYCARD WELCOME

LINEAR

				LM339	40	LM3911	120	NE566	140	TL064	96
				LM348	60	LM3914	225	▶NE567	100	TL071	30
				LM358	50	LM3915	225	▶NE570	370	TL072	45
555CMOS	80	ICL7106	680	LM377	170	LM13600	105	NE571	370	TL074	95
556CMOS	150	ICL7611	95	▶LM380	75	MC1496	68	▶RC4136	55	▶TL081	25
709	25	ICL7621	180	▶LM381	120	MC3340	135	▶RC4558	40	TL082	45
▶741	14	ICL7622	180	LM382	120	▶MF10CN	350	SL480	170	TL084	90
748	35	ICL8038	295	LM384	130	ML922	400	SL490	250	TL170	50
9400CJ	350	ICL8211A	200	LM386	90	ML924	195	SL76018	150	UA2240	120
AY-3-1270	720	ICM7224	785	LM387	120	ML925	210	▶SN76477	380	ULN2003	70
AY-3-8910	370	ICM7555	80	LM393	40	ML926	140	SP8629	250	ULN2004	70
AY-3-8912	540	▶LF351	45	LM709	25	ML927	140	TBA120S	70	XR2206	290
CA3046	60	LF353	85	LM711	60	ML928	140	TBA800	75	ZN414	80
▶CA3080	65	LF356	90	LM725	350	ML929	140	TBA810	96	ZN423	135
CA3089	190	LM10	325	LM733	75	MM5387A	465	TBA820	70	ZN424	135
CA3090AQ	375	LM301A	25	LM741	14	NE529	225	TBA950	220	ZN425E	350
CA3130E	85	LM311	50	LM747	60	NE531	140	TDA1008	320	ZN426E	300
▶CA3140E	36	LM318	120	LM1458	40	NE544	205	▶TDA1022	490	ZN427E	600
CA3161E	100	LM324	30	LM2917	200	▶NE555	16	TDA1024	125	ZN428E	410
CA3189	290	LM334Z	100	LM3900	45	▶NE556	45	TL061	40	ZN459	285
▶CA3240E	100	LM335Z	125	▶LM3909	75	NE565	110	TL062	60	ZN1034E	200

TRANSISTORS

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

CABLES

20 metre pack single core connecting cable ten different colours.	75p
Speaker cable	10p/m
Standard screened	16p/m
Twin screened	24p/m
2.5A 3 core mains	23p/m
10 way rainbow ribbon	26p/ft
20 way rainbow ribbon	47p/ft
10 way grey ribbon	14P/ft
20 way grey ribbon	28p/ft

HARDWARE

PP3 battery clips	6
Red or black crocodile clips	6
Black pointer control knob	15
Pr Ultrasonic transducers	390
▶6V Electronic buzzer	60
▶12V Electronic buzzer	65
▶PB2720 Piezo transducer	75
▶64mm 64 ohm speaker	70
▶64mm 8 ohm speaker	70
20mm panel fuseholder	25

CAPACITORS

Polyester, radial leads. 250v. C280 type: 0.01, 0.015, 0.022, 0.033 - 6p; 0.047, 0.068, 0.1 - 7p; 0.15, 0.22 - 9p; 0.33, 0.47 - 13p; 0.68 - 20p; 1u - 23p.
Electrolytic, radial or axial leads: 0.47/63V, 1/63V, 2.2/63V, 4.7/63V, 10/25V - 7p; 22/25V, 47/25V - 8p; 100/25V - 9p; 220/25V - 14p; 470/25V - 22p; 1000/25V - 30p; 2200/25V - 50p.
Tag end power supply electrolytics: 2200/40V - 110p; 4700/40V - 160p 2200/63V - 140p; 4700/63V - 230p
Polyester, miniature Siemens PCB: 1n, 2n2, 3n3, 4n7, 6n8, 10n, 15n, 7p; 22n, 33n, 47n, 68n, 8p; 100n, 9p; 150n, 11p; 220n, 13p; 330n, 20p; 470n 26p; 680n, 29p; 1u 33p; 2u2, 50p.

Tantalum bead: 0.1, 0.22, 0.33, 0.47, 1.0 @ 35V - 12p. 2.2, 4.7, 10 @ 25V - 20p; 15/16V - 30p; 22/16V - 27p; 33/16V - 45p; 47/6V - 27p; 47/16V - 70p; 68/6V - 40p; 100/10V - 90p.
Cer. disc. 22p-0.01u 50V, 3p each.
Mullard miniature ceramic plate: 1.8pF to 100pF 6p each.

Polystyrene, 5% tol: 10p-1000p, 6p; 1500-4700, 8p; 6800 0.012u, 10p.
Trimmers. Mullard 808 series: 2-10 pF, 22p; 2-22pF, 30p; 5.5-65pF, 35p

REGULATORS

78L05	30	79L05	45
78L12	30	79L12	45
78L15	30	79L15	45
7805	35	7905	40
7812	35	7912	40
7815	35	7915	40
LM309K	130	LM723	35
LM317K	270	78H05	550
LM317T	90		
LM323K	420		

POTENTIOMETERS

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

TRIACS

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

DIODES

		▶1N4001	3
BY127	12	1N4002	5
OA47	10	1N4006	7
OA90	8	1N4007	7
OA91	7	1N5401	12
OA200	8	1N5404	16
OA202	8	1N5406	17
1N914	4	400mW zen	6
▶1N4148	3	1.3W zeners	13

JUMPER LEADS

Length	14pin	16pin	24pin	40pin
Sgle ended DIP(header plug) jumper				
24 ins.	145	165	240	380
Dble ended DIP(header plug) jumper				
6 ins.	185	205	300	465
12 ins.	195	215	315	490
24 ins.	210	235	345	540
36ins.	230	250	375	695

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

OPTO

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

Clips to suit - 3p each.

Rectangular		TIL32	40
▶red	12	TIL78	40
green	17	▶TIL111	60
yellow	17	ORP12	85
▶TIL38	40	TIL100	70
2N5777	45	Dual colour	60

Seven segment displays:

Com cathode		Com anode	
DL704 0.3"	95	DL707 0.3"	95
▶FND500 0.5"	100	FND507 0.5"	100
TIL313 0.3"	115	TIL312 0.3"	115
TIL322 0.5"	115	TIL321 0.5"	115

LCD: 3½ digit 495p. 4 digit 520p.

BRIDGE RECTIFIERS

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

COMPUTER CONNECTORS

ZX81 2 x 23 way edge connector wire wrap suitable for ZX81 add-ons 150
SPECTRUM 2 x 28 way edge connector wire-wrap suitable for SPECTRUM add-ons 200

RIBBON CABLE

Grey Ribbon cable. Price per foot

10 way	14	34 way	58
16 way	25	40 way	68
20 way	28	50 way	90
24 way	38	60 way	100

IDC CONNECTORS

	PCB Plug Straight	Socket	Edge Conn.
10 way	90	85	120
16 way	130	110	175
20 way	145	125	195
26 way	175	150	240
34 way	205	170	320
40 way	220	190	340
50 way	235	200	395
60 way	330	230	495

MIN. D CONNECTORS

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

SOLDERING IRONS

Antex CS 17W Soldering iron	495
2.3 and 4.7mm bits to suit	85
CS 17Wor XS 25W element	210
Antex XS 25W	525
3.3 and 4.7mm bits to suit	85
Solder pump desoldering tool	480
Spare nozzle for above	70
10 metres 22swg solder	100

RESISTORS

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

PCB MATERIALS

Alfac transfer sheets — please state type (e.g. DIL pads etc.)	45
Dalo etch resistant pen	90
Fibre glass board 3.75 x 8"	80
Fibre glass board 8 x 12"	200
Ferric Chloride crystals	100

BOXES

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

CONNECTORS

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

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

SCRs

▶C106D	30
400V 8A	70
400V 12A	95

VOICE SYNTHESISER!

Now your computer can talk. The GI SP0256 speech processor is able through stored program to synthesize speech. Allophone (extended phoneme) system gives unlimited vocabulary. Easily interfaced with any digital system; ten TTL compatible signals are used to select the allo-phones.
SP0256 850p. Data 50p.

VERO

VEROBLOC◀	390
Size 0.1 matrix:	
2.5 x 1	22
2.5 x 3.75	75
2.5 x 5	85
3.75 x 5	95
VQ board	160
Veropins per 100:	
Single sided	50
Double sided	60
Spot face cutter	130
Pin insertion tool	162
Wiring pen	330
Spare spool 75p Combs	6

SWITCHES

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

MICRO

		6116P3	320	6852	240	8228	220
		6502CPU	325	6875	495	8251	250
		6522VIA	295	6880	100	8253	390
		6532	570	81LS95	85	8255	225
		6551 ACIA	650	81LS96	85	8259	390
2114L2	99	6800CPU	220	81LS97	85	MC1488	55
2716	240	6802CPU	250	8080A	250	MC1489	55
2532	290	6809CPU	620	8085AC	340	Z80ACPU	290
2732	290	6810RAM	115	8156	350	Z80APIO	260
2764	425	6821 PIA	110	8212	110	Z80ACTC	260
4116P20	85	6840	360	8216	100	Z80ASIO	900
5101L-1	220	6850	110	8224	120	Z80ADMA	1150

SOCKETS

	Low profile	Wire wrap
8 pin	6p	28p
14 pin	8p	45p
16 pin	9p	55p
18 pin	12p	60p
20 pin	13p	68p
22 pin	16p	75p
24 pin	18p	82p
28 pin	23p	95p
40 pin	25p	135p

COMPONENT KITS

An ideal opportunity for the beginner or the experienced constructor to obtain a wide range of components at greatly reduced prices. ¼W 5% Resistor kit. Contains 10 of each value from 4.7 ohms to 1M (total of 650 resistors) 530
Ceramic Cap. kit. 5 of each value - 22p to 0.01u (135 caps) 370
Polyester Cap. kit. 5 of each value from 0.01 to 1uF (65 caps) 575
Preset kit. Contains 5 of each value from 100 ohms to 1M (total 65 presets 425
Nut and Bolt kit (total 300 items): 180p
25 6BA ¼" bolts — 50 6BA washers — 50 6BA nuts
25 6BA ½" bolts — 25 4BA ¼" bolts — 50 6BA washers
50 6BA nuts — 25 6BA ½" bolts

CMOS

		4016	20	4034	140	4054	78	4081	12	40193	65	4528	45
		4017	30	4036	249	4055	80	4082	12	4502	60	4529	150
		4018	45	4039	280	4059	430	4085	48	4503	32	4532	60
4000	10	4019	25	4040	40	4060	42	4086	50	4507	35	4534	400
4001	10	4020	42	4041	40	4063	80	4089	125	4508	110	4538	60
4002	12	4021	40	4042	38	4066	22	4093	18	4510	45	4543	50
4006	50	4022	45	4043	40	4067	225	4094	68	4511	40	4549	360
4007	14	4023	16	4044	40	4068	14	4095	65	4512	40	4553	215
4008	36	4024	33	4046	40	4069	13	4097	290	4514	115	4555	35
4009	24	4025	12	4047	35	4070	13	4098	70	4515	115	4556	35
4010	24	4026	75	4048	38	4071	13	4099	70	4516	55	4559	390
4011	10	4027	20	4049	21	4072	13	40106	40	4518	40	4560	140
4012	15	4028	40	4050	21	4073	13	40109	110	4520	50	4584	35
4013	20	4029	45	4051	42	4075	13	40163	60	4521	90	4585	60
4014	45	4030	14	4052	48	4076	45	40173	100	4526	60	4724	140
4015	40	4031	125	4053	48	4077	14	40175	75	4527	50		

LS TTL

		LS20	15	LS75	26	LS123	48	LS160	38	LS197	45	LS353	60
		LS21	15	LS76	20	LS125	30	LS161	38	LS221	55	LS365	28
		LS22	15	LS78	20	LS126	30	LS162	38	LS240	60	LS366	28
LS00	14	LS26	15	LS83	35	LS132	35	LS163	38	LS241	55	LS367	28
LS01	14	LS27	15	LS85	42	LS136	28	LS164	40	LS242	58	LS368	29
LS02	14	LS30	15	LS86	24	LS138	60	LS165	50	LS243	58	LS373	58
LS03	15	LS32	15	LS90	25	LS139	30	LS166	70	LS244	100	LS374	60
LS04	15	LS37	16	LS92	25	LS145	60	LS170	80	LS245	78	LS375	43
LS05	15	LS38	16	LS93	25	LS147	95	LS173	60	LS247	50	LS377	60
LS08	15	LS40	16	LS95	40	LS148	90	LS174	36	LS251	36	LS378	57
LS09	15	LS42	30	LS96	95	LS151	40	LS175	36	LS257	32	LS390	45
LS10	15	LS47	38	LS107	40	LS153	40	LS190	40	LS258	35	LS393	40
LS11	15	LS48	38	LS109	30	LS154	95	LS191	40	LS259	60	LS399	56
LS12	15	LS51	15	LS112	27	LS155	30	LS192	40	LS266	24	LS541	78
LS13	18	LS55	15	LS113	28	LS156	36	LS193	40	LS273	55	LS670	35
LS14	33	LS73	20	LS114	28	LS157	26	LS195	36	LS279	32		
LS15	16	LS74	20	LS122	38	LS158	30	LS196	45	LS283	40		

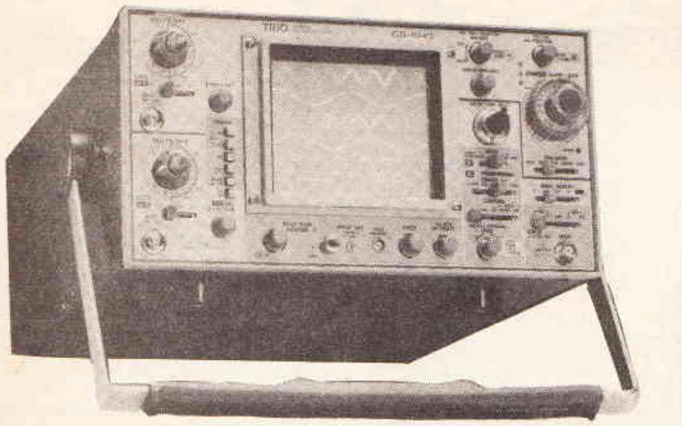
TTL

		7413	25	7444	70	7483	38	74122	38	74161	46	74190	48
		7414	30	7446	55	7485	80	74123	40	74162	40	74191	48
		7416	26	7447	40	7486	26	74125	33	74163	40	74192	48
7400	14	7417	26	7448	42	7489	165	74126	33	74164	45	74193	40
7401	14	7420	16	7450	16	7490	22	74132	36	74165	45	74194	40
7402	14	7421	22	7451	16	7491	35	74141	55	74167	150	74195	40
7403	14	7422	22	7453	16	7492	25	74145	45	74170	125	74196	45
7404	16	7427	20	7454	16	7493	25	74147	75	74173	58	74197	40
7405	16	7428	22	7460	16	7494	35	74148	60	74174	54	74198	80
7406	28	7430	16	7472	24	7495	35	74150	55	74175	50	74199	80
7407	28	7432	22	7473	27	7496	35	74153	36	74176	40		
7408	16	7433	22	7474	23	7497	90	74154	60	74177	42		
7409	16	7437	25	7475	30	74100	80	74155	36	74179	70		
7410	16	7438	25	7476	27	74107	26	74156	36	74180	40		
7411	16	7440	16	7480	48	74109	30	74157	30	74181	105		
7412	16	7442	32	7482	65	74121	28	74160	40	74182	40		

The Rapid Guarantee

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

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



Dual Timebase 'Scopes

Trio have introduced a range of dual timebase oscilloscopes which are claimed to represent the ultimate in modern 'scope technology with regard to functions available, specification, reliability and value for money.

The CS-1040 and CS-1060 are three channel, six trace 'scopes with bandwidths of 40 MHz and 60 MHz respectively. Both use a large rectangular domed mesh, post-accelerator CRT with 12 KV and 16 KV of accelerator potential, providing both high intensity and excellent resolution. Their inner face graticule eliminates parallax errors, while the auto focus maintains a sharp clear wave-form display at all times. Vertical axis sensitivity is continuously adjustable from 1mV/cm through 5V/cm, the very sensitive 1mV/cm range being of great assistance in observing complex, low level waveforms. Part of the input signal is diverted and fed to an output at approximately 50mV/cm of the input level, the gain making it easy to measure frequency using normal frequency counters.

Alternate delayed sweep provides magnification of an intensified portion of the waveform simultaneously with the original. Channels 1, 2 and 3 can be displayed together using the main sweep, with the individual delayed waveforms of these channels simultaneously shown using the alternate sweep function to give a 6 trace capability. Sweep time is continuously variable from 0.5 sec/cm to 5 nanosec/cm wth an internal delay line to provide accurate observation and measurement of the leading edge of high frequency signals. A ± 3% accuracy allows for extremely precise waveform measurement.

Video signals both vertical and horizontal can be observed using a new video clamping function in which manual syncing has been eliminated, ensuring high stability syncing. Other features include V mode triggering, quickly switchable alternate and chop, high sensitivity X-Y mode, auto-free run, trace rotation, trigger holdoff, single sweep, line and auto sync, sweep and gate output, add and subtract, vertical control of delayed waveforms, and intensity modulation.

Completing the range is the CS-2110 four channel, eight trace 100 MHz oscilloscope. Sensitivity over its normal bandwitdth is 1mV/cm and it will trigger to beyond 140 MHz. The CS-2110 has an inner face graticule, and an accelerator potential of 20 kV ensures that the display remains bright and sharp even when viewing high speed signals on the 2 ns/cm sweep range. In addition to the features found on the other two models, the CS-2110 has an accuracy of ± 2%, a channel-to-channel skew time of less than 500 ps, and completely independent A and B sweeps.

All three models come with a two year guarantee and a full range of accessories is available. The CS-1040 and CS-1060 cost £638.00 and £799.00 respectively, exclusive of packing, delivery and VAT, and are available from House of Instruments, Clifton Chambers, 62 High Street, Saffron Walden, Essex CB10 1EE, tel 0799 24922, or from Dawne Instruments & Electronics, Shields Road, Bill Quay, Gateshead NE10 0RS, tel 0632 695117. The CS-2110 costs £1399.00 exclusive of packing, delivery and VAT and is available from House of Instruments at the address above.

Computer Filter Plug

Galatrek International Ltd have introduced a new Filter Plug which can be fitted to the supply cable in place of a standard 13 amp plug and will protect micro and minicomputers, word processors and all voltage sensitive equipment from mains born interference.

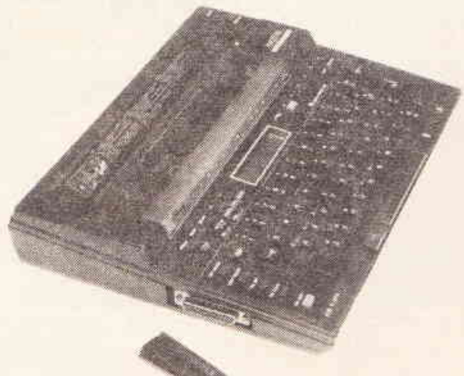
This compact unit will protect equipment from transients and spikes which can wipe out memory and corrupt data. It also provides protection against momentary supply interruption, mains RF interference and lightning disturbance. The current rating of 2 amps is sufficient for most micros and accessories, and frequency is 50/60 Hz. The Filter Plug is available as described, or in a small box with a socket outlet to choice for any country in the world and a flylead mains input, for £29.95 including VAT and post and packing. Order from the manufacturers, Galatrek International Ltd., Scotland Street, Llanrwst, Gwynedd, North Wales, tel 0492 640311.

Low Cost EPROM Eraser

Ground Control have introduced a low cost ultra violet EPROM eraser which is aimed at development laboratories, home computer enthusiasts, and other applications where rapid erasure of just a few EPROMs is required.

The Uvipac EPROM Eraser is mains powered and will erase up to three EPROMS of any size at one time, or one CPU with on-board EPROM. Erasure takes between five and twenty minutes depending upon the type of EPROM and the Uvipac can be supplied with a built in fifteen minute timer if required. EPROMs are simply loaded into the conductive foam pad supplied and inserted into the unit. When the door has been closed and the unit switched on, an optical fibre indicator shows that the eraser is operating. The complete unit measures just 90 x 80 x 49 mm and spare conductive foam pads and UV tubes are available from the manufacturers.

The basic Uvipac eraser costs £19.95 and the Uvipac—T with built-in timer costs £24.95. Both prices include VAT, and postage and packing for the UK is £1.50. Ground Control, Alfreda Avenue, Hullbridge, Essex SS5 6LT, tel 0702 230324.



Baby Brother

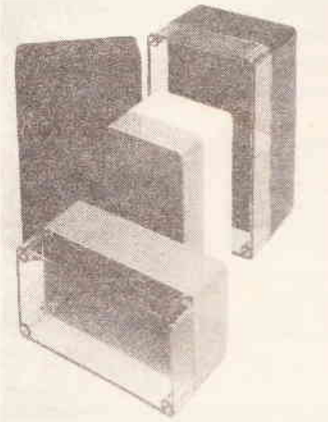
Brother's new EP-22 is probably the smallest and lightest typewriter in the world, and its plain paper thermal printing system makes it one of the quietest as well. It is battery powered, fully portable, and has a built-in RS-232C interface which allows it to be used as a printer with personal computers.

The EP-22 is no bigger than an A4 pad and its weight, including batteries, is just 5 lbs. The 5 x 7 dot matrix printer can be used with either thermal paper or with plain paper by means of a cassette-loading thermal ribbon. The calculator style QWERTY keyboard features a second shift for all the accents used in Roman script European languages, a range of signs for arithmetic and chemical formulae, and automatic superior or inferior numerals. A sixteen character LCD with adjustable angle brightness allows text to be checked, and if necessary amended using the 32 character correction buffer. Up to a page of corrected text can be stored in the 2K memory, ready to be printed at the touch of a button, and the display indicates the amount of memory remaining. The EP-22 can also be used as a 12 digit calculator.

The EP-22 comes complete with batteries, 3 thermal cassette ribbons, and both thermal and plain paper, and costs £169.95. Jones & Brother, Office Equipment Division, Shepley Street, Audenshaw, Manchester M34 5JD, tel 061-330 6531.

Now You See It . . .

Boss Industrial Mouldings Ltd have introduced a series of coloured tops to complete their range of ABS BIM 2000 Bimboxes. The existing range is available in seven sizes ranging from 100 x 50 x 25 mm to 190 x 110 x 60 mm and features a choice of five different coloured bases with a clear top. The new tops are made from the same material and come in the same five colours as the bases, allowing you to select matching or contrasting case sections as desired. Colours available are black, grey, white, orange and blue and all cases incorporate slots on a 0.2" spacing which can support PCBs. The case parts are secured by screws inserted through the base



and when assembled have excellent water repellant properties. Boss Industrial Mouldings Ltd, James Carter Road, Mildenhall, Suffolk IP28 7DE, tel 0638 716101.

Touch Sensitive Keyboard

The Concept keyboard has a flat surface which is divided into an 8 x 16 matrix of touch sensitive areas, each producing a unique 7-bit ASCII code which the programmer defines as required. The surface accepts A4 size overlay sheets which can be marked as desired to define areas and functions, and the manufacturers claim that it will work with any microcomputer.

The keyboard is intended for educational use, allowing pupils to communicate with a computer using a minimum of clearly marked functions rather than having to cope with the complexity of a full QWERTY keyboard. Other possible applicatons include games, demonstrations, and simulation exercises. The format obviously lends itself to the representation of, for example, a floor plan around which people and furniture must be moved. It is possible to use a number of areas together and thus produce large touch sensitive pads which could be used by those who have handicaps or are otherwise unable to manipulate a conventional keyboard.

The Concept keyboard comes complete with full documentation, a connecting lead to suit the majority of microcomputers, and a set of demonstration software. Star Microterminals Ltd, 22 Hyde Street, Winchester, Hampshire SO23 7DR, tel 0962 51422.

SHORTS

● Downing Electronics have introduced a portable test pattern generator for use with all 525 and 625 line RGB display units. It provides 9 different patterns, has a signal frequency accuracy of ± 0.02%, and will test both separately synchronised and green signal pulse synchronised units. Cost is £325.00 plus VAT from Downing Electronics Ltd, 24 Downing Road, Reading, Berkshire RG3 5BB, tel 0734 22556.

● An international users group for owners of Oric-1 microcomputers has recently been set up. The Oric Owner's/Users Group (International) Ltd has the full approval of the computers' manufacturers and produces a monthly magazine called Oric Computing. Membership costs £10 a year, and £1 plus an A4 SAE will bring you full details and a sample magazine. 1 Marlborough Drive, Worle, Avon BS22 0DQ, tel 0934 510279.

● The NMS Relay Controller is designed for use with the ZX Spectrum and has four channels each with a double pole 5A 240V relay. The relays are operated by simple BEEP commands either from a program or the keyboard, and the unit plugs into the MIC socket leaving the expansion port free. It costs £24.95 plus £1.50 post and packing from Ness Micro Systems, 100 Drakies Avenue, Inverness IV2 3SD, tel 221 194.

● Cricklewood's latest catalogue covers 31 sides of A5 with mail order electronics parts, many of them illustrated. Items listed include semiconductors, books, tools, connectors, cases, switches, etc and copies cost £1 including postage from Cricklewood Electronics Ltd, 400 Cricklewood Broadway, London NW2 3ET, tel 01-452 0161.

● Bulgin have produced new catalogue listing their range of bulkhead mounting and integral IEC socket type mains filters. Ratings up to 6A are covered. Also new is a catalogue describing their Buccaneer range of waterproof connectors covering both mains and signal applications. A.F. Bulgin & Company PLC, Bypass Road, Barking, Essex IG11 0AZ, tel 01-594 5588.

● Inmac have produced an 88 page illustrated catalogue of computer and business accessories. Their range includes dedicated accessories for Apple and CBM machines and general accessories like cables, disc systems, etc to suit most other machines. The catalogue is free from Inmac UK Ltd, Davy Road, Astmoor, Runcorn, Cheshire WA7 1PZ, tel 09285 67551.

● Riscomp's US 5063 is an ultrasonic movement detection module which processes the received signal using digital techniques. It offers a choice of three levels of discrimination, fixed alarm time, exit delay, and selectable entrance delay and costs £13.95 plus VAT. Riscomp Ltd, 21 Duke Street, Princes Risborough, Bucks HP17 0AT, tel 08444 6326

● Salford University are running a series of one, two and three day short courses during December and January on the BBC, Apple II and CBM microcomputers. The courses cover all levels from complete beginner upwards and each student is guaranteed individual use of an appropriate machine. Details from The Microprocessor Short Courses Unit, Department of Electronics & Electrical Engineering, University of Salford, Salford M5 4WT, tel 061-736 4843 ext 248.

● The Integrex BX80 7—colour printer is designed for use with the BBC microcomputer and will work in all modes, including mode 7 Teletext, using the supplied colour screen dump listing. It prints at 125 cps on plain paper, has an internal 2.5K byte buffer, and connects to the BBCs RS-423 socket using the lead supplied. Price is £495 plus VAT from Integrex Ltd, Portwood Industrial Estate, Church Gresley, Burton-on-Trent, Staffs DE11 9PT, tel 0283 215432.

● Further to last month's report of a record number of bankruptcies among British electronics companies, a recent surprise casualty is Scopex Instruments Ltd. It may be of some consolation to owners of Scopex products to learn that a former design engineer with the company has formed a new company, Mendascope, which offers a full repair service including collection and free estimate. Mendascope Ltd, Otter House, Western Underwood, Olney, Bucks MK46 5JS, tel 0234 712445.

● Make light work of different number base arithmetic with Casio's new FX450. This solar-powered scientific calculator will rapidly convert between binary, octal, decimal and hexadecimal, has 64 functions and holds eight fundamental constants in memory. It comes in a protective folding wallet and costs £22.95. Casio Electronics Co. Ltd, Unit 6, 1000 North Circular Road, London NW2 7JD, tel 01-450 9131.

● Wilmslow Audio's new catalogue doesn't just list loudspeakers by manufactuers like Tannoy, Kef, Gauss and Chartwell, it also contains kits, amplifiers, microphones and stands, effects units, and a lot of useful information. Price is £1.50 from Wilmslow Audio Ltd, 25/39 Church Street, Wilmslow, Cheshire SK9 1AS, tel 0625 529599.

● The AMS 3" disc drive which is suitable for use with the BBC microcomputer is to be sold through W.H. Smiths. The unit comes in 100K format at £225 or 200K format at £399 and runs from the BBCs power supply. A number of software houses have produced packages for the drives.

● The 1984 London Home Computer Show runs from Friday January 6th to Sunday 8th in the large New Hall of the Royal Horticultural Society, just around the corner from the Old Hall where it was staged last year. The show is aimed at microcomputer hardware and software enthusiasts and is open from 10 am to 6 pm each day (4 pm Sunday). Admission costs £2.00 or £1.50 if you're under sixteen. ETI

VECTOR GRAPHICS

4,294,967,296 vectors should take over a year to draw, even at 100 per second. However if you want to try — the ETI Graf-vec will do it.

This project takes us away from the familiar world of the TV display and shows us instead the other principal means of producing a picture. The ordinary TV set produces a picture by moving an electron beam backwards and forwards across a phosphor coated screen so that it traces a fixed number of parallel horizontal lines. The actual picture is produced by turning the beam on to display a bright dot at the right time and turning it off where no light is required. This method works very well for broadcast pictures but is sometimes not so good for pictures generated electronically. For a home computer to generate a picture, it must generate a pattern of bits which determine when the electron beam in the display tube is to be on and off. Since the transitions can only occur at discrete time intervals, the picture produced does not always appear as smooth as we might wish. This effect is usually most noticeable on diagonal lines where there are marked contrast changes.

While we cannot pretend that this project will replace a TV type of display for home computer applications, it does provide an interesting alternative output device for graphics.

The method employed by the Graf-vec in producing a picture is to define the start and finish of a line and cause an electron beam to traverse the intervening space relatively slowly. Drawing many such lines in a short space of time allows us to build up a picture. The main disadvantage of this method is that if too many lines are drawn the whole display will appear to flicker. This can be reduced by the use of long persistence phosphors if available.

As described, the Graf-vec will draw lines between any two points on a 256x256 grid. The relatively simple circuitry used does not compensate for differing line lengths changing the brightness but still gives an interesting result.

The Circuit

The circuit consists of a power supply, digital input and control section, and two linear scan generators. The basic mode of operation requires a data source — probably your trusty home computer — to put two bytes of data into the device to represent the coordinates to which a vector is to be drawn (The starting point is assumed to be where you are now). The Graf-vec will draw the vector and then wait for the next set of data and indicate that it is ready. The digital input circuitry of the Graf-vec is designed so that one byte of the next vector can be input at any time as it is stored in a

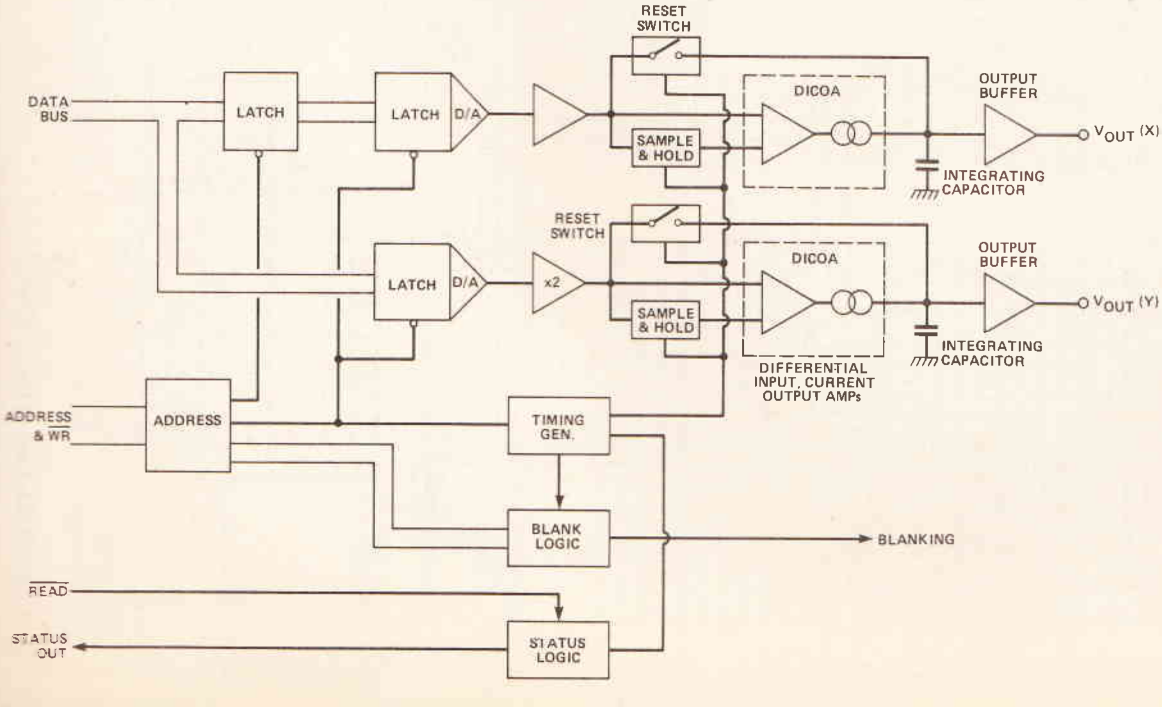


Fig. 1 Block diagram of the Graf-vec.

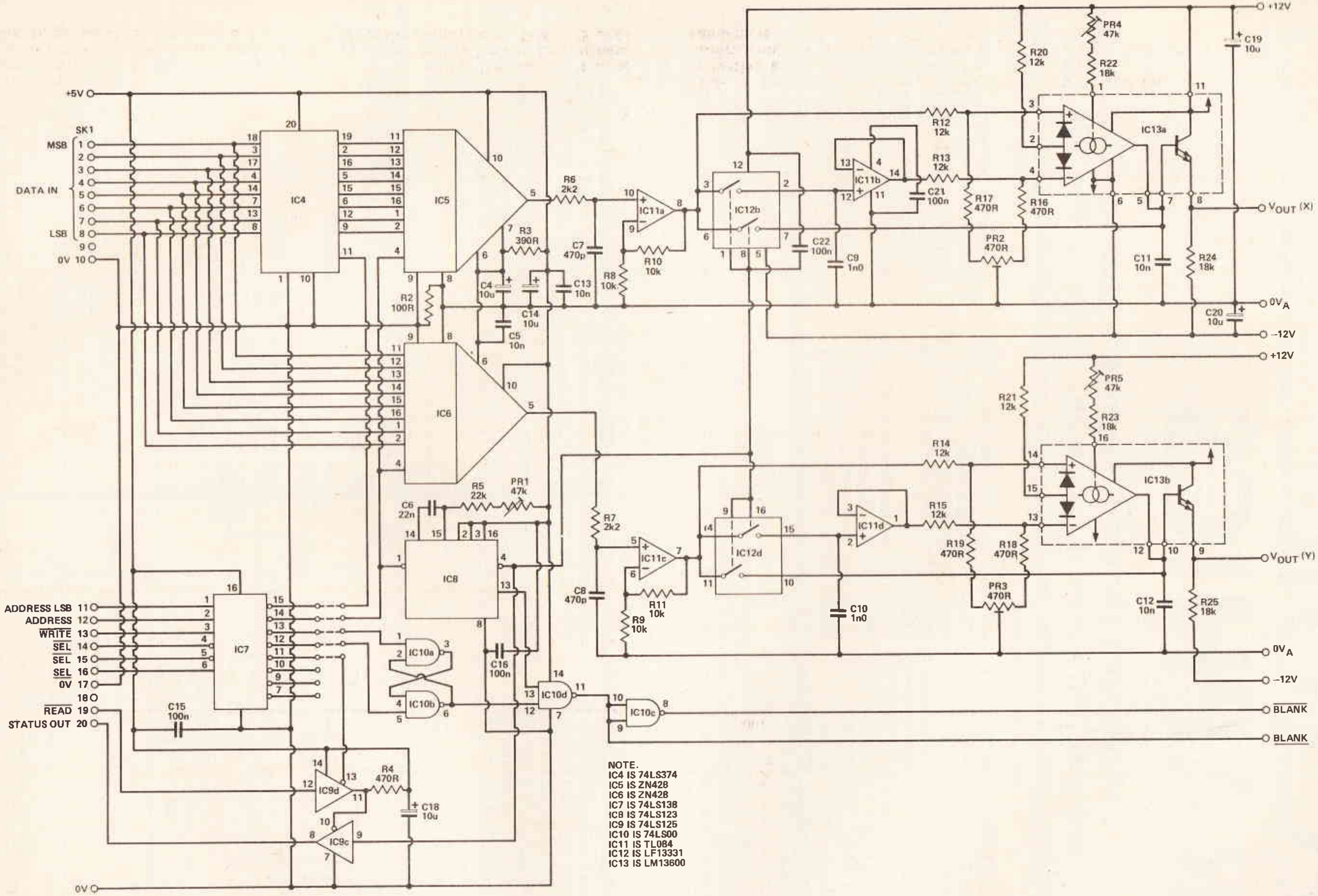


Fig. 2 Circuit diagram of the Graf-vec.

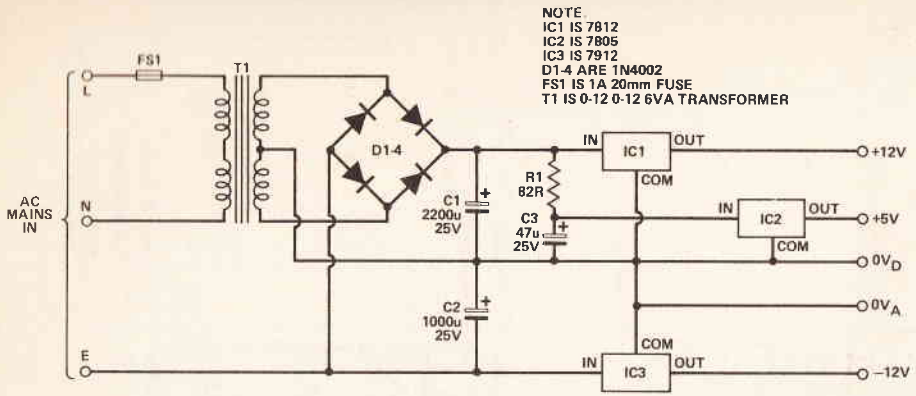


Fig. 3 Circuit diagram of the PSU.

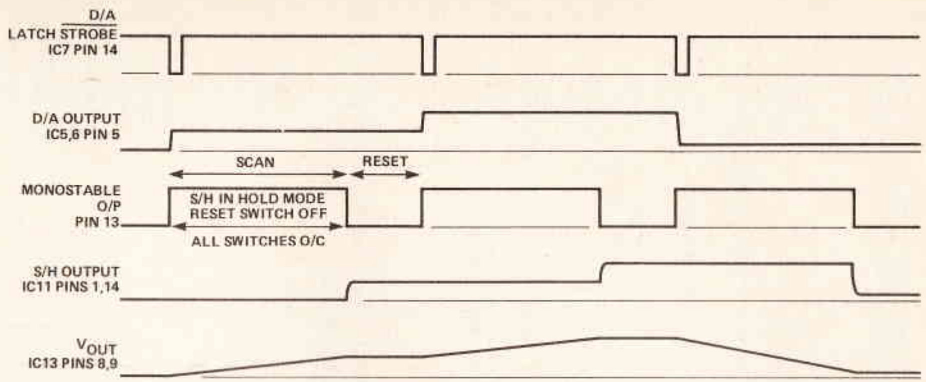


Fig. 4 Timing diagram of the Graf-vec.

How It Works

The Graf-vec consists of three major parts. The first of these is a straightforward stabilised power supply giving ± 12 V and +5 V at about 100 mA each. Only one transformer is used to save on cost and space. The output is regulated by three IC stabilisers which often need no heatsink in normal operation. However, R1 is provided to dissipate some of the excess power in the +5 V regulator, and a small piece of aluminium would not go amiss.

The second major part consists of the logic, timing and digital to analogue conversion. IC7 is a 74LS138, 1 of 8 decoder whose inputs are available at the input connector. This enables simple interfacing to some computer systems without additional circuitry. The outputs from this device are all available on the board via links and are used to enable the other logic functions. The first output drives the strobe input of a 74LS374 (IC4), which is an octal latch with three-state outputs. The outputs from the device are permanently on in this circuit and it is used to store the data corresponding to the X vector before it is loaded into the DAC (IC5).

The next output from IC4 has two uses. It drives the data input enable pins on the DACs (IC5 & 6) and it also drives the trigger input on IC8. ICs 5 & 6 are ZN428 monolithic digital to analogue converters which accept data from the inputs when the enable pin is low and store it while the pin is high. They convert the digital data to a corresponding analogue output voltage in the range 0 to 2.55 V. Note that IC6 gets its data from the input data bus whereas IC5 gets it from the output of IC4.

IC8 is a dual monostable device only one part of which is used in this circuit. Its purpose is to provide the timing signals for the sweep generator, a display enable signal, and status indication back to the controller.

The next two outputs from IC7 are used to set or reset a simple latch made from two parts of IC10. An output from this latch is gated with the output from IC8 and enables or disables the display (if this facility is used.).

The final output from IC7 enables part of IC9 which is a 74LS125 Quad three state buffer. This transfers the logic level at SK1 pin 19 onto the enable pin of another section of IC9. If this is low, the logic state of IC8 Q output is impressed on SK1 pin 20. This indicates that the unit is ready to start display when the pin is high.

The final part of the Graf-vec is made up of two identical circuits. Each of these takes the output from a DAC (IC5 or 6) and processes it to give the required output. We shall only explain one of these circuits as the other is exactly the same.

The output from the DAC comes via R6 and C7 which remove glitches and high frequency noise from the signal. It is then amplified by a factor of 2 by IC11a. This also provides a low impedence drive to the rest of the circuit.

Consider firstly the case when the Q output from IC8 is high (ie not triggered). The output from IC11a is connected via two of the four FET switches in IC12, an LF13331, to C9 and C11. This ensures that these capacitors are charged to a defined voltage before each sweep. Nothing further happens to this part of the circuit until the DACs are loaded with new information and IC8 is triggered. When this happens all the switches in IC12 are turned off. This isolates C9 which will hold its previous voltage for some time, and also removes the clamp on C11. The voltage on C9 is buffered by IC11b and applied via R13 to the inverting input of IC13. A new voltage now appears on the output of IC11a as the DAC has been updated. This is applied via R12 to the non-inverting input of IC13, an LM13600, which contains two transconductance amplifiers and two buffers. The transconductance amplifiers provide an output current which is proportional to the difference of the two input currents, modified by currents into two other inputs.

In this circuit, one amplifier and buffer combination is used for each channel. The currents through R12 and R13 are subtracted and a current proportional to their difference flows into C11. Currents flowing through R20 and VR4, R22 determine what the actual gain will be. As the voltage on IC11a output is constant after its initial change and that on IC11b output is also constant, the resulting current flowing into C11 will be constant. The result of this is that C11 will charge linearly and will also tend to go in the direction of the voltage on IC11a output. In fact, when everything is set up correctly, the voltage on C11 will just reach the voltage on IC11a output as the monostable pulse ends. At this time the capacitor voltage will be clamped by the FET switches being turned on again. The capacitor voltage is buffered by buffers in the LM13600 before being sent out.

Finally it should be mentioned that R16,17 and VR2 form a balancing network and DC return path for the input currents and one of the control currents.

```
16514          11 10 00    LD DE,0010         :Scan counter = 256
   17 PICOUT   06 0E       LD B , 0E          :Points/scan = 14
   19          21 A0 40    LD HL,40A0         :Start of data table = 16544
   22 POINTOUT 7E          LD A,(HL)          : Get "X" data
   23          D3 1F       OUT (1F),A         :Output "X" data
   25          23          INC HL             :Move data pointer
   26 TESTIT   DB 1F       IN A,(1F)          :Input status indicator
   28          CB 7F       BIT A.7            :Isolate status bit
   30          28 FA       JRZ (TESTIT)       : Jump back if not ready (low)
   32          7E          LD A,(HL)          :Get "Y" data
   33          D3 3F       OUT (3F),A         :Output "Y" data
   35          23          INC HL             :Move data pointer
   36          10 F0       DJNZ (POINTOUT)    :Repeat for all points
   38          1B          DEC DE             :Decrement scan counter
   39          7A          LD A,D             :Get scan count high byte
   40          B3          OR A,E             :OR with scan count low byte
   41          20 E6       JRNZ (PICOUT)      : Repeat if not zero
   43          C9          RTS                :Return to calling program

DATA LIST
16544          00 80 40 C0 7F 80 AE C0
               FE 80 7F 80 97 68 7F 50
               68 68 7F 80 7F 30 7F 80
               40 80 00 00
```

Table 1 Z80 machine code demo program.

```
  10 REM ) ( ▞:5▇RNDACS ▇C IF .?▇
4 NEW TAN XXXXXXXXXXXXXXXXXXXXXX
XXXXXXX
  15 FAST
  17 LET X=10
  18 LET Y=X
  30 POKE 16545,X
  35 POKE 16553,X
  40 LET X=X+Y
  41 IF X>235 OR X<15 THEN LET Y
=(-1)*Y
  45 GOTO 20
  50 FOR K=16514 TO 16575
  60 PRINT K,
  70 INPUT A$
  75 IF A$="" THEN STOP
  80 IF LEN A$<>2 THEN GOTO 70
  90 LET A=CODE (A$(1 TO 1))
 100 LET B=CODE (A$(2 TO 2))
 110 LET C=CODE "F"
 120 LET D=CODE "0"
 130 IF A>C OR A<D OR B>C OR B<D
THEN GOTO 70
 140 POKE K,16*(A-D)+B-D
 150 PRINT CHR$ A;CHR$ B
 160 NEXT K
```

Table 2 ZX81 BASIC program. Note that you must go to line 50 to enter data and RUN to display.

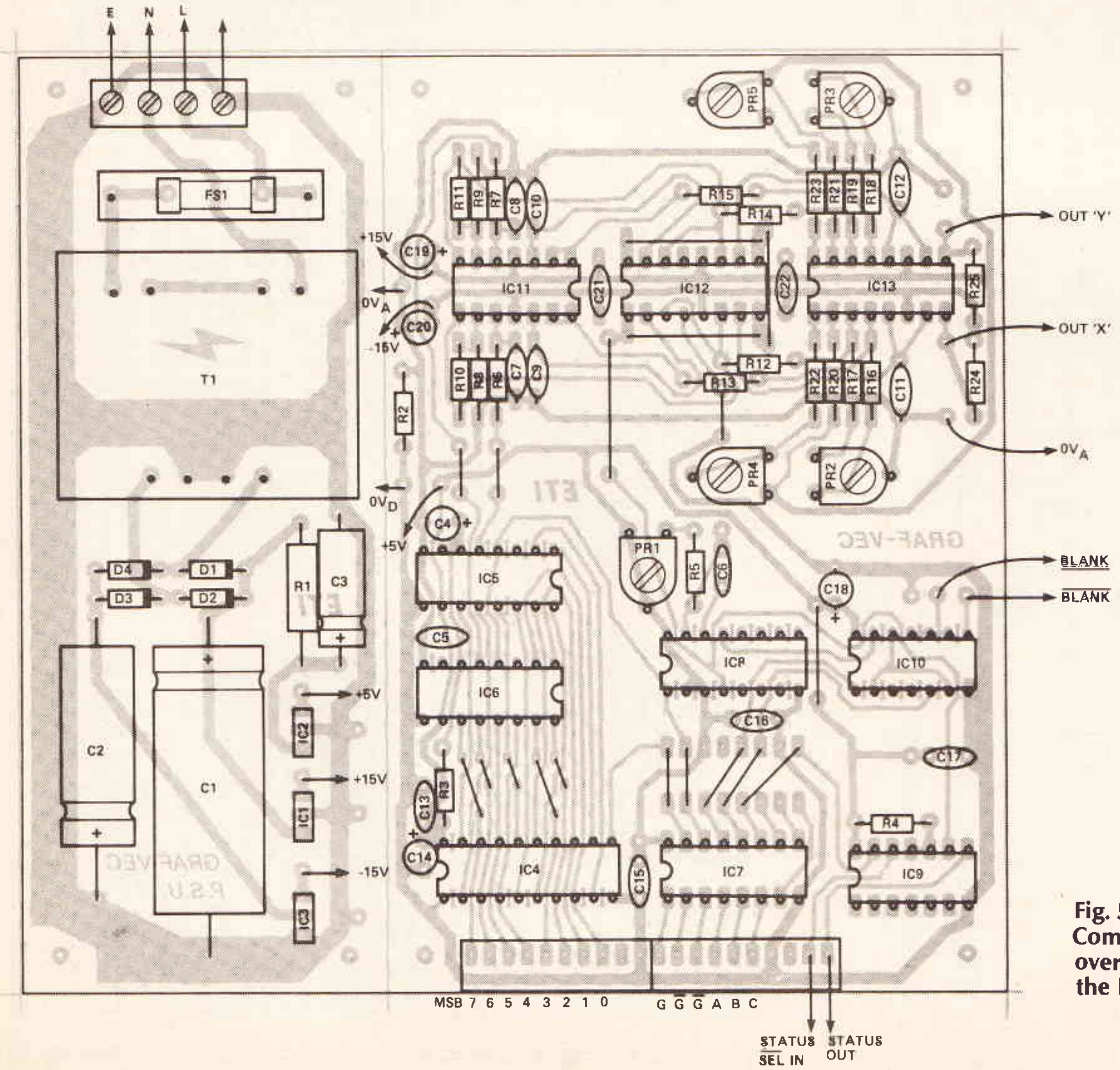
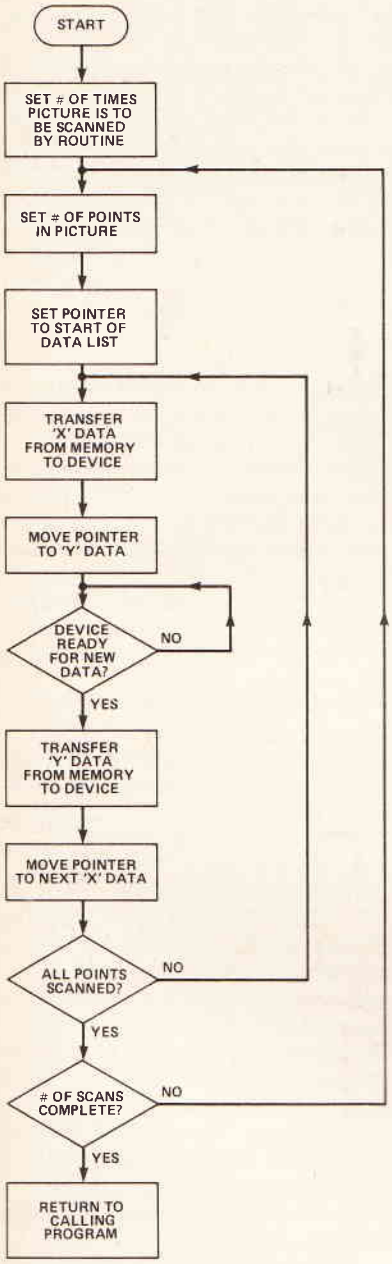


Fig. 6 (opposite) Flow chart showing how the display is formed.

Fig. 5 (left) Component overlay of the PCB.



latch, but the second byte should only be put in after the status bit is detected as high as this will start the next scan.

When the second byte of a new vector is written in, the logic section generates a 400 us enable pulse for the linear scan generators. This allows them to generate the linear voltage ramps which eventually move the spot around on the oscilloscope or other display device.

Once the 400 us pulse has finished, the linear scan generators are set up ready for the next vector and the display enable or blank output will go low. If you have the facility available, this can be used to blank the display between vector scans or, by means of the internal latch accessible by writing to two further addresses, the display can be turned on and off to allow you to move position without drawing a line.

The Linear Scan Generator

This is the heart of the whole system and is basically an integrator. Before each scan starts, the output voltage and the voltage stored on a sample and hold circuit are clamped to the current output from the D to A circuits. When a scan starts, the sample and hold circuit changes to its hold function and the output is unclamped. Since the output is closely associated with the integrator capacitor it does not change immediately.

The D to A circuit now changes its output voltage to the new value and a current is generated which is proportional to the difference between the old and new input voltages. This current is used to charge the integrator capacitor and will do so at a constant rate. This gives a linear voltage ramp between the old output voltage and (if set up properly) the new one.

At the end of the scan pulse the sample and hold circuit and the output voltages are again clamped in readiness for the next scan. Note that while in the clamped state there is ideally no current flowing in the output circuit of the current generator as its input voltages are equal.

Semi-Solid Section

This is about the interface between the hardware described in this project so far and the software needed to make it do anything interesting. Fig. 6 shows in flow chart form the actions needed to form the display. In order to prevent a lot of flicker, the routine scans all the points in the display many times each time it is called. The main cause of any residual flicker is the relatively slow response of the BASIC program which calls it. If this too were in machine code a very smooth display could result.

Table 1 shows how the flow chart is implemented in Z80 code while Table 2 (up to line 45) is the ZX81 basic program which is used to control it. Lines 50 onward are a simple program which allows hexadecimal codes to be typed into the machine which are then held in the REM statement in line 10.

For initial entry of the machine code, alter line 50 to read:—

50 FOR K=16514 TO 16543

Then you can run the program from line 50 and input the program code. Changing line 50 back again will let you type in the data for the picture. The format for typing hex numbers in is two charac-

Parts List

Resistors (¼ W Carbon film unless otherwise stated)

R1	82R	1W
R2	100R	
R3	390R	
R4,16,17,18,19	470R	
R5	22K	
R6,7	2K2	
R8,9,10,11	10K	
R12,13,14,15, 20,21	12K	
R22,23,24,25	18K	
VR1,4,5	47K	min. horizontal preset
VR2,3	470R	min. horizontal preset

Capacitors

C1	2,200	uF 25V axial electrolytic
C2	1,000	uF 25V axial electrolytic
C3	47	uF 25V axial electrolytic
C4,14,18,19,20	10	uF 25V Tant. Bead
C5,13	10	nF ceramic disc
C6	22	nF polycarbonate
C7,8	470	pF ceramic
C9,10	1	nF polycarbonate
C11,12	10	nF polycarbonate
C15,16,17,21,22	100	nF ceramic

Semiconductors

IC1	1N4002
IC2	7805
IC3	7915
IC4	74LS374
IC5,6	ZN428
IC7	74LS138
IC8	74LS123
IC9	74LS125
IC10	74LS00
IC11	TL084
IC12	LF1331
IC13	LM13600
D1,2,3,4	1N4002

Miscellaneous

T1	0-12, 0-12 V 6 VA PCB mount mains transformer
FS1	1 A, 20 mm fuse + PCB mount holder
SK1	2 off, 10 way 0.1 in pitch PCB connector

4 way, PCB mount mains screw connector; PCB; Small heatsink for IC2; 23 way double sided edge connector 0.1 in pitch; 16 way(min) or 20 way ribbon cable.

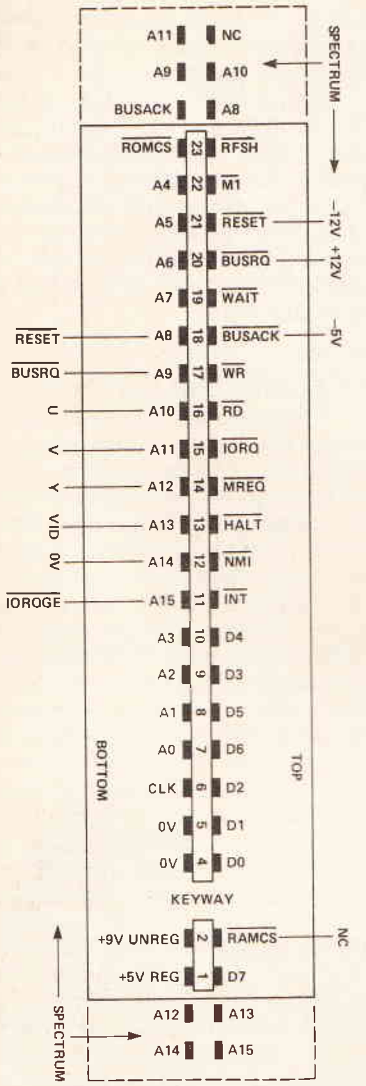


Fig. 7 The ZX81 and Spectum edge connector.

Graf-vec, socket 1	ZX81
pins 1 - 8 (data in)	D0 - D7
pins 10, 17 (OV)	OV
pin 11 (address LSB)	A5
pin 12 (address)	A6
pin 13 (WRITE)	WR
pin 14 (SEL)	A7
pin 15 (SEL)	IORQ
pin 19 (READ)	RD
pin 20 (status out)	D7

Table 3 Connections to the ZX81.

ters 0 to 9, A to F followed by newline. Wrong characters or wrong number of characters will require re-entry of the correct ones. To abort this entry mode type a single space and newline. When first entered, line 10 can be REM with at least 64 characters after it.

While the development work for the project was done on a Z80 system, there is no reason why any other processor could not be used. The only differences would be in the actual interface hardware and the machine code realisation of our flow chart.

There are 8 data lines, 7 control lines and one status output to the project. Normally the data lines will be connected to the controller's data bus. The status output line is from a three state buffer and can be connected to the data bus (we used bit 7). One of the remaining control lines is devoted to reading the status bit and must go low when a read operation is required (on a 6502 system it could be tied low permanently as the read and write are controlled by the same line). Of the remaining 6 control lines, one must be high and two must be low before anything happens. These would normally be used as select lines. The last three lines are used to select the operation to be carried out. One of these should be the R/W or similar function while the others will be simple address lines to select the particular operation to be performed. Exactly how these various lines are connected will depend on your particular requirements but Table 3 shows how we did it for a ZX81.

Construction

This should cause no headaches as it is quite straightforward. First of all, decide whether you want to use the PCB as it is or to split it into two parts (it might be tricky to cut it once the parts are assembled!). Note that there are eighteen links on the main board and five on the power supply, and begin by inserting these, the resistors, and the IC sockets. We recommend the use of sockets if only because some of the devices cost well over a pound and are therefore worth protecting . . . Next, fit the smaller capacitors, potentiometers, and sockets, followed by the power supply diodes, resitor (mounted 6 mm above the board), larger capacitors, fuse, and mains connector. Finally, fit the mains transformer and insert the ICs into their sockets. Check that the ICs and capacitors are mounted the right way round.

Test the power supply section fully before connecting it to the other board and BE CAREFUL, there is MAINS VOLTAGE present. If all is well, all that remains is to wire the PCB connectors to suit your microcomputer or whatever and then connect up.

Setting Up

If you have an oscilloscope at hand — you need one for the display — set up the sample driver program or something similar on your computer etc and check that you get negative going pulses on the outputs of IC7 pins 15,14 and 11. (this could change if you use a different jumper pattern for a different computer interface.) Set VR1 to give a low pulse period of 400 us at pin 4 of IC8.

Check the outputs from IC13 with the oscilloscope. These should consist of straight line segments with no sudden jumps. If this is not the case, adjust VR2 and VR4 for the X channel and VR3 and VR5 for the Y channel. VR2 and VR4 are effectively offset controls which tend to have the effect of shifting the lines in one direction whereas VR3 and VR5 are gain controls which increase the slope of the lines in whichever direction they happen to be going. The proper setting of these controls is vital to the production of a good display. If you have difficulty setting them, set up the data in the display table to be 00,00,FF,FF etc. This will give a repeating full scale display.

When the controls have been set up reasonably, run the demonstration program and set the 'scope to X-Y mode. You should now have a moving display. Final trimming of the pots. may be made to clear up any defects visible. If you do not have an oscilloscope, connect up the device to whatever you are using for a display, set all pots to mid travel and run the demo program and tweak for best results.

ETI

Buylines

There should be no problems with this lot. The LM12600, LF13331, and ZN428, etc are all available from Technomatic, among others. The transformer is available from Rapid, the PCB connectors from Ambit, and the mains screw connector from Electrovalue. The PCB is available from our PCB service on page 75.

THE NEW MPF1 PLUS...

...THE LOWEST COST
Z80 SINGLE BOARD COMPUTER
AVAILABLE WITH ALL THESE FEATURES!

BUILT-IN ASSEMBLER

The MPF1 PLUS incorporates the Z80 – the most widely used 8-bit microprocessor in the world, to form a Single Board Computer (SBC). Packed in a plastic bookcase together with three comprehensive manuals and power supply (to BS3651 standard), the MPF1 PLUS is a microprocessor learning tool for every application.

Teaching you in a step-by-step method the MPF1 PLUS helps the user fully understand the Software and Hardware of a microprocessor easily and conveniently – as opposed to micro-computers that aim to teach high-level languages instead of microprocessor systems fundamentals.

Not only is the MPF1 PLUS a teaching tool but with the available accessories it can also be used as a low-cost development tool or simply for OEMs.

FLIGHT
Electronics Ltd.

Quayside Rd, Southampton, Hants SO2 4AD. Telex 477793. Tel. (0703) 34003/27721.

Micro-Professor is a trade mark of Multitech Industrial Corporation. Z80 is a trade mark of Zilog Inc.

THE MPF1 PLUS

Just look at the specification:-

Technical Specification

CPU: Z80A – 158 instructions
Software:
- Z80/8080/8085 machine code
- Z80 Assembler, line and 2 pass.
- 8K BASIC interpreter (Extra)
- 8K FORTH (Extra)

ROM: 8K Monitor (full listing and comments)
RAM: 4K CMOS (2 x 6116)
Input/Ouput: 48 system I/O lines
Speaker: 2.25'' coned linear
Display: 20 character 14 segment green phosphorescent
Expansion:
- Socket for 8K ROM
- Cassette interface
- Connectors 40 way, complete CPU bus

Keyboard: 49 key. Full "QWERTY" real movement good tactile feedback
Batteries: 4 x U11 for memory back-up (batteries not included)
Serial Interface: 165 baud for read/write via audio cassette

Manuals

1. User's Manual. 8 chapters.
   1. Over view and Installation. 2. Specification (hardware and software). 3. Description of Operation. 4. Operating the MPF-1 Plus. 5. 44 Useful Sub-Routines. 6. The Text Editor. 7. Assembler and Disassembler. 8. System Hardware Configuration.
2. Experiment Manual. 16 experiments.
3. Monitor Program Source Listing with full commenting.
4. Also available the MPF-1 Plus Student Work Book (self-learning text).

Accessories

- **PRT-MPF-1P:** 20 character printer. Ready to plug in. Memory dump.
- **EPB-MPF-1P:** Copy/list/verify 1K/2K/4K/8K ROMS. Ready to plug in.
- **SSB-MPF-1P:** Speech Synthesizer. Inc. 20 words and clock program. 1200 words available.
- **SGB-MPF-1P:** Sound Synthesizer Board.
- **I/O – MPF-1P:** Input/output board

Yes! I now realise that I need an MPF1 PLUS and that it is the lowest cost Z80 SBC available with all these features.

I enclose £165.00 (£140.00 + £21 VAT plus £4 carriage). Overseas P.O.A.

Cheques payable to FLIGHT ELECTRONICS LTD.

Please debit my Barclaycard/Access ☐ ☐

Account No. ______________

An invoice will automatically be sent.

Name ______________
Address ______________

Signature ______________
Date ______________

ETI

SINCLAIR'S NEW POCKET TV

Why is there no love from Russia? Why are the French in tears? And why do Chinese gentlemen remain inscrutable? Ask Vivian Capel.

The reason is that these are among the very few places in which Clive Sinclair's new pocket TV will not work. Considering the many different TV standards in use throughout the world the fact that such exclusions are so few is certainly remarkable. Even more remarkable is that the set automatically adjusts itself to whatever standard is being received without any user switching at all. In fact the only external controls are the tuner and the on/off volume control.

The IC is unique in that it contains almost the whole of the TV circuitry; only the output stages and the tuner are external with just a few resistors and capacitors. This obviously reduces component costs considerably when the cost of originating the IC has been recovered, which it soon should be if the anticipated million sales a year materialise. Furthermore, it drastically cuts assembly costs, hence the price tag of under £80 which is about a third of the price of its nearest competitor, the Sony Watchman.

With the exception of the French 819-line system which is being phased out, most of the world has a 625-line standard, with the American continent and associated countries and islands having 525 lines. All the 625-line systems run at 50 Hz field frequency. Thus the line frequency for the 625-line standard is 15, 625 Hz, while that of the 525-line system is 15,750. Five of the standards use AM sound while the rest employ FM. However, four of the five are obsolete systems (including our own 405-line system) which are either being dropped or have already disappeared. So apart from one, all current systems are FM. Much the same is true of vision modulation sense. The four obsolete systems use positive modulation but, with one exception, all the others are negative.

There are various differences in channel and vision bandwidths as well as vestigial sidebands, but these do not materially affect receiver design, they only produce minor differences in video response. There are also three basic colour systems but as all are compatible with black-and-white reception, they present no problems for a monochrome receiver.

This leaves us with one factor that does have an effect, the separation between sound and vision carriers. Apart from the obsolete systems there are four standards of separation, 4.5 MHz as used with all 525-line systems, 5.5 MHz, 6 MHz and 6.5 MHz which are used with various 625-line systems. This separation is important because the FM sound carrier and the AM vision carrier produce a beat frequency at the vision detector which is equivalent to their difference. After limiting to remove the AM video modulation, the result is an FM sound signal which is further amplified by sound IF stages at this new beat frequency. The arrangement is termed intercarrier sound, and it is obvious that any difference in the spacing of the original sound and vision carriers will produce an equal difference in the sound IF frequency. So, TV standards using different spacings cannot normally be received with conventional sound IF circuits.

In order to cope with all these variables, the IC uses a voltage controlled oscillator which runs at a high multiple of the line frequency. Its frequency range can be set by an external resistor, but it is synchronised by the line sync pulses derived from the incoming video signal. The output is split into two paths, one of which is counted down by a logic stage to the line frequency. It is then converted from digital pulses to a suitable scanning waveform by a digital-to-analogue converter and fed to the line output stage. A line PLL stage compares the output of the logic circuit with that of the sync separator to provide a correction voltage for the oscillator. Thus whatever the incoming line frequency might be, the frequency of the oscillator will change to match it. From the line logic circuit there is a further countdown by the field logic stage to the field frequency. This too is locked to the incoming signal by means of the field sync pulses, so the field scan rate is dependant on the standard of the signal being received.

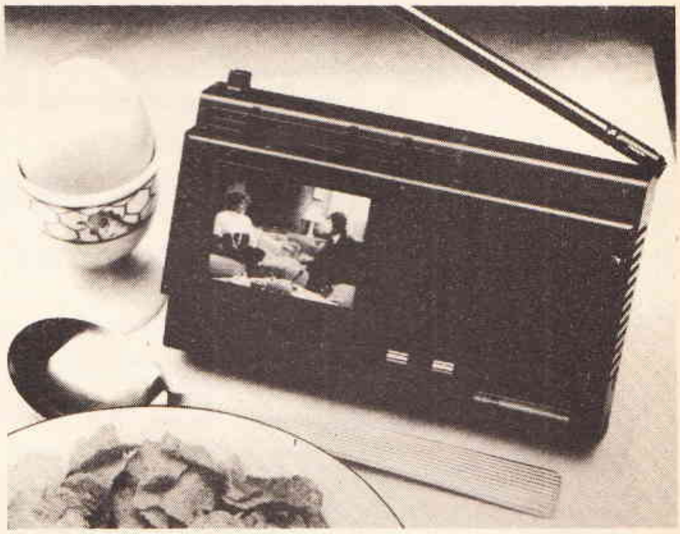
How, though, are the different vision/sound carrier spacings handled? The sound IF is set at 0.25 MHz, which means that there must be a means of converting the incoming intercarrier sound frequency to that value. This is done by another voltage-controlled oscillator which is also controlled by the line VCO. When the line oscillator is running at the 625-line standard the sound oscillator gives an output of 5.75 MHz, but when it is operating at 525 lines, the sound frequency is 4.75 MHz.

Just how it does this is not made very clear by the makers, but a possible method is to run the line oscillator at 8,000 times the line frequency which, at 15,625, Hz, the 625-line frequency, is 125 MHz, and at 15,750 Hz, the 525-line frequency, is 126 MHz. If the sound oscillator is set to run at 130.75 MHz, mixing with the line oscillator frequency will produce difference signals of 130.75 — 125 = 5.75 MHz at 625 lines, and 130.75 — 126 = 4.75 MHz at 525 lines. So, with an intercarrier signal of 4.5 MHz at 525 lines, and the oscillator producing 4.75 MHz, the result is a difference frequency of 0.25 MHz, which is the required IF. In the case of the 625-line system, a spacing and hence intercarrier frequency of 5.5 MHz together with the 5.75 MHz output from the oscillator again gives the 0.25 MHz IF. If, though, a spacing of 6 MHz is received (which is the intercarrier frequency for the U.K.) the same oscillator output of 5.75 MHz also produces a difference frequency of 0.25 MHz.

This leaves the 6.5 MHz separation signal out in the cold as the one not capable of being accommodated. It is found in the D, K, and L systems which are used in Russia, France, China, and several Eastern European countries as well as a few African states. The L system, which is used in France, is the one having positive vision modulation and AM sound, so this is totally non-receivable, though the others could produce a picture without sound. However, as the produced difference signal is 0.75 MHz, which is the third harmonic of 0.25 MHz, the D and K systems might produce weak sound in the presence of a very strong signal.

Output from the sound detector is taken from the chip to the volume control and from there back to the audio output stage which is also contained within the IC. Tuner output is applied to the vision IF stages which operate at the unusually high frequency of 230 MHz. This has the advantage of eliminating image-frequency interference from other UHF channels.

The tuner receives only UHF signals, and there are a number of countries that still have TV transmissions on VHF. Most of these also operate UHF transmitters as was the case in the UK, but for the benefit of those few areas that have only VHF services, a set with combined VHF/UHF tuner is planned.



The Flat Tube

The second major innovation in this remarkable set is the display tube. While LCD screens can offer compact low-current displays, the phosphor screen still takes some beating, if you can get around the awkward CRT shape which would be hard to fit into pocket TVs.

Size of the Sinclair tube is 4 x 2 x ¾ inches, and the screen is 2 inches wide. It is constructed from two pieces of glass, a front plate and a backing plate which is vacuum formed by a new method developed for the project. The screen is deposited on the inside surface of the back plate which means that the image is viewed through the front plate on the same side of the phosphor that the electrons strike. With normal tubes viewing takes place through the layer of phosphor with attendant loss of light. Thus a much brighter picture is obtained for the same power dissipated, or conversely, lower power is required to give a picture of similar brightness as a conventional tube. Actual brightness is from two to three times greater.

Half of the width of the device is occupied by the screen, the other half accomodating the gun and deflector plates. These are mounted so that the electron beam is parallel to the screen surface, at least at the start. To strike the screen, it must be bent sideways, but this cannot be a gradual bend which would make it strike at a narrow angle as this would produce an elliptical spot, like a torch beam striking the ground at an acute angle. Such a spot would reduce the definition of the picture. To minimise this effect a strong electrostatic field is formed in front of the screen. A positive EHT potential is applied to a conductive coating behind the phosphor which attracts the beam, and a repelling negative potential is given to a conductive transparent layer of tin oxide on the front plate. As the beam enters the region between them it is deflected suddenly toward the screen at an angle which makes it strike the screen almost perpendicularly, giving a virtually round spot.

Another problem involving focus is caused by the unequal lengths of the beam path from the nearside to

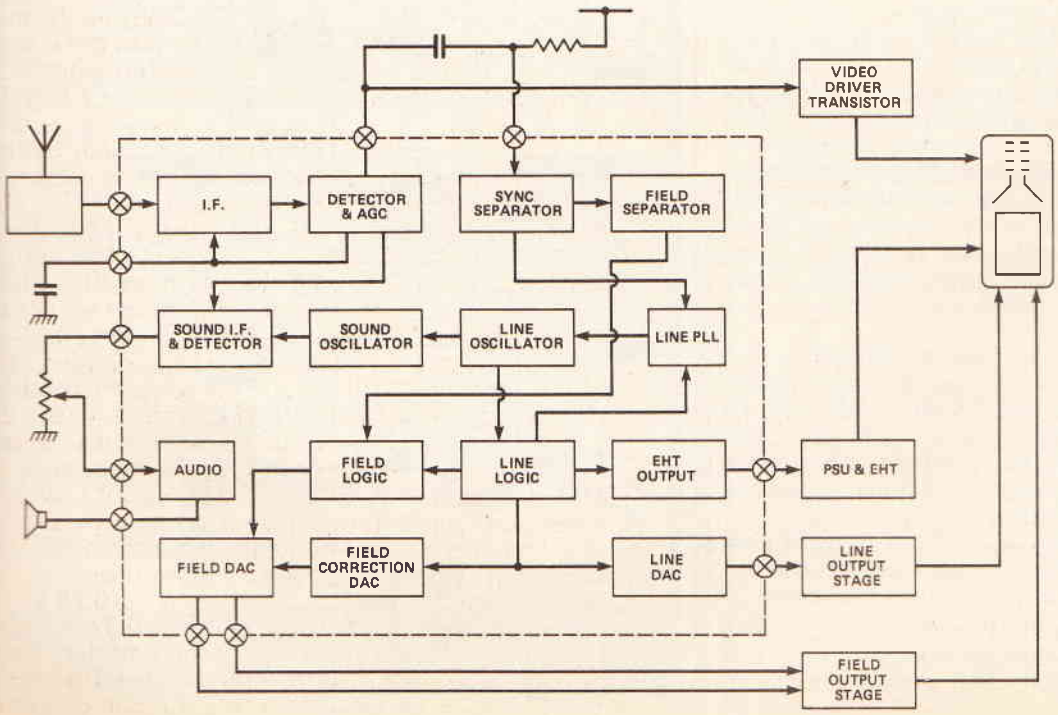


Fig. 1 Block diagram of the receiver. Everything within the dotted line is contained on the single IC.

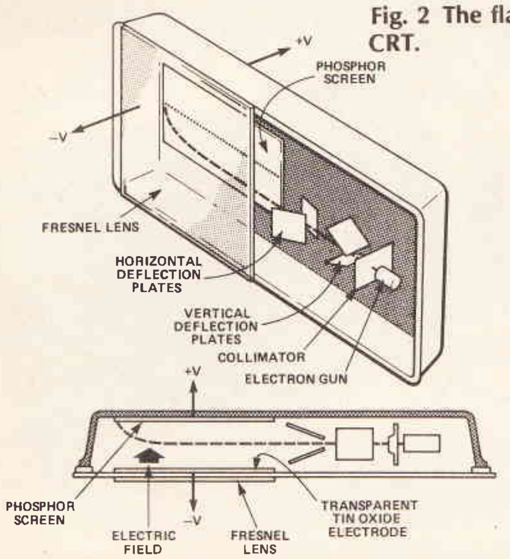


Fig. 2 The flat-screen CRT.

far side of the screen. If the beam is focused by conventional focusing electrodes it will be in focus at only one length, hence at only one part of the screen. This is avoided by passing the beam through a collimator as it emerges from the gun, giving it parallel sides. Being non-divergent it remains in focus over the whole screen.

Scanning the screen from the side produces two forms of distortion, both of which can be demonstrated by aiming a slide projector similarly on to a screen. The first and most obvious is that of trapezium distortion, in which the top of the picture slopes upward away from the gun and the bottom slopes downward. The second, which is apparent only when the projector is at a really sharp angle from the screen as is the case here, is that of curved verticals which curve toward the gun near the top of the screen. Both of these forms of distortion are moderate over the central regions of the picture, but increase considerably toward the top and bottom. The simple expedient employed here is to remove the top and bottom! The height is compressed to about half normal size giving a cinemascope effect, but the viewer gets the correct aspect ratio by means of a fresnel lens formed of transparent plastic over the front plate.

This almost eliminates the curved verticals, but a degree of trapezium distortion remains, and this is dealt with by means of electronic compensation. A line sawtooth is applied to the field circuit inside the chip. This varies the speed of the field scan during the period of one line and thus results in the tilting of that line. The tilt is opposite to the trapezium slope and thereby corrects it. The amount of compensation is reduced from the top to the middle of the raster, and then it is increased from the middle to the bottom, but in opposite phase. Hence a symmetrical picture is produced, a minor miracle considering the angles involved.

Though in danger of being overshadowed by the other technical advances, even the battery is something of an achievment. Developed for Sinclair by Polaroid, it is a lithium type, is small and flat, yet gives 15 hours operation. In contrast the four alkaline penlight cells used in the Sony Walkman last 2½ hours at a cost of nearly a half the £3 price of the lithium battery.

In the face of all this it may seem churlish to criticize, but I find the idea of a 2-inch screen just a mite too small, and a certain way of ensuring the future prosperity of opticians! Perhaps Sir Clive will apply his considerable ingenuity to increasing the picture size with little if any increase in receiver dimensions. This I feel certain would really assure its success. **ETI**

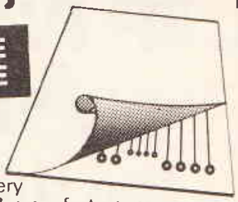
hobbyboard

The Complete Printed Circuit Workshop

COMPUTING AND ELECTRONICS

Project development materials

ULTRA VIOLET SENSITIVE COPPER CLAD LAMINATE



Top quality glass fibre with 1 oz Cufoil.
Will reproduce tracks down to .01 inch.
Positive & Negative Resist Systems for high quality PCB production. - Economic packs at very competitive prices direct from the innovators & manufacturers.
Full range of complementary chemicals and process equipment available.

PHOTO RESIST KIT

Complete kit containing artwork PCB, and all necessary process materials. Order ref HB/2 **£24.50**

ARTWORK LIGHT TABLES & UV EXPOSURE UNITS

Low cost, purpose designed units enabling high standards of design and reproduction to be achieved.

UV EXPOSURE UNIT AND ARTBOX (illus)

A portable ready made unit containing two 8 watt UV tubes giving a 6" x 9" exposure area which may also be used as a light box with the UV filter supplied. Order ref UV2 **£64.50**

DIY UV EXPOSURE UNIT

Perfect results everytime. Kit contains: Lamp, Holder & Shade together with full instructions for DIY Unit which offers PCB, Precision Photo, Label & Panel manufacture. Order ref UV1 **£27.50**

FOTOTOOL - DAYLIGHT PHOTOGRAPHIC PCB LABEL & PANEL MAKING SYSTEM

Daylight handling - UV exposable.
Fototool provides highly professional photographic masters - either positive or negative - for high quality PCB reproduction - Fototool films exhibit superb resolution, stability and high image densities normally only found in professional darkroom films.
Fotopanel complements Fotofilm with a range of 10 highly attractive backing colours (including brushed aluminium), and enables professional labels & panels to be made simply and cheaply.

FOTOTOOL KIT

Containing artwork, film and all the necessary process materials required for professional quality labels and panels. CAN ALSO BE USED TO PRODUCE PRECISION PCB PHOTOMASTERS. Order ref HB3 **£23.00**

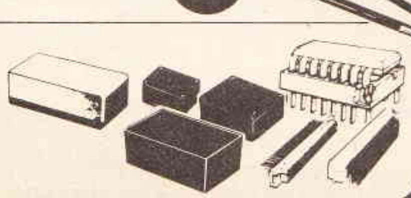
PRINTED CIRCUIT ARTWORK AIDS

Three comprehensive stock ranges to suit all preferences including dry transfers, printed acetate and crepe. Precision track tapes, pads, DIL/MICROLOGIC PATTERNS ETC. Includes etch resistant symbols & tapes.

DIRECT ETCH KIT

COPY DIRECT FROM MAGAZINE or OWN DESIGN. Simple system - Complete kit containing PCB, Pattern Transfer & Etch Resist Sheets, Tray & Etchant, Copper Cleaning Block, Gloves & full instructions. Order ref HB/1 **£15.50**

PCB HARDWARE



★ CASES & BOXES
★ PCB MOUNTING & AIDS
★ CONNECTORS & PINS
★ TERMINALS
★ DIL SOCKETS

COMPUTER ADD-ON/ INTERFACE PROTOTYPING SYSTEM

This system, designed and manufactured by Kelan, provides an attractively styled moulded case, pre-patterned PCB, 28 way connector, user port extender, and 9 way PCB mounting 'D' connector to add-ons. Custom designed circuits may be easily built from this kit with a highly professional finish. Order ref HB/2090 **£9.50**

Easy Add-ons for ZX Spectrum & ACE

17 exciting electronic projects to build and run your own micro.

- **LIGHT PEN**
- **PICTURE DIGITISER**
- **KEY PAD**
- **MODEL CONTROLLER**
- **WEATHER STATION**
- **+ OTHER EXCITING & INTERESTING PROJECTS**

REALISE THE REAL WORLD POTENTIAL OF YOUR MICRO

A newly released book written by well known author Owen Bishop and published by Bernard Babani gives full descriptive details on how to build all 17 projects - all are fairly simple and inexpensive to construct - The most complex component (the DECODER) is supplied in kit form ready to assemble with all components and plated through PCB. - Components for the projects are readily available locally or found in your workshop drawers.
Simple programmes are included to get you started but of course the more experienced programmer can have hours of fun writing complex programmes. Please state computer when ordering.

Order ref HB 2000 "EASY ADD-ONS" BOOK + DECODER KIT	**£24.00**
Order ref HB 2001 "EASY ADD-ONS" BOOK ONLY	**£3.00**
Order ref HB/2002 DECODER KIT ONLY	**£22.00**
Order ref HB/2003 DECODER PCB ONLY	**£8.00**

BBC MICRO INTERFACE

Initially designed to interface the acorn BBC Micro with turtle type robotics this unit, supplied in kit form, provides 8 control outputs and 4 Data inputs providing a useful interface to operate numerous control applications. Order ref HB 2030 **£26.50**

HOBBYBOARD CATALOGUE

Newly Published Full Catalogue price £1.50 (refundable with 1st order over £10)

Please send by return:-

QTY	REF	DESCRIPTION	PRICE	TOTAL
Full Catalogue (see above)			£1.50	
			TOTAL	

Price inclusive of VAT & carriage (U.K.). Please allow 21 days for delivery. Cheques, PO's or signed Access orders welcomed. Overseas customers please add extra post & packaging.

NAME ______

ADDRESS ______

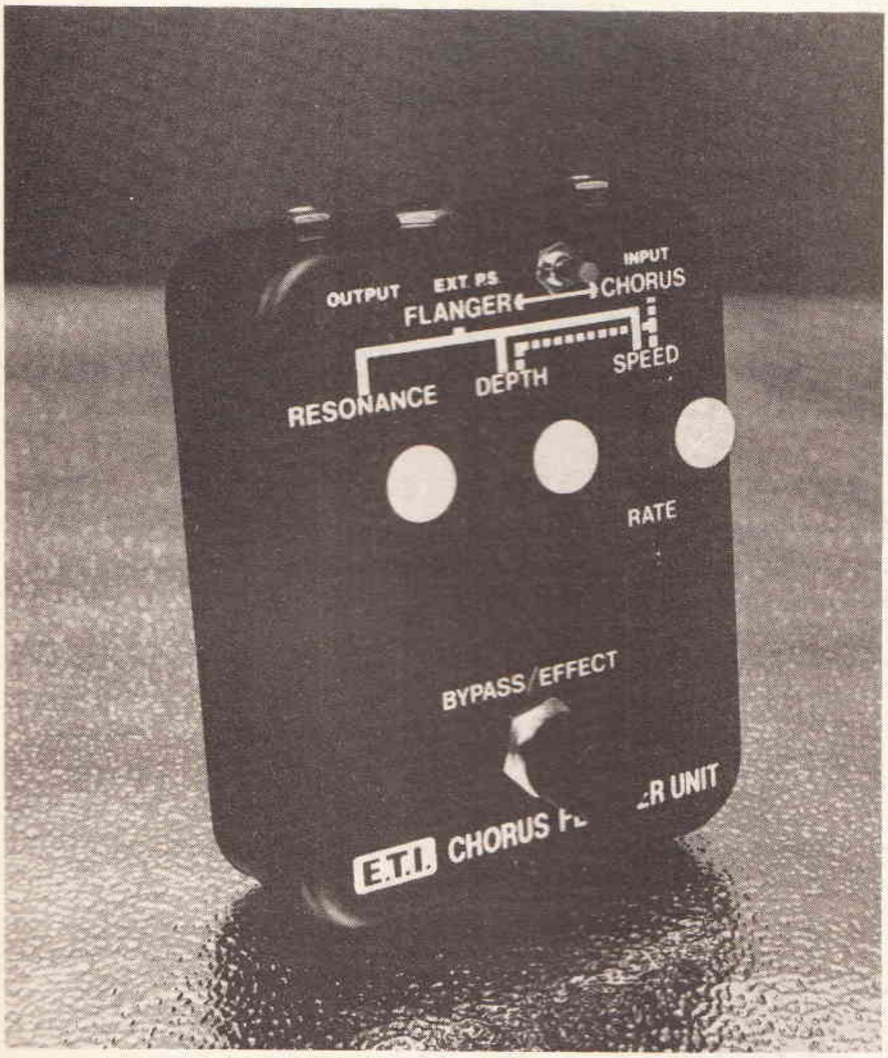
ETI/1/84

hobbyboard
complete P.C.B. workshop

a division of
KELAN ENGINEERING Ltd
Hookstone Park
Harrogate, N. Yorks

CHORUS/ FLANGER UNIT

Tim Orr returns to the pages of ETI with a project to make your amplifier see double — a chorus/flanger.

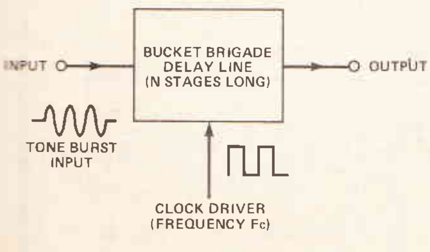


The Chorus/Flanger unit is a device for processing musical and other signals to produce a wide range of effects. The electronics have been optimised for an electric guitar input but the unit can run equally well from line level signals (−6dBm) and high output microphones.

The chorus effect simulates a second instrument, which is producing the same sound as the input signal, but which is slightly delayed in time. This tends to generate the illusion of a second instrument and also enriches the overall sound quality. If a relatively fast (10Hz) time modulation is used, then genuine vibrato is generated. Flanging is a very dramatic colouration of the input sound. An instrument played through a flanger sounds like it is being heard in a drain pipe, the size of which is changing!

Flanging, chorus and vibrato are all time delay effects, and so their implementation is relatively simple if we use a bucket brigade delay line, Fig. 1. Voltages presented to the input of the delay line are sampled and then converted into small quantities of charge. These charges are passed along several hundred electronic 'buckets' until they reach the output, whereupon they are reconverted back into the original voltage. This process takes time, in fact the time delay is equal to the number of buckets divided by the speed at which the charge is passed along the line. The signal recovered at the other end very closely resembles the input signal except for a small amount of noise and distortion (it's an imperfect world).

As this is a sampled information system we must sample the input signal much more frequently than the highest frequency compon-



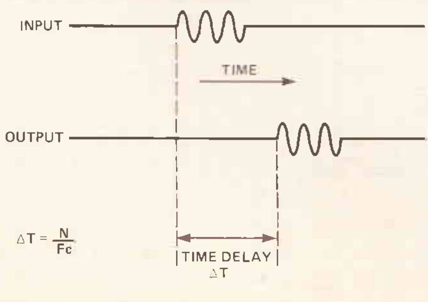
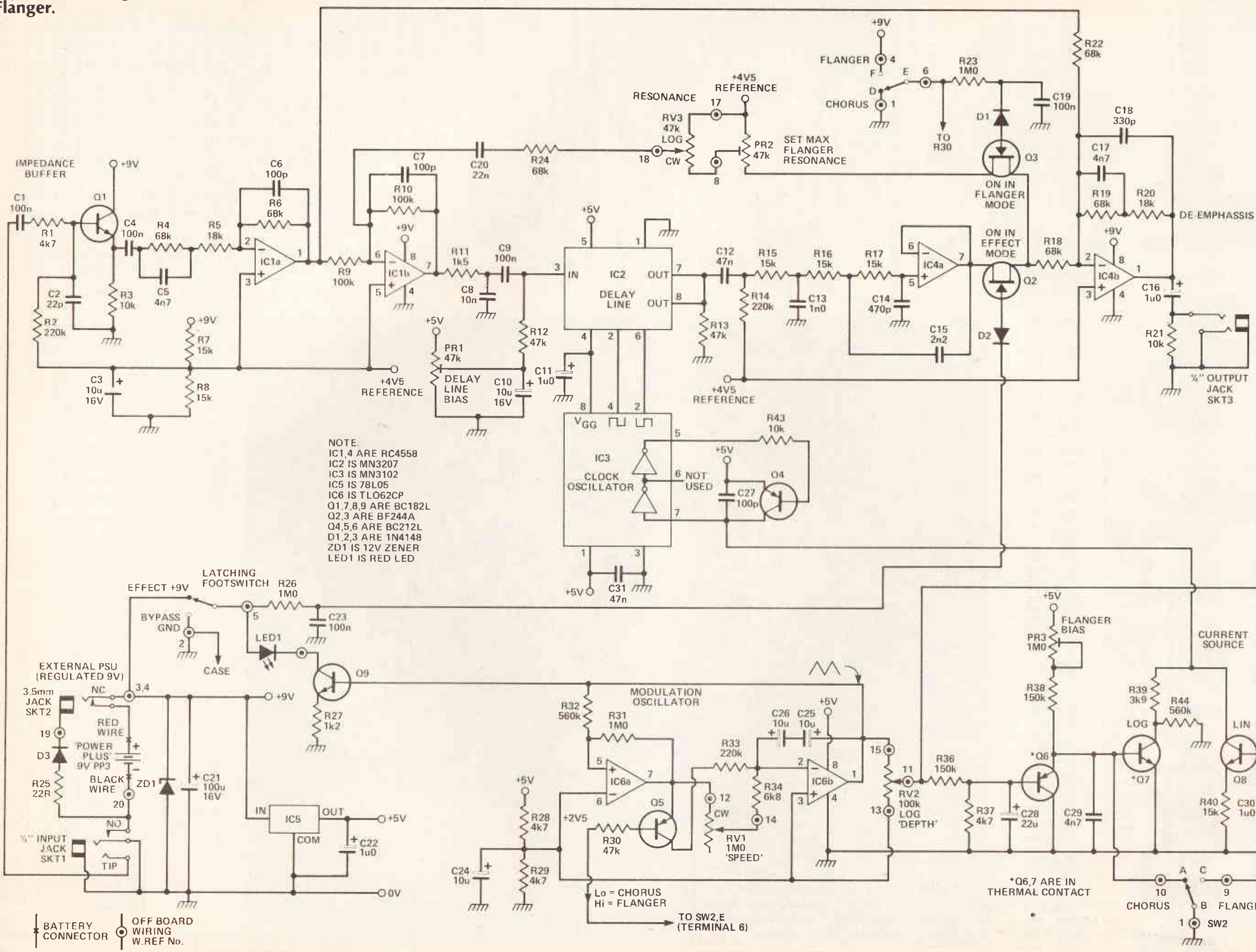


Fig. 1 The basic principle of producing a time delay.

Fig. 5 Circuit diagram of the Chorus/ Flanger.



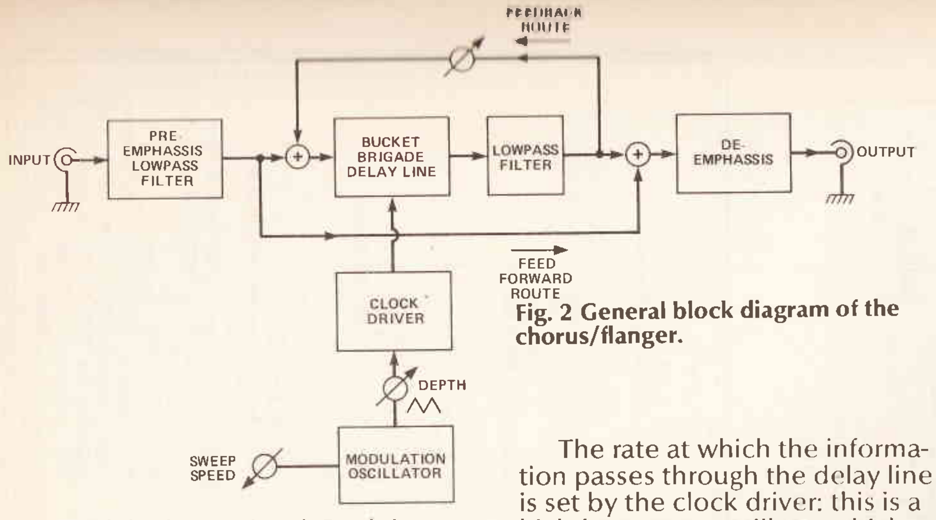


Fig. 2 General block diagram of the chorus/flanger.

nents of the input signal. By doing this, we can avoid the dreaded aliasing distortion (which sounds like ring modulation) and hope to recover the input signal with some degree of integrity.

The general block diagram of the chorus-flanger unit is shown in Fig. 2. The low-pass filter at the front end of the unit limits the input bandwidth and so helps to avoid any aliasing problems. The low-pass on the output recovers the delayed signal and rejects unwanted high frequency clock and noise signals.

The audio signal is given a treble lift (pre-emphasis) at the front end of the unit and a treble cut (de-emphasis) at the output. This helps to produce a better signal to noise ratio throughout the unit: most natural sounds have an energy spectrum that drops off very rapidly with increasing frequency, so by giving a frequency lift to these parts of the spectrum, more information can be elevated above the noise floor of the delay line. At the output end of the system, the de-emphasis restores the overall frequency response back to a flat one, but also suppresses high frequency noise from the delay

The rate at which the information passes through the delay line is set by the clock driver: this is a high frequency oscillator which can be frequency modulated. The delay line (MN3207) has a delay length of 512 buckets, so a clock frency of 512 kHz will produce a delay time of 1 millisecond. The modulation oscillator is used to produce slowly-varying time delays of variable speed and depth.

The chorus-flanger unit has been configured to look like a comb filter, Fig. 3. This is a filter

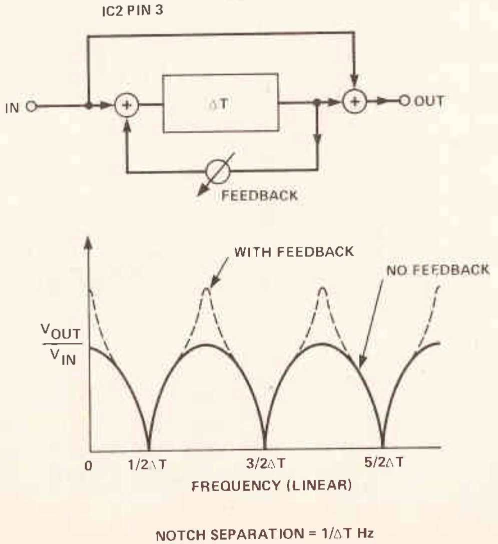


Fig. 3 A basic time delay comb filter.

HOW IT WORKS

Q1 forms a conventional high-impedance buffer: experience has shown that electronic guitars sound better when presented with a fairly high input impedance.

IC1a performs signal pre-emphasis, lifting all frequencies above about 500 Hz; IC1lb performs the low-pass anti-aliasing filtering, as well as mixing the fed-back proportion of the delayed output (which comes in via RV3, R24 and C20).

PR1 sets the DC bias level of signal going to the input of the bucket-brigade device; this is needed to obtain minimum signal distortion. The output from IC2 is recovered by the low-pass filter around IC4a, and passed to the FET signal switch, Q2 (FETs are used rather than mechanical switches to save loudspeaker cones!). Q2 allows the signal to pass except when the unit is in the bypass mode.

Q3 is another FET signal switch, and when the unit is in the flanging mode, this feeds a proportion of the delayed signal back to the input via PR2, the resonance control RV3,R24 and C20. At the same time, the fed-forward signal and the delayed signal are combined by IC4b, which also performs the de-emphasis. From here the signal is passed to the output.

IC6 forms a simple triangle/square-wave oscillator. RV1 controls the oscillation speed. Q5 is used to limit the low frequency range of the oscillator when in the chorus mode.

Q9 is used to drive the panel LED. When the effect is selected (via the footswitch) the LED will light up and flash at the modulation rate.

IC3 and Q4 form the clock oscillator for the delay line. C27 is charged up by either Q7 or Q8, both of which act as current sources. When pin 7 of IC3 drops below about +2.5 V, pin 5 of the same IC goes low, which turns on Q4, which discharges C27 back up to +5V. Thus the circuit oscillates at a rate determined by the size of the current sink from either Q7 or Q8. In the chorus mode Q8 generates a linearly varying current over a maximum two-to-one range. C30 limits this sweep at faster rates. In the flanger mode, Q6 and Q7 generate an exponentially varying current over a seven-to-one range. Again the modulation depth is limited at fast rates by a capacitor, C28.

IC5 provides a stable +5V power supply for the modulation oscillator, clock oscillator and the delay line. Battery voltages droop with time! The battery starts life at about +9.5 V and has an end of useful live at about 6.5 V. For maximum battery life, plug in the effect unit only when it is needed and never leave it on over night. The ON/OFF switch is the input jack which has a switched earth pin. For infinite battery life use a mains power supply (a PP3 eliminator)!

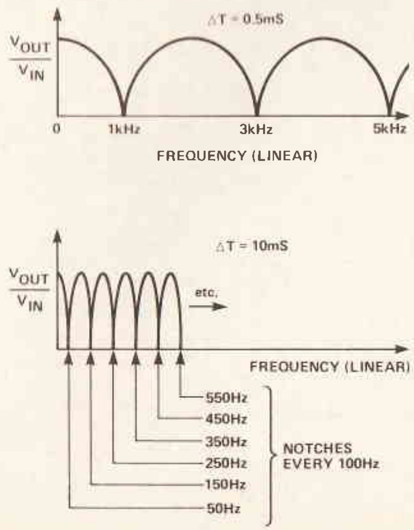
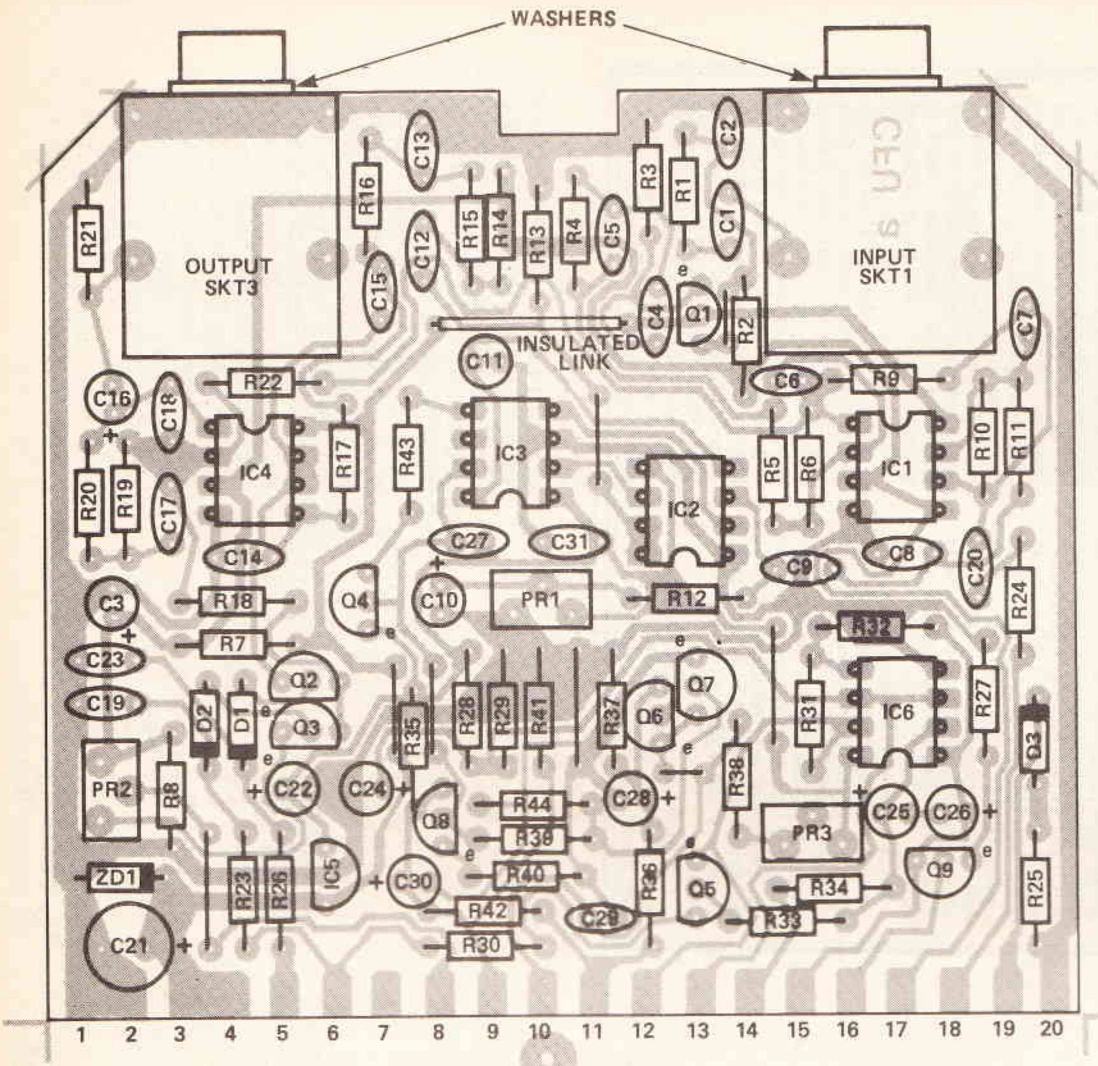


Fig. 4 Comb filter frequency responses for different time delays.

with a frequency response that is full of notches, and which looks like the teeth of a comb! When the delayed signal is 180° out of phase with the direct signal, then cancellation will occur and a notch in the frequency response is generated. These notches are linearly spaced with a separation of 1/(the time delay). Feedback around the delay line (used in flanging) makes the comb response much more peakey when the phase shift around the delay line is zero. Short time delays produce few notches and long time delays produce several, Fig. 4. Note that the frequency separation of the notches is linearly proportional to the clock frequency.



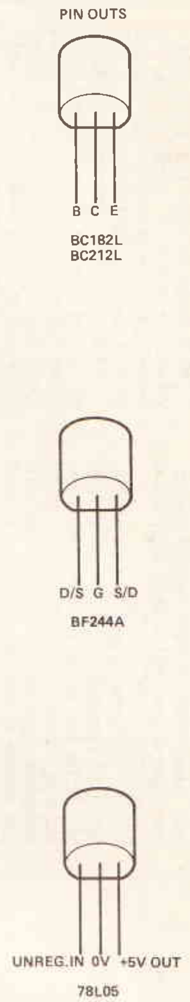


Fig. 6 Overlay diagram of the PCB for the Chorus/Flanger

PARTS LIST

RESISTORS (all ¼W 5%)

R1	4k7
R2	220k
R3	10k
R4,6	68k
R5	18k
R7,8	15k
R9,10	100k
R11	1k5
R12,13	47k
R14	220k
R15,16,17	15k
R18,19,22,24	68k
R20	18k
R21	10k
R23,26,31	1M0
R25	22R
R27	1k2
R28,29,37	4k7
R30	47k
R32	560k
R33	220k
R34	6k8
R35	270k
R36,38	150k
R39	3k9
R40	15k
R41,42	100k
R43	10k
R44	560k

POTENTIOMETERS

RV1	1M0 reverse logarithmic
RV2	100k logarithmic
RV3	47k reverse logarithmic
PR1,3	47k preset
PR2	1M0 preset

CAPACITORS

C1,4,9	100n polyester
C2	22p ceramic
C3,10	10µ 16V PCB electrolytic
C5	4n7 polyester
C6,7	100p ceramic
C8	10n ceramic
C11,16	1µ0 63V PCB electrolytic
C12	47n polyester
C13	1n0 polyester
C14	470p ceramic
C15	2n2 polyester
C17	4n7 polyester
C18	330p ceramic
C19	100n polyester
C20	22n polyester
C21	100µ 16V PCB electrolytic
C22,30	1µ0 63V PCB electrolytic
C23	100n polyester
C24,25,26	10µ 16V PCB electrolytic
C27	100p ceramic
C28	22µ 16V PCB electrolytic
C29	4n7 ceramic
C31	47n polyester

SEMICONDUCTORS

IC1,4	RC4558
IC2	MN3207
IC3	MN3102
IC5	78L05
IC6	TL062CP
Q1,7,8,9	BC182L
Q2,3	BF244A
Q4,5,6	BC212L
D1,2,3	1N4148
ZD1	BZY88-12V zener
LED1	0.2" red LED

MISCELLANEOUS

SKT1,3	¼" mono switched jack sockets
SKT2	3.5 mm mono jack socket
SW1	latching footswitch SPCO plus cap
SW2	DPDT switch

PCB; knobs; PP3 battery connector; case; self-adhesive foam strip (for securing the PCB); 8-pin IC sockets (5 off); holder for LED; wire, solder, Gibson Les Paul Special, etc.

Assembly And Setting Up

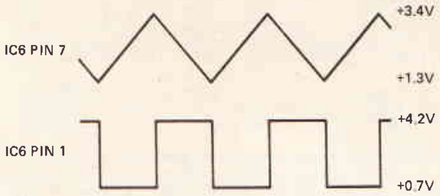
Assemble the PCB and connect to the controls as shown in Figs. 6 and 7. When testing is complete, the PCB is mounted in the box, supported by the jack sockets, with the foil side to the case bottom. Put some thin sticky-backed foam rubber on the inside of the case bottom to prevent shorts.

Table 1 shows various DC test voltages around the circuit and Fig. 8 shows some of the waveforms you should find using an oscilloscope. As regards the setting of the presets, you *can* just plug in, switch on and hope for the best and set the presets by trial and error, but if you do have access to

IC1,4, PIN 8	+9V (FOR BATT. OPERATION)
IC1, PINS 3,5	+4.5V APPROX
IC1, PINS 1,7	+4.5V APPROX*
Q1 EMITTER	+3.8V APPROX*
IC2, PIN 5	+5V
IC3, PIN 1	+5V
IC3, PIN 8	+4.67V
IC4, PINS 1,7	+4.5V APPROX*
IC6, PIN 8	+5V
IC6, PIN 3,6	+2.5V

* VOLTAGE WITH NO INPUT SIGNAL

Table 1 DC test voltages.

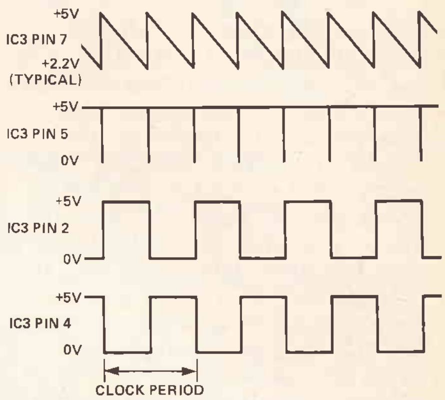


TYPICAL SPEEDS	MAX	MIN
CHORUS	10Hz	0.33Hz
FLANGER	10Hz	0.06Hz

Fig. 8a Waveforms for the modulation oscillator; note that the voltage levels for IC6 are only approximate, as are the oscillator frequencies.

some test gear, here is the proper way to set up the unit.

Inject a 2.0 V peak-to-peak 500 Hz sinewave into the input socket, and select chorus on SW2 with the footswitch, SW1, set to effect. Set the rate control to maximum and the depth control to minimum. Using an oscilloscope, check that the undistorted signal is present at



CLOCK PERIOD	MIN	MAX
CHORUS	7.0uS	12uS
FLANGER	3.5uS	22uS

Fig. 8b Waveforms for the clock oscillator; select minimum depth (RV2) for these waveforms. The table shows the limits of the clock period for depth set to maximum and rate set to minimum; the preset PR3 should be adjusted to bing the oscillator into the range given for the flanger mode (with the flanging effect selected).

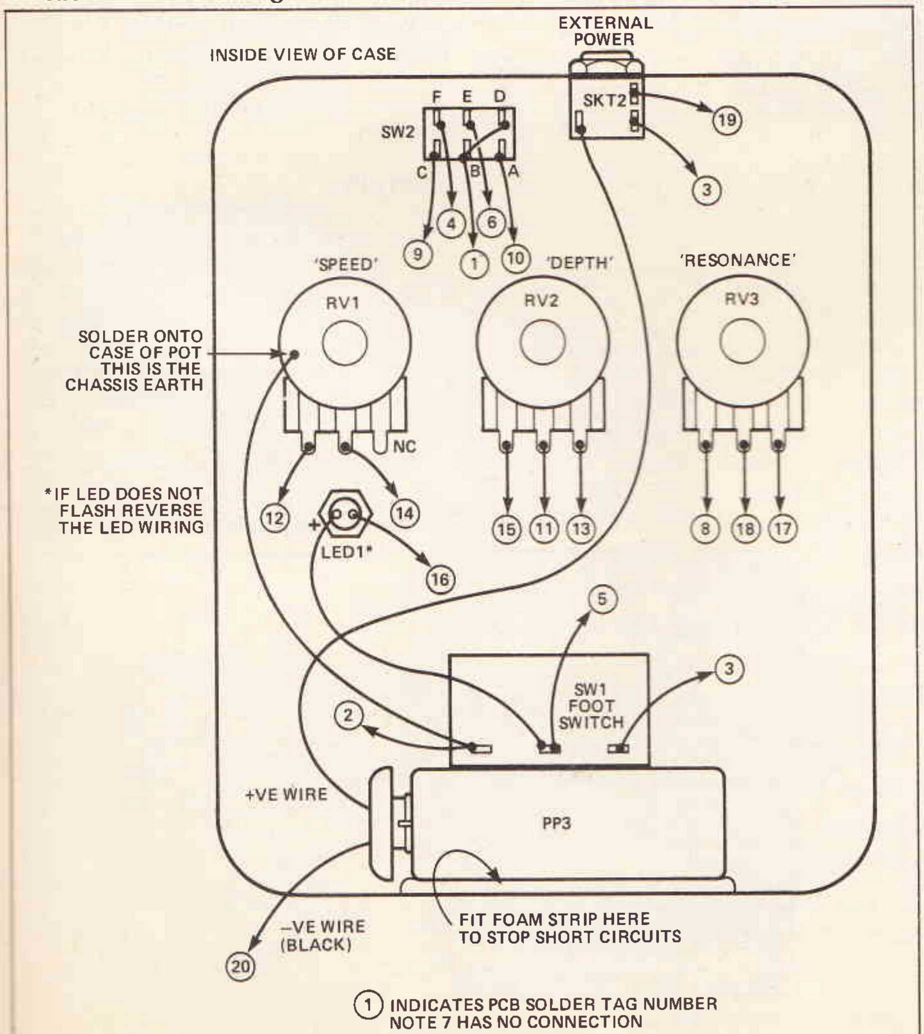


Fig. 7 Inside view of the case and interconnections.

Q1 emitter, IC1 pins 1 and 7 and IC2 pin 3.

Set PR1 to its mid-way position and look at the signal present on IC2 pin 8; adjust PR1 until the signal is clipping symetrically (see Fig. 9). Note that this signal will have a lot of high-frequency clock signal breakthrough: this is normal.

Examine the output at IC4 pin 7; this should be the same signal without the HF breakthrough. Reduce the input signal level to remove the clipping on this signal. Turn the depth control to maximum and the sinewave at IC4 pin 7 will be frequency modulated by the modulation oscillator; a mixture of this signal plus the direct signal should appear at IC4 pin 1.

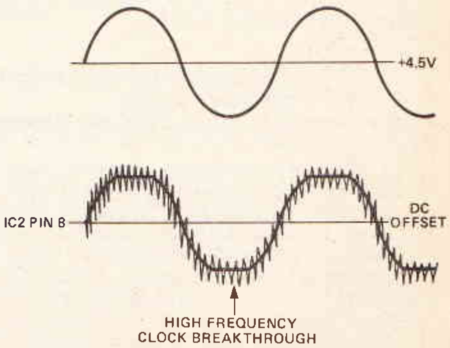


Fig. 9 Waveforms at the input and output of IC2.

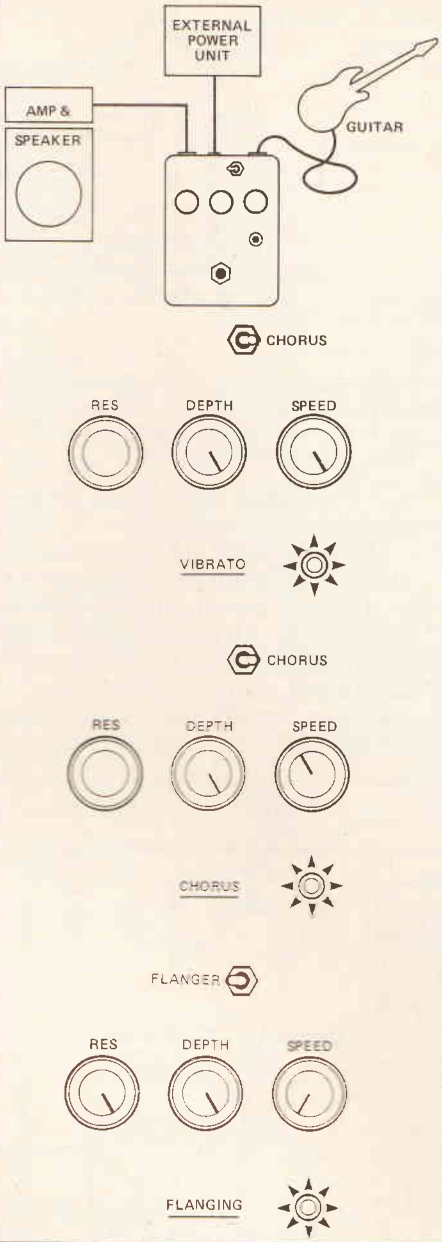
The flanging effect is best tested with a 200 mV P-P square wave oscillating at 2 Hz. This excites the unit with two clicks per second. Set resonance to maximum, speed to minimum and SW2 to the flanger position (footswitch SW1 should still be set to effect and not bypass). Listen to the output from the unit via a suitable amplifier, and adjust PR2 so that the output is a rich 'drainpipe' sound (you'll hear what we mean). If PR2 is set for too much feedback, the unit will oscillate; if this occurs back off the control a little.

For both chorus and flanging effects, the time modulation depth reduces as the modulation speed increases. The modulation depth at 10 Hz should produce a pleasant vibrato effect, caused by a small time delay sweep.

Power Supply

The unit consumes about 1 mA. Using an Ever Ready PP3PP (power plus) for two hours per day, the expected battery life will be about 20 hours. If you leave the unit turned on over night, you will exhaust the battery. It is possible to use a rechargeable Nickel Cadmium PP3 battery. This has a shorter discharge life time of about 7 hours, but can be reused (charged/discharged) about 600 times! The purchase price of Nickel Cadmium batteries is about six times that of a standard PP3, and also you will need a charger unit. A non rechargeable alkaline PP3 battery (eg Duracell type) gives about four times the energy content of a zinc carbon PP3 but costs about twice as much.

A 9V battery eliminator can be used, the operating power is then derived from the mains. Note that the inner connection is +9V and the outer is 0V; if the polarity is reversed, D3 should prevent any damage to the chorus flanger, but the unit will not work.



User Guide

Plug in the guitar and the amplifier. Press the footswitch so that the LED is off. Turn up the guitar volume, set up the amplifier level and tune the guitar. This is the BYPASS mode.

Vibrato

Set up the controls as shown, with SPEED and DEPTH at maximum. RESONANCE is inoperative. Press the footswitch so that the LED is flashing. Play the guitar. A fast (10Hz) vibrato will be heard. If necessary alter the guitar and amplifier levels. Adjust both controls for less depth and different vibrato rates.

Chorus

Set up the controls as shown, with the DEPTH set to maximum and a SPEED setting of about 1 flash per second. RESONANCE is inoperative. Play the guitar. A "creamy" sound will be heard. Press the BYPASS footswitch and see how flat the original signal sounds. Go back to the effect and try some different SPEED and DEPTH settings.

Flanging

Set up the controls as shown with DEPTH and RESONANCE to maximum and SPEED to minimum. Tap the guitar strings. A slowly sweeping "drain pipe" resonance will be heard. Try playing a melody with a rhythm that has the same period as the sweep time. Try other control settings.

BUYLINES

A full kit of parts for this project is available from Sola Sound Ltd, for £49.95 all inclusive. Alternatively, some of the more unusual parts are available as follows: PCB £1.15 inclusive; case (fully screened) £3.75 inclusive; MN3207/MN3102 (IC2 and 3) £13.80 the pair. All these prices include VAT and postage. Sola Sound Ltd may be found at 18 Barton Way, Croxley Green, Rickmansworth, Herts. (Note that the PCB will not be available through the ETI PCB service.)

AUTUMN 1983

ambit INTERNATIONAL MARKETPLACE

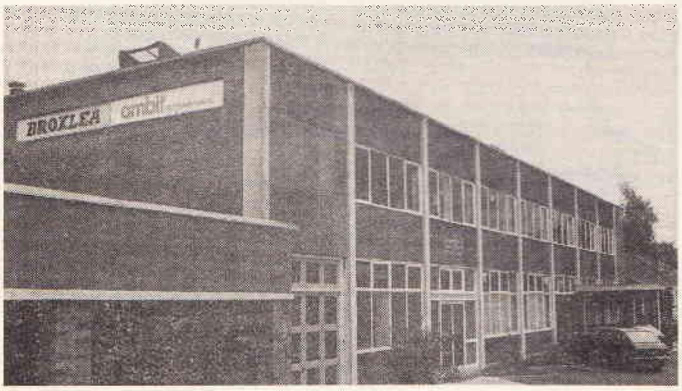
AUTUMN CLEARANCE SALE £10 WORTH OF VOUCHERS

NEW SALES COUNTERS OPEN

Portsmouth, Broxbourne & Brentwood all benefit from newly fitted sales counters

Ambit's unique range of electronic components, kits, tools, test equipment and modules is now available to industry and enthusiast from two new regional sales counters — as well as Brentwood. The Portsmouth sales counter is installed in Solent Components Supplies building, at 53 Burrfields Road where Mark Goulty will be pleased to assist with your requirements, and also offer products from Solent's own extensive stocks of Cooper tools, Multicore solder, Bulgin connectors, panelware and hardware, C&K switches and Alpha Wire.

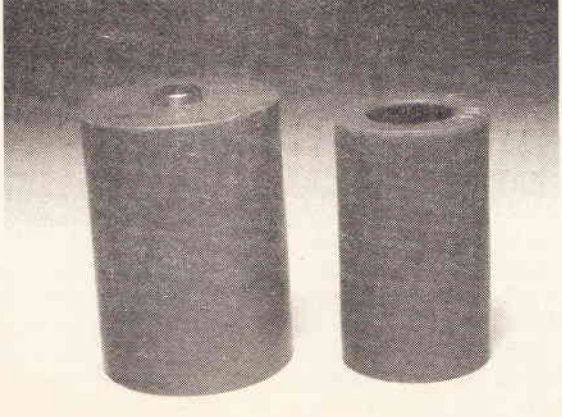
The Broxbourne sales counter is operated under the auspices of David Scott from the premises of Broxlea Limited, at Park Lane Broxbourne.



If the product you want is not available in stock at the sales counter, then leave your order with our manager: either for direct delivery from our central stores (no post charge), or for later collection. We're here to serve you, so get to know your local Ambit sales facility.

Inside this Issue

BATTERY ADAPTORS —



— never be caught without a suitable battery !

These novel adaptor sleeves will allow 'AA' to fit in 'C' or 'D' slots, and 'C' into 'D'. Use our generously priced NiCads and chargers (Page 11) for a complete solution to all your battery problems.

4 SETS FOR £2.00 96-02001

AUTUMN SAVER

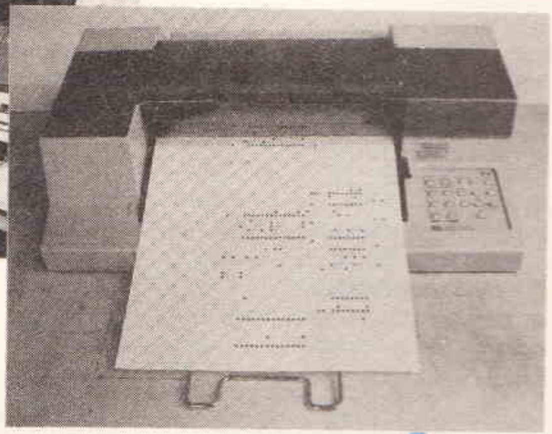
Introducing BROXLEA MANUFACTURING

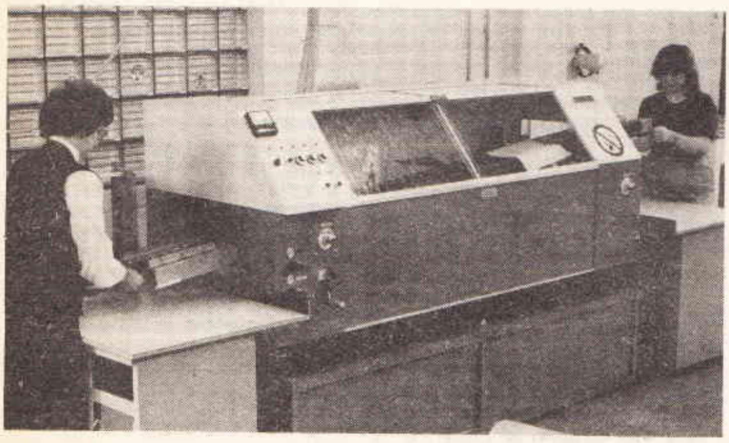
Problem solutions for hire

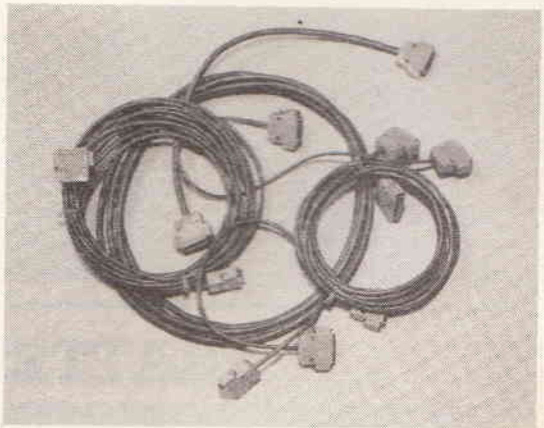
Broxlea, of Park Lane Broxbourne is the home of our North London sales counter, and the site of one of the industry's longest established manufacturers.

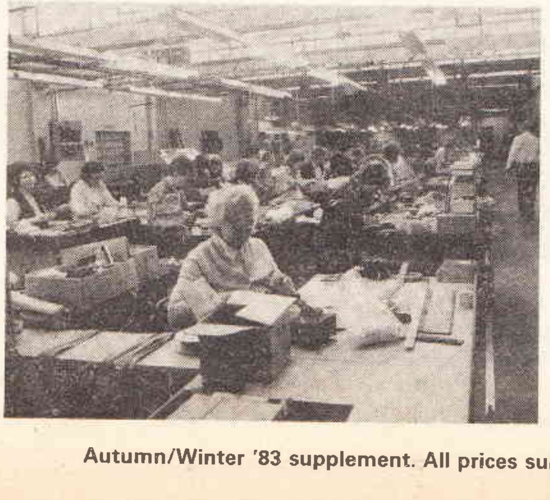
Broxlea specialises in providing experience in a range of 'manufacturing and product 'management' services that many new idea-based electronics companies find virtually impossible to locate when setting out to manufacture a new product. Things like where to source parts (at the right price), what standards apply, how to optimise a design for the best ease of manufacturing.

Broxlea's energetic MD, Peter Telling, can provide on-site assessment of your requirements and a solution to your manufacturing problems. Let your firm explore the benefits of a partnership that enables you to specialise in your own field, and not suddenly find yourself bogged down in the intricacies of production techniques, soldering at the right temperature, and simply sticking the right parts in the right places on the PCB.









The manufacturing facilities controlled by Clifford Bulgin include the most modern flow solder plant, a team of consciencious and thorough staff, experienced in electronic and electrical assembly techniques, test and QA.

Apart from supplying manufacturers' services, Broxlea specialises in supplying a range of top quality standard and custom 'D' series cable assemblies and accessories based on universally approved and accepted cables from Alpha Wire. Hand soldered, crimped and IDC terminations are available to order.

A. F. BULGIN INVEST IN THE FUTURE

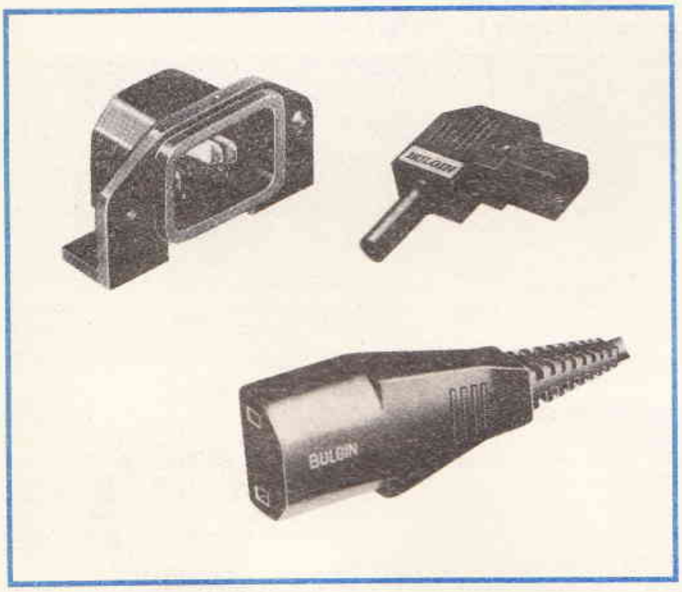
The long established component firm consolidates its subsidiary activities.

There are few participants in the electronics business who will not have come across some of the many different connectors, fuseholders, plugs, sockets, knobs etc., that are made by A. F. Bulgin & Co. PLC, of Bypass Road, Barking. 60 years in the business is unusual in electronics, and in order to establish plans that ensure the name of Bulgin will be carried forward through the next 60 years, Chairman Ronnie Bulgin and his board have decided that diversification is one of several moves to be made.

The distributive activities and associated skills of Ambit have been acquired to preceed the formal consolidation of AFB's external business interests in Portsmouth (Solent Component Supplies), Croydon (Projex Distribution Ltd.) and Broxbourne (Broxlea Limited) into a separate holding group.

The new group combines established experience in many aspects of the industry with the drive and enthusiasm of a relatively young management team. The in-group facilities include all the necessary resources to design, develop, source, manufacture and distribute a very large range of electronic products.

Ambit's innovative REWTEL direct order placement system caused quite a stir in the distribution industry, since it demonstrated the first keyword index information and bulletin service, combined with direct on-line order interrogation facilities.



Hardware versatility

The product range for which A.F. Bulgin & Co. PLC has become most famous over the past 60 years is probably its range of connectors, fuseholders and panel hardware.

The popular IEC connector range is continually being updated. There are now PC mounting types, filter inlet sockets and many other variations on the theme. Although now largely replaced in mains voltage applications by the IEC families, the round plug and socket series has been brought right up to date with the "Buccaneer" range of water resistant housings, offering a wide variety of connection options, including BNC coaxial, 3 and 6 pole types.

As with all the mains rated components, the fuseholders comply to the latest BS safety specifications to ensure acceptability of equipment and freedom from the unexpected shocks that can arise from the use of improperly designed parts.

ambit® REPORT

OPENING HOURS

Consumer admin:

(0277) 230909 - 4 lines

Availability of goods
Credit card orders

Ask for (credit card sales)	9-5.30
Customer Service problems with deliveries	10-12.30
Ask for 'Customer Service'	

Industrial sales, admin & progress:

(0277) 231616 - 4 lines

Availability, price, telesales

Keith Collins	9-5.30
Claire Mackessy	9-5.30
Carol Lawton	9-5.30

Shop Sales

Brentwood Mon-Sat	9-5.30
Lunch	1.30-2.30
Broxbourne Mon-Fri	9-5.30
Sat	9-12.30
Portsmouth Mon-Sat	9-5.30

Apart from "own brand" products, A.F. Bulgin handle a number of agencies on behalf of overseas manufacturers of complementary products — most notably the superb range of control knobs from Ritel of Switzerland, a very large selection of which are available from Ambit stock and detailed in the current catalogue.

Many lines are custom manufactured, taking advantage of Bulgin's unrivalled experience, extensive in-house tooling facilities and automatic injection molding plant. If your firm requires either a variation on a standard theme, or a completely new type of small plastic/metal component, then let us quote you for supplying it from one of the few remaining sources of British component manufacturing expertise.

Telephone Timing

Help us to help you!

When calling our central sales and service departments at Brentwood, it would help us a great deal if you would observe the following timing. At present we tend to get all the calls arriving at peak periods, when other times the lines are deserted.

We get many reports of difficulty in getting through, but it's not for lack of incoming lines! Please use the numbers designated for the nature of your enquiry, it is sometimes not possible to transfer between industrial and consumer sales due to the volume of telephone traffic.

The peak time for consumer telesales is 10.15—10.45 and 2.30—4pm. If you can avoid these, then so much the better for you and us. Telesales operate Monday to Saturday, 9.00am to 5.30pm — although you can frequently place an order outside these 'official' times.

Industrial sales calls tend to arrive (understandably) in the 2.30—4pm slot as well: remember that telex is a particularly useful medium as our telex is situated in the middle of the IM department.

We like to deal with customer service problems during the morning (10am-12.30pm) so that we have all afternoon to sort the problems out and 'catch the post'.

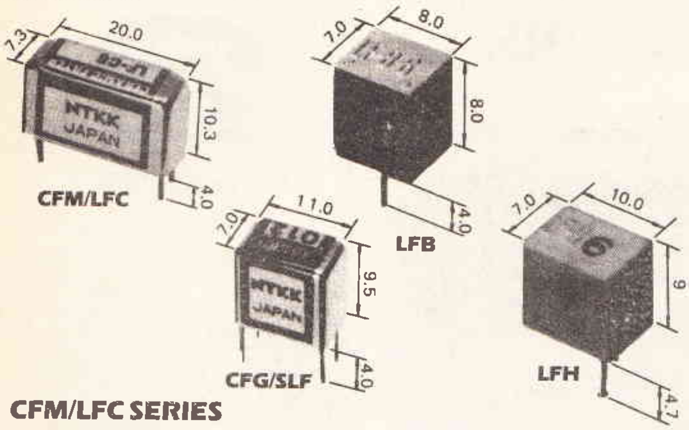
REWTEL provides on-line sales and stock enquiry facilities. (0277) 232628, a 300 baud modem and any one of a wide selection personal computers can be used to check stock and place orders, 24 hours a day, 365 days a year (less downtime!). Send an SAE marked 'REWTEL info' in the bottom left corner for more details.

ambit for communications components

The most comprehensive selection of coils, filters and components for all types of radio communications

CERAMIC FILTERS FOR 455kHz IFs

Ambit's range of ceramic filters cover most applications for communication and high quality broadcast reception. As far as we are aware, we hold the widest range of ceramic and crystal filter products anywhere in the world, and we will always do our best to assist if the type you want isn't immediately obvious from checking this section. We regret that we cannot generally assist in supplying replacements for imported equipment, unless the manufacturer's type number is available in addition to any 'house' numbers used to identify the parts.



CFM/LFC SERIES

A medium priced hermetically sealed ladder filter, suitable for most communications applications and high quality broadcast receiver equipment. Similar to the types used in receivers such as the FRG7

Type No.	-6dB BW	-50dB BW	In/Out Impedance (k ohm)	Stock No	Price
CFM455H/LFC6	6	16	1.5	16-45520	**5.20**
CFM455G/LFC8	8	20	1.5	16-45521	**5.20**
CFM455F/LFC12	12	24	1.5	16-45522	**5.20**
CFM455E/LFC15	15	28	1.5	16-45523	**5.20**
CFM455D/LFC20	20	38	1.5	16-45524	**5.20**

A high performance filter, similar to those used in the R1000 and FRG7700. Ideal for all low cost SSB filter requirements, and suitable for upgrading existing equipment

CFM455J1	2.6kHz min	8kHz max	2k	16-45513	**9.00**

CFG/SLF SERIES

A miniature high performance filter. Possibly the highest selectivity/size ratio available. Supplied in shield and hermetically sealed case, and recommended for use with designs involving the MC3357/9 and ULN3859 families, due to the excellent stopband performance.

Type No.	-6dB BW	-80dB BW	In/Out Impedance (k ohm)	Stock No	Price
CFG4551/SLFD4	4	10	1k5	16-45542	**5.20**
CFG455H/SLFD6	6	15	1k5	16-45542	**5.20**
CFG455G/SLFD8	8	18	1k5	16-45544	**5.20**
CFG455F/SFD12	12	25	1k5	16-45546	**5.20**

LFB/LFH SERIES

Probably the most popular types of low cost ceramic ladder filter — found in most types of CB transceiver, and an increasing number of designs for commercial mobile radio systems. These filters possess excellent bandpass characteristics, although watch the stop band if you are not using them with some form of 'roofing' selectivity, such as a 2 or 4 pole crystal filter at 10.7MHz/10.695MHz. The impedances of these filters (and most of the other ladder series) is directly matched by such devices as the ULN3859, so extremely compact designs can be achieved at minimum cost. Miniature 455kHz filters. I/P and O/P impedance 2k.

NTK/Murata	-6dBW (Min)	-40dB (Max)	Stock No	1-24	25-99	100+
LFB4	4kHz	15kHz	16-45511	**1.95**	**1.45**	**1.10**
LFB6/CFU455H	6kHz	18kHz	16-45512	**1.95**	**1.45**	**1.10**
LFB8	8kHz	21kHz	16-45529	**1.95**	**1.45**	**1.10**
LFB10	10kHz	23kHz	16-45514	**1.95**	**1.45**	**1.10**
LFB12/CFU455F	12kHz	26kHz	16-45515	**1.95**	**1.45**	**1.10**
LFH6S/CFW455HT	6kHz	14kHz	16-45525	**2.45**	**1.95**	**1.55**
LFH8S	8kHz	18kHz	16-45526	**2.45**	**1.95**	**1.55**
LFH12S/CFW455FT	12kHz	22kHz	16-45528	**2.45**	**1.95**	**1.55**

CERAMIC RESONATORS

Low Cost, Small size alternative to Quartz Crystals

These resonators provide an excellent alternative to costly LF quartz crystals, and are especially suited to use with MPUs, rate generators, remote control systems, dial tone and dial pulse clocks etc. There are two basic types as with crystals — series and parallel resonant types. The majority of 'clock' applications will require the parallel resonant types (CRM), whereas 'bypass' and 'trap' circuits will usually call for the series (CFE) types.

Type	Frequency	Mode	Stock No	1-24	25-99	100+
CRM455	455kHz	parallel	16-45573	**0.60**	**0.48**	**0.40**
CRM460	455kHz	parallel	16-46073	**0.60**	**0.48**	**0.40**
CRM500A	500kHz	parallel	16-50073	**0.60**	**0.48**	**0.40**
CFE455	455kHz	series	16-45575	**0.60**	**0.48**	**0.40**
CRM560	560kHz	parallel	16-56074	**0.60**	**0.48**	**0.40**
CSA1.0MK	1000kHz	parllel	16-10003	**0.94**	**0.84**	**0.76**
455D	455kHz	NBFM Disc	16-15455	**1.20**	**0.90**	**0.60**

CRYSTAL FILTERS

We are pleased to be able to extend our range of crystal filters to include the popular 10.695MHz frequency that seems to be universally adopted in the first IF of CB receivers. A transplant of the 2 pole filter in place of the usual ceramic filter can perform the single most significant improvement in blocking and cross mod in most circuits and the popularity of the modification has spurred us to include an 8 pole version for the purist. The 90dB adjacent channel attenuation of the 8 pole series effectively removes all responsibility for blocking and IM related problems from the subsequent stages, and places emphasis on the RF and most crucially the mixers. The 10.7MHz 8 pole SSB filter is featured in the R&EW HF transceiver add-on for the R1000 or FRG7700 receivers and is at last managing to dispell the mystique that surrounds 9.0MHz.

2 POLE TYPES

Model	Centre Freq.(MHz)	Band Width(kHz)	Ripple (dB)	Stop Band (kHz)	Term Imp(kR)	Case	Stock No.	Price
10M15A	10.7	15(3dB)	0.5	±25.0(18dB)	3.0	FS12	20-10152	**0.99**
21M15A	21.0	15(3dB)	0.5	±25.0(17dB)	3.0	FS12	20-21152	**3.45**
10M08AA	10.695	8kHz	0.5	±25.0(18dB)	1.8	FS12	20-11152	**3.49**

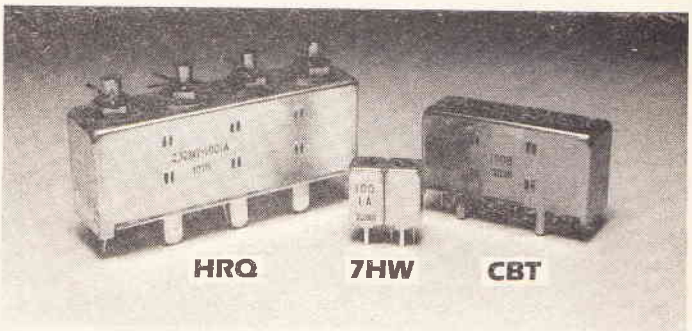
8 POLE TYPES

Model	Centre Freq.(MHz)	Band Width(kHz)	Ripple (dB)	Stop Band (kHz)	Term Imp(kR)	Case	Stock No.	Price
10M22D	10.7	2.2(6dB)	2.0	±2.4(60dB)	0.5	FS23	20-10028	**17.20**
10M8D	10.7	8(6dB)	2.0	±11.0(80dB)	3.0	FS22	20-10088	**15.50**
10M8DB	10.695	7(3dB)	2.0	±12.5(90dB)	3.3	FS22	20-11088	**14.50**
10M15D	10.7	15(6dB)	2.0	±20(80dB)	3.0	FS22	20-10158	**14.50**
21S08DA	21.4	7(3dB)	2.0	±12.5(90dB)	.850	S2	20-02108	**15.65**

Case Code	L	W	H
FS22	18.5	12	15
FS23	23.0	12	15
S2	11.0	8.5	11.5

HELICAL FILTERS

Low cost filters for VHF/UHF



STOCK TYPES 7HW — 2 CHAMBER

Toko Part No. 7HW	Freq. MHz	Z in/out	1dB BW	Atten./MHz off centre	Ins loss (max)	Stock No.	Price
252MT1001A	435	50	12MHz	23dB/+30 29dB-30	4dB	17-10011	**1.85**
252MT1090A	470	50	8MHz	23dB+30 27dB-30	5dB	17-10901	**1.85**
252MN1127A	463	50	12MHz	15dB Min±30MHz	2dB	17-11271	**2.25**
252MN1111A	432	50	7MHz	18dB Min±30MHz	5dB	17-11111	**2.25**

STOCK TYPES HRQ — 4 CHAMBER

Toko Part No. HRQ	Freq. MHz	Z in/out	3dB BW	Atten./MHz off centre	Ins loss (max)	Stock No.	Price
232MT1001A	435	50	10MHz	28dB−15 31dB-15	4dB	17-10010	**7.90**
232MT1021A	470	50	6MHz	28dB±15 31dB-15	8dB	17-10210	**7.90**

STOCK TYPES CBW — 2 CHAMBER

Toko Part No. CBW	Freq. MHz	Z in/out	1dB BW	Atten./MHz off centre	Ins loss (max)	Stock No.	Price
271MT1006A	145	500	3.0MHz	25db Min±15MHz	4.5dB	17-10062	**3.15**
271MT1007A	170	500	3.5MHz	20dB Min±15MHz	4.5dB	17-10072	**3.15**

STOCK TYPES CBT — 3 CHAMBER

Toko Part No. CBT	Freq. MHz	Z in/out	3dB BW	Atten./MHz off centre	Ins loss (max)	Stock No.	Price
272MT1006A	145	500	2.8MHz	25dB Min±6MHz	8dB	17-10063	**3.15**
272MT1007A	170	500	4.0MHz	30dB Min±6MHz	6dB	17-10073	**3.15**
272MT1019	160	500	3.5MHz	20dB Min±6MHz	6dB	17-10193	**3.15**
272MT1008	145	50	1.2MHz	30dB Min±6MHz	8dB	17-10083	**3.15**

SEE THE COMPLETE CATALOGUE FOR DETAILS OF

- ★ **Coaxial relays — PCB and connector types**
- ★ **TOKO IF transformers**
- ★ **TOKO block filters for video/radio**
- ★ **Fixed Inductors**
- ★ **Quartz crystals**

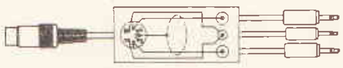
Autumn/Winter '83 supplement. All prices subject to VAT & P&P (60p per order) correct at time of going to press

ambit for computer components

COMPUTER LEADS

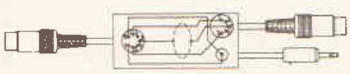
To connect BBC/Acorn computer to cassette etc. 7 pin DIN plug to 2 x 3.5mm jack plugs and 2.5mm jack plug. Length approx. 1m.

Stock No	Price
03-10001	2.05



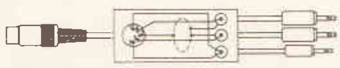
Also for BBC/Acorn. 7 pin DIN plug to 3 pin DIN plug and 2.5mm jack plug. Length approx 1m.

Stock No	Price
03-10002	2.05



5 pin DIN plug to 2 x 3.5mm jack plugs and 2.5mm jack plug. Length approx. 1m.

Stock No	Price
03-10003	1.90



Co-ax plug to phono plug. Length approx 1.2m.

Stock No	Price
03-10004	0.65

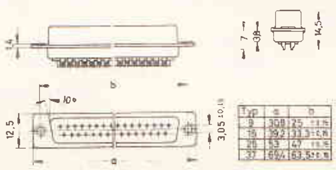
MIN 'D' SERIES CONNECTORS

A range of high performance connectors available in 15 and 25 ways, all contacts are hard gold-plated on copper alloy. Mouldings are thermoplastic resin, glass-fibre filled and metal parts are galvanized and chromatized.

SOLDER CUP

Male and female connectors with solder cup termination max 0.5mm.

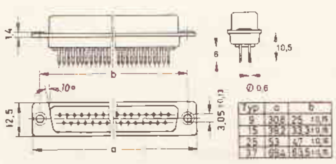
Type/Way	Stock No	Price
Plug/15	10-15100	1.30
Plug/25	10-25100	1.98
Socke/15	10-15200	1.80
Socket/25	10-25200	2.44



SOLDER PIN

Male and female connection with solder pin terminations. Max. 0.6mm. Suitable for vertical PCB mounting. Lead length 6mm.

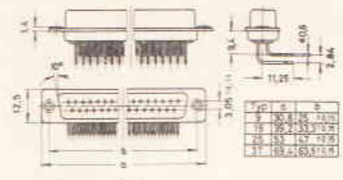
Type/Way	Stock No	Price
Plug/15	10-15110	1.42
Plug/25	10-25110	2.15
Socke/15	10-15210	1.89
Socket/25	10-25220	2.55



RIGHT ANGLE

For PCB mounting right angle version with supporting bracket. Max. lead length 4mm.

Type/Way	Stock No	Price
Plug/15	10-15111	2.55
Plug/25	10-25111	3.40
Socke/15	10-15211	2.90
Socket/25	10-25211	3.80



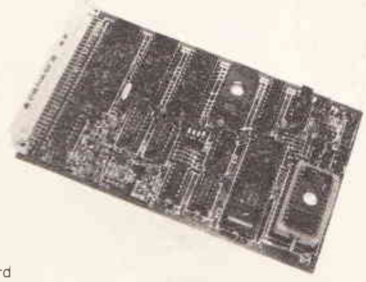
MOULDED COVER

Side entry cover with cable clamp. Moulded in thermoplastic resin, glass fibre filled.

Ways	Stock No	Price
15	10-15122	0.76
25	10-25122	0.80

Z-8 TBPDS

Beware of immitations. Jon Burchell's versatile BASIC development system, based on the Z-8 basic/debug CPU is the most adaptable and *understandable* entry to the design on MPU based control systems. The Z8 TBPDS provides 8k x 8 RAM, 4k x 8 EPROM, containing utility software, and EPROM programming. The Z-8 TBPDS needs only to be connected to an RS232 terminal (or a home computer configured as one) to provide complete program development/support. Supported by regular features in *Radio & Electronics World* magazine, and now a line assembler and CPM based cross assembler is available for fast and versatile applications and development. Further enhancements include an autostart board, to run the BASIC programme held in EPROM power-up.



	Stock No	Price
Built	40-00802	160.00
Built autostart	40-00811	6.50

Z-8 Interconnect cable connects Z8 to PSU cassette interface, and RS232 terminal.

40-00810 **8.00**

Z8 Datapack, very complete documentation of Z8 BASIC, and Z8671 CPU. Refundable against purchase of a Z8 TBDS kit, (or built version)

02-00800 **10.00**

Z8 LINE ASSEMBLER

A 2732 EPROM, contains a Z8 line assembler, permitting the use of Z8 code in programme developments. The enormously enhanced speed of development and operation offered by this software tool places the Z8 well ahead of the rival single chip MCUs for speed and versatility. The EPROM includes revised utilities written in code, and comes complete with extensive documentation to plug into your TBPDS.

	Stock No	Price
EPROM	49-07861	40.00

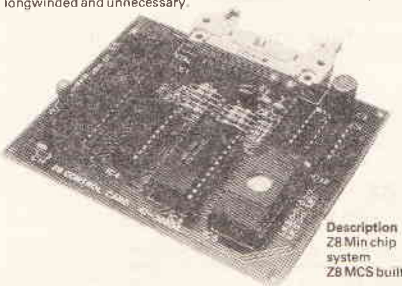
Z8 EXEC

An operating system, in BASIC for the Z8 Tiny Basic Development System. Z8 Exec helps you create, save in an EPROM filing system, load and run programs with its 15 versatile commands. A real time clock and scheduler will allow programs to run at pre-selected times. Supplied in 3 EPROMS.

Stock No	Price
49-07863	45.00

Z8 MCS

From Jonathan Burchell's cornucopia of microprocessing delights comes the Z8 single board computer: a 4 IC design capable of running BASIC/MC programs of up to 4K Bytes from switch-on. It is designed specifically to run the programs developed with the Z8 TBDS, and rejoices in the usual features of the Z8: 16 parallel I/O lines, serial I/O etc. An approach that makes any other method of developing single-chip MCU's seem rather longwinded and unnecessary.



Description	Stock No	Price
Z8 Min chip system	40-00812	30.95
Z8 MCS built	40-00813	36.78

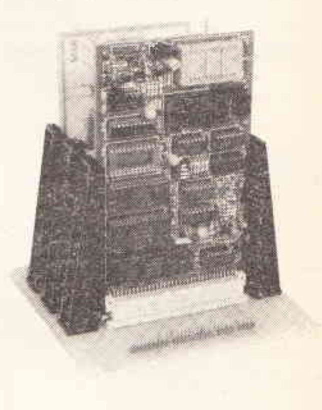
Z8 POWER SUPPLY

Available built-only a boxed version of the power supply with cassette interface for the Z8 TBDS computer development system. ±12V at 500mA, +5V at 1 amp, +25V 100mA, TTL data input, audio out to recorder.

Description	Stock No	Price
Z8 PSU	40-00814	33.00

Z8 BACKPLANE

As described in July '83 R&EW. Enables up to 2 Eurocards to be used in conjunction with the Z8 TBDS. Easy connections to I/O, RS232 ports and power supplies.



	Stock No	Price
Kit	41-00601	19.13
Built	41-00600	25.74

RS232 ADA

A serial interface A/D and D/A converter that provides easy communication with any RS232 port.

	Stock No	Price
Kit	40-90232	41.40
Built	40-99232	52.00

LOW COST A/D

Another conversion (September 1982) for the faithful from Jon Burchell, but this time a low cost approach with parallel interface. A good place to start when you want to explore the world outside your personal computer.

	Stock No	Price
Kit	40-42700	14.50

MICROPROCESSOR AND MEMORIES

6800 SERIES

Type	Stock No.	Price
6800P	26-06800	2.25
6810P	26-06810	1.15
6820P	26-06820	1.75
6821P	26-06821	1.00
6840P	26-06840	3.75
6850P	26-06850	1.10
6852P	26-06852	2.00
68488P	26-68488	4.50
6809	26-06809	8.00
6802	26-06802	3.20
68A00P	26-16800	3.90
68A21P	26-16821	2.10
68A40P	26-16840	4.55
68A52P	26-16852	2.75
68B00P	26-26800	4.65
68B21P	26-26821	2.25
68B40P	26-26840	4.65
68B50P	26-26850	2.13
68B52P	26-26852	2.95

Z80 4MHz DEVICES

Type	Stock No.	Price
Z80A	26-18400	3.40
Z80APIO	26-18420	2.95
Z80ACTC	26-18430	2.90
Z80ADMA	26-18410	7.30
Z80DART	26-18470	6.10
Z80AS10/1	26-18441	9.50
Z80AS10/2	26-18442	9.50
Z80AS10/9	26-18149	8.90

Note: The Z80A family may be used as higher speed replacements for the standard speed Z80 (2.0MHz) Devices.

Z80B 6MHz DEVICES

Type	Stock No.	Price
Z80B	26-28400	8.85
Z80BPIO	26-28420	8.45
Z80BCTC	26-28430	8.45
Z8671	26-08672	17.50

8080 1MHz SERIES

Type	Stock No.	Price
8080AP	26-08080	2.80
8212	26-08212	1.65
8224	26-08224	1.90
8251	26-08251	3.40
8255	26-08255	2.58

MEMORIES

Popular static and dynamic RAMs and EPROMs. All are first grade types from well known manufacturers — Hitachi, Texas etc.

STATIC

Device	Stock No	Price
6116-3	26-36116	3.50
2114-L2	26-02114	1.20
2112	26-02112	2.30
2111	26-02111	2.30
2102	26-02102	1.20
Z6132-6	26-06132	15.00
MC51L01P45	25-05101	3.16

DYNAMIC

Type	Stock No.	Price
8264	26-08264	3.80
4116-2	26-24116	0.90
4116-3	26-34116	0.85

UV EPROMS

Type	Stock No.	Price
2764	26-02764	6.39
2732	26-02732	4.00
2716	26-02716	3.00
2708	26-02708	2.00

IDC and many other types in the catalogue.

OEM's ask for details of our custom cable and termination facilities.

See our broad selection of computer books!

ambit for audio

100W PA MODULE

All parts for the best 100W complementary amplifier yet published

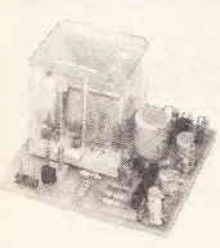
Kit

41-00504 **36.48**

HEATSINK (2 required)

21-08035 **8.60**

LOUDSPEAKER/AMPLIFIER PROTECTION



Very substantial 20A relay driven by the multifarious HA12002 amplifier monitor IC Protects against overload, temperature offset etc.

41-00505 **£8.39**

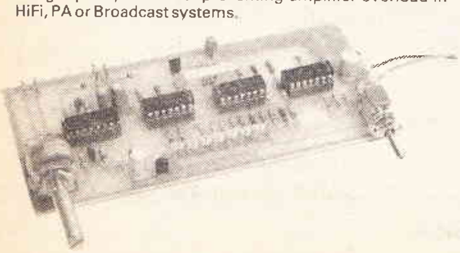
PSU — 250VA FOR PA

A multi primary toroid designed specifically for the above system with substantial reservoir capacitors

	Stock No.	Price
110/240V PRI 15-0-15V 42-0-42Vsec	57-07110	**24.45**
22000μF/63V	05-22400	**7.84**
200V PIV/ 25A Bridge Rectifier	90-00564	**2.20**

AUDIO LIMITER

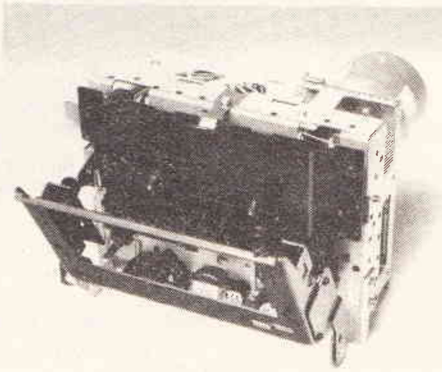
A high quality means of preventing amplifier overload in HiFi, PA or Broadcast systems.



Kit 41-00501 **£13.82**

ELECTRONIC CASSETTE

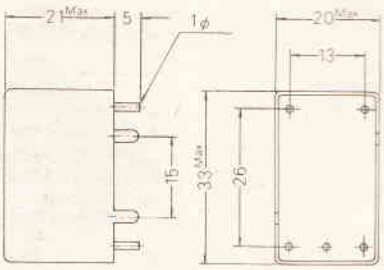
A fully solenoid operated cassette mechanism, featuring front loading and simple electronic control. Complete with Canon permalloy stereo head — although various others can be fitted if required. This is the current stock deck — OEM's can obtain details of the broader range available by contacting Ambit Industrial Marketing. Full specification and drawings on request, together with alternative head options for large volume users. Position counter available soon. See August R&EW for details of logic drive circuit.



SPECIFICATION:
Rated Operating Voltage: Motor +12VDC ±10%, Solenoids +12V DC ±10%. **Installation:** Vertical or Horizontal. **Wow and Flutter:** >0.08% WRMS (>15)(Test Tape: TEAC MTT-111). **Spooling Time:** FF or REW >115 seconds (TDK DC-60). **Tape Speed:** 3,000Hz±2%. **Motor Consumption:** (Play, FF, REW)>100mA. **Heads - REC/REP:** Canon H3332-0202 (2 channel sendust). **Erase:** Canon H53211-02 (2 channel, double gap, metal capable)

Description	Stock No.	Price
TN3600 deck	72-03600	**28.00**
BA843 Cassette deck control IC	61-00843	**1.95**
LB1288 Darlington Driver (for solenoids)	61-01288	**1.35**

TAPE OSCILLATOR BLOCK TBP23



Pre-aligned oscillator block for bias and erase use in cassette and tape decks. High stability push-pull oscillator, with shielded case.

SPECIFICATION:
Supply Voltage: 16V DC. **Current consumption:** <50mA. **Osc Frequency:** 100±5kHz. **Recording Bias Current:** 600uA per head. **Erase current:** 80mA. **Erase current distortion:** <0.6%. **Impedances: Erase Head:** 300R @50kHz. **Rec/Play Head:** 800R @1kHz. **Temperature Range:** -20° to +70°C.

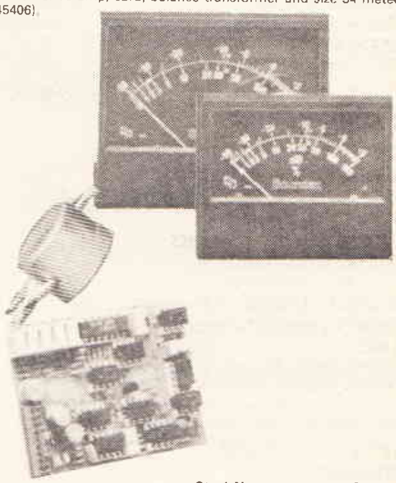
Type	Stock No.	Price
724BOR1018N	99-01018	**2.75**

PPM SYSTEMS

Professional balistic sound measurement systems

PPM SYSTEMS TO DIN45406

The PPM 302 is a Meter Movement and Drive amplifier combination complete with 1:1 isolating transformer, forming a sophisticated peak programme meter system within BS 5428 type 1 and DIN 45406 specifications. The response time is exceptionally fast and the dynamic range −50 to 5dB. The drive card, incorporates a sharp cut off low pass filter, full wave rectifier, separate attack and decay time constants, and logarithmic meter drive amplifiers. The gain of the card is adjustable. The drive card and meter are sold as a pre-aligned pair and are issued with a calibration certificate. There are two meter sizes available and the size should be stated when ordering. PPM302/24 drive amp, card, balance transformer and size 24 meter (DIN45406). PPM302/34 drive amp, card, balance transformer and size 34 meter (DIN45406).



Type	Stock No.	Price
PPM302/24	50-30201	**114.92**
PPM302/34	50-30202	**119.12**

LOW COST PPM SYSTEMS

The PPM402 is a meter movement and Drive Amplifier card combination forming a cost effective peak programme meter of high quality and reliability. The driver consists of a variable sensitivity input stage, precision full-wave active rectifier and output stage with a transfer characteristic suitable for the meter scale. Each driver and meter is individually aligned to be within published data so that repeatability of response is guaranteed. In operation this means that peaks are not only captured, but also valued closely to what the ear may perceive. PPM402/24 drive amp, card with size 24 meter. PPM402/34 drive amp, card with size 34 meter. PPM402/K drive amp kit with size 24 meter.

Type	Stock No.	Price
PPM402/24	50-40201	**55.13**
PPM402/34	50-40202	**59.73**
PPM402/K	50-40203	**45.98**

DRIVE AMPLIFIERS

PPM 121 (ENCAPSULATED)

Features: ★ BS5428 compatibility. ★ Small external component count. ★ Maximum opportunity for user options. ★ Two-point line-up. ★ Small size 30 x 20 x 15mm. ★ Wide supply variation tolerance. ★ Wide supply variation tolerance. ★ Low current consumption.
The full wave rectifier, piece-wise processor and drive amplifiers, make this small module ideal for achieving Peak Programme Metering in a wide variety of applications. The module is sufficiently accurate to perform BS4297 and BS5428 processing with negligible thermal drift and wide supply tolerance. A minimum of external components are needed which allow dynamic and static parameters to be user-adjusted.

Type	Stock No.	Price
PPM121	50-00121	**28.35**

PPM 131 (CARD)

PPM 131 is a small, high quality meter drive amplifier, ideal for incorporation into mixers and other equipment where unbalanced signals are present. There is adequate gain to cope with non-standard levels. Power supplies present no problem to the PPM 131, since apart from being protected against reverse biasing, the amplifier may be operated from either single or dual rail power — the 0V generator onboard can be linked in or out of use. Each PPM 131 leaves the Soundex factory having been aligned, both statically and ballistically, to the BS5428 specification and because only high stability close tolerance components are used, alignment is achieved in two steps.

Type	Stock No.	Price
PPM131 Card to affix to meter	50-00131	**36.75**

PPM 181 (CARD)

A high performance peak programme meter amplifier card of small size for mounting directly onto the rear studs of meter movements. The input is electronically balanced with a high input impedance and large common mode rejection. An unbalanced output is available for sum and difference measurement, where two PPM 181 cards are used as a stereo pair. The gain of the PPM 181 may be selected as unity (0dBm = 0dB indicated) or varied by appropriate linking. Realignment is a simple one pass procedure. The PPM 181 is supplied with 10 way edge connector, certificate of calibration and full data.

Type	Stock No.	Price
PPM181 Card to affix to meter	50-00181	**69.35**

★ BOOKS ★ BOOKS ★ BOOKS ★ BOOKS ★

MOTOROLA DATA BOOKS

EUROPEAN MASTER SELECTION
468pp; Paperback; Motorola
Stock No: 02-14000 Price £4.05

LOW POWER SCHOTTKY TTL
468pp; Paperback; Motorola
Stock No: 02-29478 Price £4.05

LINEAR INTEGRATED CIRCUITS DATA
830pp; Paperback; Motorola.
Stock No: 02-08182 Price £7.20

MOTOROLA MEMORY DATA MANUAL
280pp; Paperback; Motorola.
Stock No: 02-02168 Price £5.20

THE EUROPEAN CMOS SELECTION
860pp; Paperback; Motorola
Stock No: 02-04000 Price £7.55

EUROPEAN HOME ELECTRONICS: INTEGRATED CIRCUITS
590pp; Paperback; Motorola
Stock No: 02-18182 Price £6.05

EUROPEAN HOME ELECTRONICS: DISCRETE DEVICES
590pp; Paperback; Motorola
Stock No: 02-28182 Price £6.05

RADIO & ELECTRONICS

ACTIVE FILTER COOKBOOK
By D Lancaster
1975; 240pp; 135 x 215mm; Paperback; Sams: ISBN 0-672-21168-8
Stock No: 02-21168 Price £12.45

ACTIVE FILTER DESIGN
By Carson Chen
1982, 134pp, 150 x 225mm, Paperback, Hayden ISBN 0-8104-0959-3
Stock No: 02-09593 Price £10.95

BEGINNERS GUIDE TO ELECTRONICS
By O Bishop
1982, 240pp, 120 x 185mm, Paperback, Butterworth, ISBN 0-408-00413-4
Stock No: 02-04134 Price £4.35

BEGINNERS HANDBOOK OF AMATEUR RADIO
By C Laster
1979, 384pp, 135 x 215mm, Paperback, Sams, ISBN 0-672-21569-1
Stock No: 02-02-02156 Price £11.45

BEGINNERS HANDBOOK OF IC PROJECTS
By D L Heiserman
1981, 216pp, 175 x 235mm, Paperback, Prentice, ISBN 0-13-074286-4
Stock No: 02-07428 Price £11.00

BUILDING & INSTALLING ELECTRONIC INTRUSION ALARMS
By J E Cunningham
New Ed 1977, 128pp, 135 x 215mm, Paperback, Sams, ISBN 0-672-21954-9
Stock No: 02-21465 Price £9.30

CMOS COOKBOOK
By D Lancaster
1977, 416pp, 135 x 215mm, Paperback, Sams, ISBN 0-672-21398-2
Stock No: 02-02-21398 Price £11.85

DESIGN OF ACTIVE FILTERS
By H M Berlin
1977, 240pp, 135 x 215mm, Paperback, Sams, ISBN 0-672-21539-X
Stock No: 02-21539 Price £9.30

DESIGN OF OP AMP CIRCUITS with experiments
By H M Berlin
1977, 244pp, 135 x 215mm, Paperback, Sams ISBN 0-672-21531-3
Stock No: 02-21537 Price £9.30

DESIGN OF PHASE-LOCKED LOOP CIRCUITS with experiments
By H M Berlin
1978, 256pp, 135 x 215mm, Paperback, Sams, IBN 0-672-21545-3
Stock No: 02-21545 Price £9.30

DIGITAL ELECTRONIC TECHNOLOGY
By D C Green
1982, 171pp, 185 x 245mm, Paperback, Pitman, ISBN 0-273-01722-5
Stock No: 02-17225 Price £6.95

EFFECTIVELY USING THE OSCILLOSCOPE
By R G Middleton
1981, 168pp, 135 x 215mm, Paperback, Sams, ISBN 0-672-21794-5
Stock No: 02-21794 Price: £9.30

ELECTRONICS II
By D C Green
2nd Ed 1982, 150pp, 175 x 235mm, Paperback, Pitman, ISBN 0-273-01827-2
Stock No: 02-01827 Price: £6.90

ELECTRONICS III
By D C Green
2nd Ed 1982, 206pp, 175 x 235mm, Paperback, Pitman, ISBN 0-273-01831-0
Stock No: 02-01831 Price: £7.65

ELECTRONIC PROJECTS FOR HOME SECURITY
By O Bishop
1981, 92pp, 135 x 215mm, Paperback, Butterworth, ISBN 0-408-00535-1
Stock No: 02-05351 Price: £3.60

ELECTRONIC TELEPHONE PROJECTS
By A J Caristi
1979, 168pp, 135 x 215mm, Paperback, Sams, ISBN 0-672-21618-3
Stock No: 02-21618 Price: £7.60

FERROMAGNETIC CORE DESIGN
By M F 'Doug' DeMaw
1981, 251pp, 155 x 235mm, Paperback, Prentice, ISBN 0-13-314088-1
Stock No: 02-40881 Price: £22.45

FOUNDATIONS OF WIRELESS AND ELECTRONICS 9th Ed
By M G Scroggie
1980, 520pp, 135 x 210mm, Paperback, Butterworth, ISBN 0-408-00188-7
Stock No: 02-01887 Price: £6.50

HANDBOOK OF ELECTRONIC TABLES FORMULAS
By Howard Sams Engineering Staff
5th Ed 1979, 288pp, 155 x 255mm, Hardcover, Sams 0-672-21532-2
Stock No: 02-21532 Price: £11.00

OSCILLOSCOPES
By S Prentiss
1981, 161pp, 155 x 245mm, Paperback, Prentice, ISBN 0-8359-5353-X
Stock No: 02-53548 Price: £11.85

POPULAR CIRCUITS: READY-REFERENCE
By J Markus
1982, 216pp, 210 x 280mm, Paprback, McGraw-Hill, ISBN 0-07-040458-5
Stock No: 02-04585 Price: £12.50

PRACTICAL SOLID-STATE CIRCUIT DESIGN
By J E Oleksy
2nd Ed 1981, 216pp, 135 x 215mm, Paperback, Sams, ISBN 0-672-21787-2
Stock No: 02-21787 Price: £8.45

SOLAR HEATING
By W G Scheller
1980, 160pp, 5½ x 8½, Paperback, ISBN 0-672-21621-3
Stock No: 02-02-00101 Price: £7.15

SON OF CHEAP VIDEO
By D Lancaster
1980, 224pp, 135 x 215mm, Paperback, Sams, ISBN 0-672-21723-1
Stock No: 02-21723 Price: £9.30

STUDY NOTES FOR TECHNICIANS: ELECTRICAL AND ELECTRONIC PRINCIPLES — VOL 1
By J B Pratley
1982, 72pp, 190 x 250mm, Paperback, McGraw-Hill, ISBN 0-07-084661-8
Stock No: 02-46618 Price: £3.75

TRANSMISSION SYSTEMS TEC II
By D C Green
2nd Ed 1982; 148pp, 175 x 235mm, Paperback, Pitman, ISBN 0-273-01826-4
Stock No: 02-01826 Price: £5.25

TV ANTENNAS & SIGNAL DISTRIBUTION SYSTEMS
By M J Salvati
1979, 256pp, 135 x 215mm, Paperback, Sams, ISBN 0-672-21584-5
Stock No: 02-21584 Price: £10.15

555 TIMER APPLICATIONS SOURCEBOOK
By H Berlin
1976, 160pp, 135 x 215mm, Paperback, Sams ISBN 0-672-21538-1
Stock No: 02-21538 Price: £6.40

99 PRACTICAL ELECTRONIC PROJECTS
By H Friedman
1979, 128pp, 135 x 215mm, Paperback, Sams, ISBN 0-672-21635-3
Stock No: 02-21635 Price: £5.90

COMPUTER BOOKS

CHEAP VIDEO COOKBOOK
By D Lancaster
1978, 256pp, 135 x 215mm, Paperback, Sams, ISBN 0-672-21524-1
Stock No: 02-67221 Price: £6.75

COMPUTER GRAPHICS PRIMER
By M Waite
1979, 184pp, 135 x 215mm, Paperback, Sams, ISBN 0-672-21650-7
Stock No: 02-21650 Price: £12.70

INTRODUCING THE BBC MICRO
By I Sinclair
1983, 160pp, Paperback
Stock No: 02-00103 Price: £5.95

INTRODUCTION TO MICROCOMPUTERS FOR THE HAM SHACK
By H L Helms
1979, 96pp, 135 x 215mm, Paperback, Sams, ISBN 0-672-21681-7
Stock No: 02-21800 Price: £5.05

MASTERING THE COLOUR GENIE
By I Sinclair
1983, 160pp, Paperback
Stock No: 02-02-00102 Price: £5.95

MICROCOMPUTER INTERFACING WITH THE PPI CHIP
By P F Goldsbrough
1979, 224pp, 135 x 215mm, Paperback, Sams, ISBN 0-672-21614-0
Stock No: 02-21614 Price: £8.45

PRACTICAL HARDWARE DETAILS OF Z80, 8080, 8085, & 6800 MICROCOMPUTER SYSTEMS
By J W Coffron
1981, 330pp, 180 x 240mm, Hardcover, Prentice, ISBN 0-13-691089-0
Stock No: 02-69108 Price: £22.45

PRACTICAL PROGRAMS FOR THE BBC COMPUTER AND ACORN ATOM
By D Johnson-Davies
1982, 120pp, 145 x 210mm, Paperback, Sigma (W), ISBN 0-905104-14-5
Stock No: 02-04145 Price: £5.95

PRACTICAL TROUBLESHOOTING TECHNIQUES FOR MICROPROCESSOR SYSTEMS
By J W Coffron
1981, 256pp, 180 x 240mm, hardcover, Prentice, ISBN 0-13-694273-3
Stock No: 02-69427 Price: £20.65

PROGRAMMING WITH BASIC
By B S Gottfried
2nd Ed 1982, 282pp, 210 x 275mm, Paperback, McGraw-Hill, ISBN 0-07-023855-3
Stock No: 02-38553 Price: £5.95

TRS-80 ASSEMBLY LANGUAGE
By H S Howe
1981, 186pp, 175 x 235mm, Paperback, Prentice, ISBN 0-13,931121-1
Stock No: 02-93112 Price: £8.45

WORDSTAR MADE EASY
By W A Ettlin
1981, 126pp, 185 x 235mm, Paperback, McGraw-Hill, ISBN 0-931988-69-1
Stock No: 02-88691 Price: £9.95

THE ZX SPECTRUM — YOUR PERSONAL COMPUTER
By I McLean, S. Rushbrook Williams and P Williams
1983, 240pp, Paperback
Stock No: 02-00100 Price: £5.95

Z80 MICROCOMPUTER DESIGN PROJECTS
By W Barden Jnr
1981, 208pp, 210 x 280mm, paperback, Sams, ISBN 0-672-21682-5
Stock No: 02-21682 Price: £12.70

Z-80 MICROCOMPUTER HANDBOOK
By W Barden
1978, 304pp, 135 x 215mm, Paperback, Sams ISBN 0-672-21500-4
Stock No: 02-21500 Price: £11.85

Z-80 MICROPROCESSOR PROGRAMMING AND INTERFACING BOOKS 1 & 2
By Nichols et al
Book 1 — 1979, 304pp, 155 x 245mm, paperback, Sams, ISBN 0-672-21609-4
Stock No: 02-21609 Price: £11.00
Book 2 — 1979, 496pp, 155 x 245mm, Paperback, Sams, ISBN 0-672-21610-8
Stock No: 02-21610 Price: £14.40

Z8000 MICROPROCESSOR: A DESIGN HANDBOOK
By B K Fawcett
1982, 308pp, 175 x 230mm, Paperback, Zilog (P), ISBN 0-13-983734-5
Stock No: 02-37345 Price: £14.40

16-BIT MICROPROCESSOR HANDBOOK
By A Osborne & G Kane
1981, 600pp, 175 x 235mm, Paperback, McGraw-Hill, ISBN 0-931988-43-8
Stock No: 02-88438 Price £14.50

68000: PRINCIPLES AND PROGRAMMING
By L J Scanlon
1981, 238pp, 155 x 235mm, Paperback, Sams, ISBN 0-672-21853-4
Stock No: 02-21853 Price £12.70

8080/Z80 ASSEMBLY LANGUAGE
By A R Miller
1981, 328pp, 170 x 255mm, Paperback, Wiley ISBN 0-471-08124-8
Stock No: 02-81248 Price £8.50

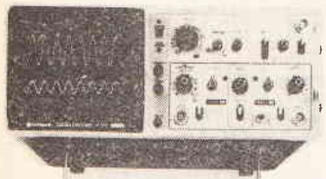
6809 ASSEMBLY LANGUAGE PROGRAMMING
By L A Leventhal
1981,600pp, 160 x 235mm, Paperback, McGraw-Hill, ISBN 0-931988-35-7
Stock No: 02-88357 Price £12.95

6809 MICROCOMPUTER PROGRAMMING AND INTERFACING with experiments
By A C Staugaard
1981, 272pp, 135 x 215mm, Paperback, Sams, ISBN 0-672-21798-8
Stock No: 02-21798 Price £12.70

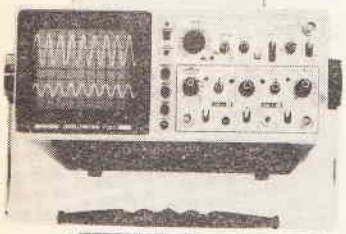
68000 MICROPROCESSOR HANDBOOK
By G Kane
1981, 114pp, 175 x 235mm, paperback, McGraw-Hill, ISBN 0-931988-41-1
Stock No: 02-88411 Price £7.95

ambit for low cost test gear and tools

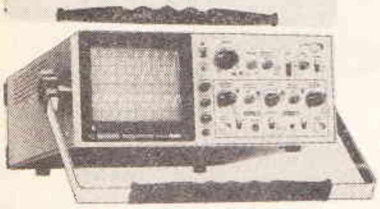
HITACHI PORTABLE OSCILLOSCOPES



V212
DC to 20MHz
56-00212 £305



V222
DC to 20MHz
56-10222 £350



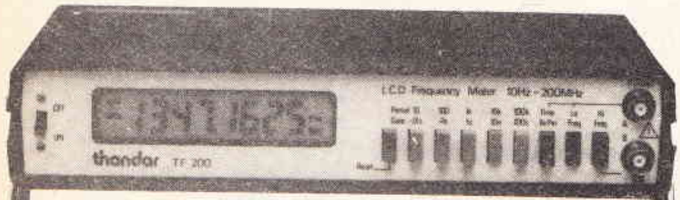
V422
56-00422 £520

LOW COST HIGH PERFORMANCE OSCILLOSCOPES

from one of the best known manufacturers in the industry

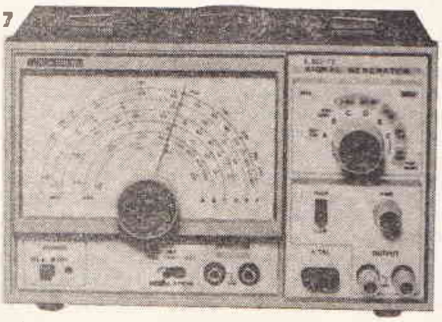
★ **All above are dual beam, with built-in calibrator, probes etc.**

THANDAR TF040 8 DIGIT LCD FREQUENCY METER



Freq. Range:	10Hz-40MHz (To 400MHz when used with TP600 prescaler)
Resolution:	Down to 1Hz
Sensitivity:	40mV rms
Functions:	Frequency, Totalize and Reset. 2 Gate times. Power take-off for optional TP600 prescaler
Accuracy:	±(1 count + timebase accuracy). Timebase factory set within ±0.5ppm
Battery Life:	Typically 80 hours from 6 alkaline 'C' cells
Size:	255 x 150 x 50mm
Weight:	1200gms with batteries
Stock No:	56-20000
Price:	**145.00**

RF GENERATOR LSG17



A stable wide-range generator for the hobbyist, service technician, schools, colleges, etc.

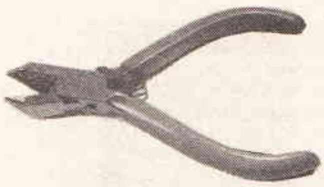
Freq. range:	A/100kHz-300kHz, B/300kHz to 1MHz (Harmonics 96-450MHz) c/1MHz-3.5MHz, d/3.0MHz-11MHz, E/10MHz-35MHz, F/32MHz-150MHz
Accuracy:	±1.5%. Output greater than 100mV (no load). Ext. xtal osc for 1 to 15MHz FT243 crystal
Power required:	AC100, 115 or 230V 3VA
Size & Weight:	150(H) x 238(W) x 130(D)mm. 2.5kg approx.
Stock No:	56-90017
Price:	**71.00**

'ENGINEER' RANGE PLIERS, CUTTERS

A range of low cost but superb quality handtools that feature best Japanese steel and box-joint construction (other than 54-30510). The cutter range includes slant and oblique types which are considerably better suited to trimming component leads through PCBs than standard diagonal types. We have no hesitation in recommending these as excellent value for money. Hardened bench engineers have been known to prefer these to other better known Swedish-made types costing twice as much.

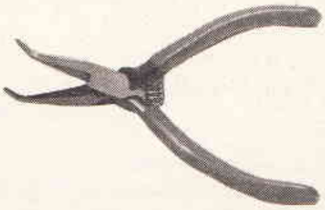
SLANT EDGE CUTTERS

Stock No.	Price
54-50505	**5.30**



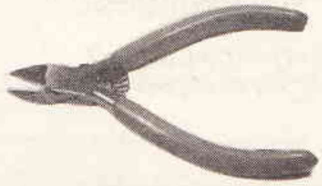
FLAT ANGLE NOSED PLIERS

Stock No.	Price
54-30500	**5.30**



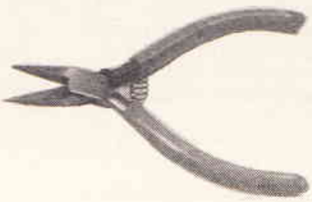
OBLIQUE CUTTERS

Stock No.	Price
54-30506	**5.44**



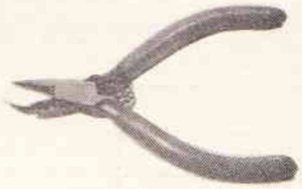
FLAT NOSED PLIERS

Stock No.	Price
54-30501	**5.15**



DIAGONAL CUTTERS

Stock No.	Price
54-30507	**5.15**



LONG TAPER NOSED PLIERS

Stock No.	Price
54-30504	**5.44**

LAP JOINT DIAGONAL CUTTERS

Stock No.	Price
54-30510	**2.95**

MANY MORE IN THE COMPLETE CATALOGUE

Autumn/Winter '83 supplement. All prices subject to VAT & P&P (60p per order) correct at time of going to press

- SAME DAY DESPATCH WHENEVER POSSIBLE.
- PLEASE USE THE STOCK NO's – ORDERS WITHOUT MAY BE DELAYED.
- ONLY MANUFACTURER'S FIRST QUALITY GOODS.
- THE BROADEST RANGE , THE BEST PRICES.

ORDER FORM

Customer account No. if known

Please check your last invoice.

AMBIT INTERNATIONAL
200, NORTH SERVICE ROAD
BRENTWOOD
ESSEX
CM14 4SG

Tel: (0277) 230909
Tlx: 995194

NAME & ADDRESS

POSTCODE

TELEPHONE:

PLEASE USE BLOCK CAPITALS

Qty	STOCK No.	PART No.	DESCRIPTION	Unit Price	SUB TOTAL
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				
	-				

METHOD OF PAYMENT (please delete where appropriate)

SUB TOTAL

CARRY OVERLEAF

MINIMUM ORDER £2.00

CHEQUE
POSTAL ORDER
ACCESS or BARCLAYCARD
No.
OTHER
AMOUNT OF PAYMENT ENCLOSED
AMOUNT OF CREDIT OR DEBIT NOTES

Please tick if ordering by credit card and would prefer any out of stock items to be cancelled. ☐

Please note that a flat rate P&P charge of 60p is made on all C.W.O. orders irrespective of value, this is in addition to any extra charges levied on heavy items e.g. mains transformers.

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

AMBIT international 200 North Service Road, Brentwood, Essex

ORDER FORM CONTINUED

CARRIED FORWARD

Qty	STOCK No.	PART No.	DESCRIPTION	Unit Price	SUB TOTAL
	-				
	-				
	-				
	-				
	-				
	-				
	-				

Have you any ideas for products not already shown?
If so please tell us here.....

	SUB TOTAL	
Current rate: 15%; 0% for export orders.	V.A.T.	
60p unless otherwise stated	P/P	
	TOTAL	

AMBIT international TELEPHONE (STD 0277) 230909 TELEX 995194 AMBIT G POSTCODE CM14 4SG
200 North Service Road, Brentwood, Essex

HOW TO ORDER

Please send in your order, on a Standard Order Form using Stock Numbers as indicated, to Ambit International, 200 North Service Road, Brentwood, Essex CM14 4SG. Do not forget to add VAT, and 60p Postage & Packing.
As with our standard discount voucher scheme, these discounts are only applicable if payment is by cash, cheque or postal order.
We will not accept the use of 'normal' discount vouchers with the above special offer items. Finally include the special offer discount voucher below with your order. All offers are subject to availability.

CHRISTMAS DISCOUNT VOUCHER NO.1

WORTH £1.15

Against an order for 4 × 01-12004
1 × 01-00409

CHRISTMAS DISCOUNT VOUCHER NO.2

WORTH £3.29

Against an order for 4 × 01-12004
4 × 01-12034
1 × 01-84054
1 × 01-02204

CHRISTMAS DISCOUNT VOUCHER NO.3

WORTH £1.50

Against an order for 1 × 01-84059
1 × 01-00159

CHRISTMAS DISCOUNT VOUCHER NO.4

WORTH £1.01

Against an order for 1 × 56-05020
1 × 01-12001

CHRISTMAS DISCOUNT VOUCHER NO.5

WORTH £9.00

Against an order for 1 × 56-00901
AD901 Multimeter

CHRISTMAS DISCOUNT VOUCHER NO.6

WORTH £2.50

Against an order for 1 × 40-20001
LCD Stopwatch

CHRISTMAS OFFERS

No.1

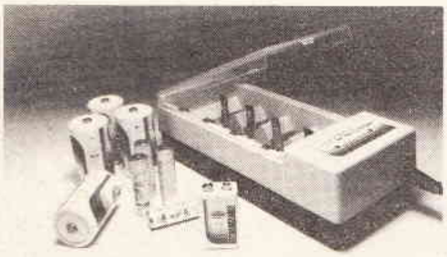
4 × **01-12004** AA Full Spec NICAD 4 × 80p = £ 3.20
1 × **01-00409** AA Charger £ 4.95

CATALOGUE COST £ 8.15

Less **£1.15 CHRISTMAS DISCOUNT**

Means you pay **ONLY £ 7.00**

No.2



4 × **01-12004** AA NICADS 4 × 80p = £ 3.20
4 × **01-12034** Sub 'D' NICADS 4 × £1.60 = £ 6.40
1 × **01-84054** PP3 NICAD = £ 3.70
1 × **01·02204** CH4/RX4 Universal NICAD Charger = £ 7.49

CATALOGUE COST £20.79

Less **£3.29 CHRISTMAS DISCOUNT**

Means you pay **ONLY £17.50**

No.3

1 × **01-84054** PP3 NICAD = £ 3.70
1 × **01-00159** PP3 NICAD Charger = £ 4.30

CATALOGUE COST £ 8.00

Less **£1.50 CHRISTMAS DISCOUNT**

Means you pay **ONLY £ 6.50**

No.4

1 × **56-05020** X-8 Battery Tester £ 3.95
1 × **01-12001** Battery Adaptors £ 0.96

CATALOGUE COST £ 4.91

Less **£1.01 CHRISTMAS DISCOUNT**

Means you pay **ONLY £ 3.90**

No.5

Features
Full Autoranging digital multimeter with 3.5 digit LCD, range change and continuity bleeper.
Input impedance: 10MΩ
DC Volts: 200mV-2-20-200-1000V
AC Volts: 2-20-200-600V
DC Current: 0-200mA, 10A
AC Current: 0-200mA, 10A
Resistance: 200Ω-20kΩ-200kΩ- 2000kΩ
Accuracy: DC; 1% of reading +0.4% of full scale
Dimensions: 160×80×30mm
Weight: 250g
Supplied with batteries and spare fuse.

1 × **56-00901** AD901 Digital Multimeter £49.00

Less **£9.00 CHRISTMAS DISCOUNT**

Means you pay **ONLY £40.00**

No.6

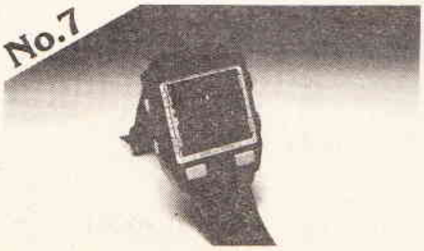
Features:
Stopwatch with 1/100ths of a second, normal time with seconds display and selectable European/US data formats, pace maker 'bleeper' for joggers etc. Complete with neck cord.

1 × **40-20001** LCD Stop Watch £12.50

Less **£2.50 CHRISTMAS DISCOUNT**

Means you pay **ONLY £10.00**

No.7



- ★ LCD Digital Quartz
- ★ Game and Watch in one
- ★ Normal Time function (hour, minute, second, date)
- ★ 12/24 hour system
- ★ Automatic digital scoring and sound effect

No.8

1 × **90-00187** Plane & Tank Battle Game Watch

SPECIAL CHRISTMAS PRICE £5.50

1 × **90-00188** Sea Ranger Game Watch

SPECIAL CHRISTMAS PRICE £5.50

TRANSISTORS - ICs - CAPACITORS - RESISTORS

TRANSISTORS
Small Signal/Low Frequency

Device	Stock No.	Price
BC182	58-00182	0.10
BC212	58-00212	0.10
BC237	58-00237	0.08
BC238	58-00238	0.08
BC239	58-00239	0.08
BC307	58-00307	0.08
BC308	58-00308	0.08
BC309	58-00309	0.08
BC327	58-00327	0.13
BC337	58-00337	0.13
BC413	58-00413	0.10
BC414	58-00414	0.11
BC415	58-00415	0.10
BC416	58-00416	0.11
BC546	58-00546	0.12
BC550	58-00550	0.12
BC556	58-00556	0.12
BC560	58-00560	0.12
BC639	58-00639	0.22
BC640	58-00640	0.22
MPSA13	58-04013	0.30
MPSA63	58-04063	0.30
ZTX108	58-01108	0.10
ZTX212	58-01212	0.10
2N2904	58-02904	0.25
2N2905	58-02905	0.25
2N3905	58-03905	0.10
2SB646A	58-03646	0.30
2SB648A	58-03648	0.40
2SD666A	58-03666	0.30
2SD668A	58-03668	0.40
2SA872A	58-02872	0.19
2SA1084E	58-01084	0.25
2SA1085E	58-01085	0.25
2SC1775A	58-01775	0.19
2SC2646E	58-02546	0.24
2SC2547E	58-02547	0.24

TRANSISTORS
Small Signal RF Devices

Device	Stock No.	Price
BFY50	58-06500	0.22
BF241	58-06241	0.18
BF273	Use BF241	
BF274	Use BF241	
BF362	58-06362	0.49
BF440	58-06440	0.21
BF441	58-06441	0.21
BF479	58-06479	0.66
BF679S	58-06679	0.55
BFR91	58-07091	1.33
BFR96	58-07096	1.45
BFT95	58-10095	0.99
BFW92	58-08092	0.60
BFY90	58-09090	0.90
NE21936	58-21936	5.00
ZTX323	58-06232	0.60
2N2369A	58-02369	0.38

TRANSISTORS
Small Signal RF FET/MOSFET

Device	Stock No.	Price
BF256	59-00256	0.38
BF960	60-06960	0.99
BF961	60-06961	0.70
BF963	60-06963	0.99
BF981	60-06981	1.20
J310	59-02310	0.80
J176	59-02176	0.65
MEM680	60-05680	0.75
2SK55	59-01055	0.32
2SK168	59-01168	0.37
3SK45	60-04045	0.49
3SK51	60-04051	0.54
3SK60	60-04060	0.58
3SK81	60-04081	1.32
3SK88	60-04088	0.99
40673	Replaced by **3SK51**	
40822	Replaced by **3SK45**	
3SK112	60-04112	4.60

TRANSISTORS
Audio Power

Device	Stock No.	Price
BD139	58-15139	0.29
BD140	58-15140	0.31
BD165	58-15165	0.46
BD166	58-15166	0.48
BD179	58-15179	0.38
BD180	58-15180	0.41
TIP31A	58-15031	0.35
TIP32A	58-15032	0.35
MJ2955	58-12955	0.68
2N3055	58-13099	0.58
2SB720	58-15720	0.60
2SD760	58-17600	0.60
2SJ49	60-01049	3.10
2SJ50	60-01050	4.25
2SJ83	60-01083	3.55
2SK135	60-00135	4.25
2SK227	60-00227	3.55
2SD753	58-03753	2.34
SM3159	58-03159	5.95
SM3160	58-03160	5.95

TRANSISTORS
RF POWER DEVICES

Device	Stock No.	Price
MRF237	58-14237	3.20
MRF238	58-14238	16.50
MRF245	58-14245	40.00
MRF449A	58-14449	16.50
MRF472	58-14472	1.25
MRF475	58-14475	4.60
MRF629	58-14629	4.99
PT8811	58-18811	9.50
2SC1945	58-01945	2.60
2SC1971	58-01971	2.49
2SC2053	58-02053	0.63
2SC2097	58-02071	14.75
TP2320	58-12320	10.24
VN66AF	60-02066	0.95
ZTX3866	58-03866	0.45
2N3866	58-13866	1.20

DIODES
Signal, Rectifier, etc.

Device	Stock No.	Price
BA244	12-02447	0.17
BA379	12-03797	0.35
ND4981-7E	12-49817	0.51
OA91	12-00916	0.07
OA47	12-00476	0.10
TDA1061	12-10617	0.95
PW02	12-62006	0.75
SO4	12-24006	0.45
W005	12-10506	0.28
IN4001	12-40016	0.06
IN4002	12-40026	0.07
IN4004	12-40046	0.07
IN4148	12-41486	0.05
IN5404	12-54046	0.16
IN6263	12-62637	0.62

DIODES
Varicap

Device	Stock No.	Price
BA102	12-01025	0.30
BA121	12-01215	0.30
BB105B	12-01055	0.30
BB109B	12-01095	0.27
BB204B	12-02045	0.36
BB212	12-02125	1.95
ITT210	12-02105	0.30
MVAM115	Use KV1235	
MVAM125	Use KV1225	
KV1210	12-12105	2.45
KV1211	Use KV1236	
KV1225	12-12255	2.75
KV1235	12-12355	2.75
KV1236	12-12365	2.55
KV1310	12-13105	0.40
KV1320	12-13205	0.40

INTEGRATED CIRCUITS
LINEAR

Device	Stock No.	Price
LM10CN	61-00010	3.88
MF10	61-00011	5.05
L149	61-00149	1.86
ZNA234	61-02340	8.50
U237B	61-00237	1.28
U247B	61-00247	1.28
U257B	61-00257	1.28
U267B	61-00267	1.28
LM301AH	61-03010	0.98
LM301AN	61-03011	0.44
LM308CN	61-03081	0.65
LM311CN	61-00311	0.46
LM324	61-03240	0.48
LM339N	61-03390	0.68
LM346	61-00346	3.72
LF347	61-00347	1.82
LM348	61-03480	1.26
LF351	61-03510	0.49
LF353	61-03530	0.76
LM380N	61-00380	1.00
LM381	61-00381	1.81
LM382	61-00382	1.81
ZN419CE	61-00419	1.98
ZNA423	61-02430	1.40
ZN425E/8	61-04250	4.50
ZN426E/8	61-04260	3.48
ZN427E/8	61-04270	6.80
ZN428E/8	61-02480	5.50
ZN429E/8	61-04290	2.50
ZN432CJ10	61-04320	29.90
ZN433CJ10	61-04330	24.79
ZN450E	61-04500	7.61
NE542	61-05420	1.20
NE544	61-00544	1.80
NE555N	61-05550	0.21
NE556N	61-05560	0.50
SL560C	61-05600	2.24
NE564	61-00564	4.29
NE565	61-00565	1.00
NE566	61-00566	1.40
NE567	61-00567	1.30
NE570N	61-00570	3.85
uA709HC	61-07090	0.64
uA709PC	61-07091	0.52
uA710HC	61-07100	0.64
uA710PC	61-07101	0.59
uA711CN	61-07110	0.85
uA741CH	61-07410	0.66
uA709PC	61-07411	0.22
uA741CN	61-07470	0.70
uA748CN	61-04780	0.40
uA758	61-00758	2.35
TBA820M	61-00820	0.78
TDA1028	61-01028	2.11
TDA1029	61-01029	2.11
ZNA1034	61-01034	2.10
LM1035	61-01035	4.50
TDA1054M	61-01054	1.45
TDA1062	61-01062	1.95
TDA1072	61-01072	2.69
TDA1074A	61-01074	5.04
TDA1083	61-01083	1.95
TDA1090	61-01090	3.05
HA1196	61-01196	2.00
HA1197	61-01197	1.00
TDA1220	61-01220	1.40
LM1303	61-01303	0.99
MC1310P	61-01310	1.90
MC1330	61-01330	1.20
MC1350	61-01350	1.20
HA1370	61-11370	1.90
HA1388	61-01388	1.75
LM1458N	61-14580	0.45
MC1496P	61-01496	1.25
SL1610	61-01610	2.10
SL1611	61-01611	2.60
SL1612	61-01612	2.10
SL1613	61-01613	2.55
SL1620	61-01620	2.17
SL1621	61-01621	3.50
SL1623	61-01623	3.50
SL1625	61-01625	1.90
SL1630	61-01630	1.62
SL1640	61-01640	3.50
SL1641	61-01641	3.50
MC1648	61-01648	3.25
TDA2002	61-02002	1.25
ULN2240	61-02240	3.25
ULN2242	61-01090	3.05
ULN2283	61-02283	1.00
CA3080	61-03060	0.96
CA3089	61-03089	1.84
CA3123	61-03123	1.40
CA3130E	61-31300	0.80
CA3130T	61-31301	0.90
CA3140E	61-31400	0.46
CA3189E	61-03189	2.20
CA3240E	61-32400	1.27
MC3357	61-03357	2.85
MC3359	61-03357	2.85
ULN3859	61-03859	2.95
KM3701	61-03701	85.53
KM3702	61-03702	74.84
LM3900	61-39000	0.60
LM3909N	61-39090	0.68
LM3914N	61-03914	2.80
LM3915N	61-03915	2.80
KB4400	61-04401	0.90
KB4412	61-04412	1.95
KB4413	61-04413	1.95
KB4417	61-04417	1.80
KB4420B	61-04420	1.09
TDA4420	61-14420	2.65
TDA4421	61-14421	2.65
KB4423	61-04423	2.30
KB4424	61-04424	1.65
KB4430	61-04430	2.30
KB4431	61-04431	1.95
KB4432	61-04432	1.95
KB4433	61-04433	1.72
KB4436	61-04436	1.53
KB4437	61-04437	1.75
KB4438	61-04438	2.22
KB4441	61-04441	1.35
KB4445	61-04445	1.29
KB4446	61-04446	2.75
KB4448	61-04448	1.65
NE5044	61-05044	2.26
MC5229	61-05229	9.60
NE5532	61-55320	2.20
KM5624	61-05624	4.35
SD6000	61-06000	3.75
SL6270	61-06270	2.00
SL6310	61-06310	2.00
SL6600	61-06600	3.75
SAS6610	61-06610	1.48
SL6640	61-06640	2.30
SL6690	61-06690	3.75
SL5700	61-06700	3.20
SAS6710	61-06710	1.48
ICM7555	61-75550	0.98
ICL8038CC	61-08038	4.50
MSL9362	61-09362	1.75
MSL9383	61-09363	1.75
TK10170	61-10170	1.87
TK10321	61-10321	2.75
HA11223	61-11223	2.15
HA11225	61-11225	1.45
HA12002	61-12002	1.22
HA12017	61-12017	0.80
HA12402	61-12402	1.95
HA12411	61-12411	1.20
HA12412	61-12412	1.55
LF13741	61-13741	0.33
MC14412	61-14412	6.85
MK50366	61-50366	3.36
MK50375	61-50375	3.85
MM53200	61-53200	3.90

PRESCALERS, FREQUENCY DISPLAY AND SYNTHESISERS

Device	Stock No.	1-24
U264	61-02640	2.27
U265	61-02650	3.16
U266	61-02660	2.43
11C90DC	61-01190	12.95
MSL2312R	61-02312	3.94
MSM5523	61-05523	11.30
MSM5524	61-05524	11.30
MSM5525	61-05525	7.85
MSM5526	61-05526	7.85
MSM55271	61-55271	9.75
ICM7106CP	61-07106	9.55
LC7137	61-07137	7.50
ICM7216B	61-72161	23.95
ICM7216C	61-72162	23.95
SP8629	61-08629	3.85
SP8647	61-08647	6.00
SP8793	61-08793	7.70
HD10551	61-10551	2.45
HA12009	61-12009	6.00
MC12016	61-12016	6.90
HD44015	61-44015	4.45
HD44752	61-44752	8.00
MC145151P	61-14151	6.00
MC145152P	61-14152	12.30
MC145156P	61-14156	4.60

VOLTAGE REGULATORS

Device	Voltage	Stock No.	Price
7805	+5V	27-78052	0.40
7806	+6V	27-78062	0.40
7808	+8V	27-78082	0.40
7812	+12V	27-78122	0.40
7815	+15V	27-78152	0.40
7818	+18V	27-78182	0.40
7824	+24V	27-78242	0.40
7905	−5V	27-79052	0.49
7906	−6V	27-79062	0.49
7908	−6V	27-79082	0.49
7912	−12V	27-79122	0.49
7915	−15V	27-79152	0.49
7918	−18V	27-79182	0.49
7924	−24V	27-79242	0.49
78L05	+5V	27-78050	0.40
78L06	+6V	27-78060	0.40
78L08	+8V	27-78080	0.40
78L12	+12V	27-78120	0.40
78L15	+15V	27-78150	0.40
78L24	+24V	27-78240	0.40
79L05	−5V	27-79050	0.55
78GKC	+adj	27-78993	3.95
78GUIC	+adj	27-78992	1.10
78H05	+5V	27-78054	4.25
78H12	+12V	27-78124	5.45
78HG	+adj	27-78994	7.45
79HG	−adj	27-79994	7.45
LM317MP	+adj	27-03175	1.75
LM337MP	−adj	27-03175	1.75
LM317K	+adj	27-03173	2.35
LM317U	+adj	27-03172	2.15
L200	+adj	27-02006	1.95
uA723	+adj	27-07230	0.65

ALL PRICES SHOWN FOR 1 OFF QUANTITY DISCOUNTS IN THE COMPLETE CATALOGUE

Autumn/Winter '83 supplement. All prices subject to VAT & P&P (60p per order) correct at time of going to press

The concise Ambit Component Listings!

CMOS/74LS TTL

STOP PRESS: Please call for current CMOS price and availability due to world shortages etc.

400 SERIES CMOS

Device	Stock No.
4000UB	22-04000
4001	23-04001
4002	23-04002
4007	23-04007
4008	23-04008
4009UB	22-04009
4011	23-04011
4011UB	22-04011
4012	23-04012
4013	23-04013
4015	23-04015
4016	23-04016
4017	23-04017
4020	23-04020
4021	23-04021
4022	23-04022
4023	23-04023
4024	23-04024
4025	23-04025
4027	23-04027
4028	23-04028
4029	23-04029
4035	23-04035
4040	23-04040
4042	23-04042
4043	23-04043
4044	23-04044
4046	23-04046
4049UB	23-04049
4050	23-04050
4051	23-04051
4052	23-04052
4053	23-04053
4060	23-04060
4066	23-04066
4068	23-04068
4069UB	23-04069
4070	23-04070
4071	23-04071
4072	23-04072
4073	23-04073
4075	23-04075
4076	23-04076
4077	23-04077
4078	23-04078
4081	23-04081
4082	23-04082
4093	23-04093
4099	23-04099
4175	23-04175
4502	23-04502
4503	23-04503
4506	23-04506
4507	23-04507
4508	23-04508
4510	23-04510
4511	23-04511
4512	23-04512
4514	23-04514
4515	23-04515
4516	23-04516
4518	23-04518
4520	23-04520
4521	23-04521
4522	23-04522
4526	23-04526
4527	23-04527
4528	23-04528
4529	23-04529
4531	23-04531
4532	23-04532
4534	23-04534
4536	23-04536
4538	23-04538
4539	23-04539
4543	23-04543
4549	23-04549
4553	23-04553
4554	23-04554
4555	23-04555
4556	23-04556
4557	23-04557
4558	23-04558
4559	23-04559
4560	23-04560
4561	23-04561
4562	23-04562
4566	23-04566
4568	23-04568
4569	23-04569
4572UB	23-04572
4580	23-04580
4581	23-04581
4582	23-04582
4583	23-04583
4584	23-04584
4585	23-04585
4702	23-04702
4703	23-04703
4704	23-04704
4705	23-04705
4706	23-04706
4720	23-04720
4723	23-04723
4724	23-04724
4725	23-04725
40014	23-40014
40085	23-40085
40098	23-40098
40106	23-40106
40160	23-40160
40161	23-40161
40162	23-40162
40174	23-40174
40192	23-40192
40193	23-40193
40195	23-40195

74LS SERIES TTL

74LS00	31-07400	0.12
74LS01	31-07401	0.12
74LS02	31-07402	0.12
74LS03	31-07403	0.12
74LS04	31-07404	0.15
74LS05	31-07405	0.15
74LS08	31-07408	0.15
74LS09	31-07409	0.15
74LS10	31-07410	0.15
74LS11	31-07411	0.15
74LS12	31-07412	0.15
74LS13	31-07413	0.35
74LS14	31-07414	0.35
74LS15	31-07415	0.15
74LS20	31-07420	0.15
74LS21	31-07421	0.15
74LS22	31-07422	0.15
74LS26	31-07426	0.15
74LS27	31-07427	0.15
74LS28	31-07428	0.20
74LS30	31-07430	0.15
74LS32	31-07432	0.15
74LS33	31-07433	0.15
74LS37	31-07437	0.20
74LS38	31-07438	0.15
74LS40	31-07440	0.20
74LS42	31-07477	0.33
74LS47	31-07447	0.72
74LS48	31-07448	0.44
74LS49	31-07449	0.88
74LS51	31-07451	0.15
74LS54	31-07454	0.15
74LS55	31-07455	0.15
74LS74	31-07474	0.23
74LS75	31-07475	0.23
74LS76	31-07476	0.23
74LS78	31-07478	0.21
74LS83	31-07483	0.36
74LS85	31-07485	0.48
74LS86	31-07486	0.16
74LS90	31-07490	0.26
74LS91	31-07491	0.40
74LS92	31-07492	0.35
74LS93	31-07493	0.26
74LS95	31-07495	0.40
74LS107	31-74107	0.34
74LS109	31-74109	0.27
74LS112	31-74112	0.23
74LS113	31-74113	0.23
74LS114	31-74114	0.23
74LS115	31-74122	0.30
74LS123	31-74123	0.40
74LS125	31-74125	0.30
74LS126	31-74126	0.30
74LS132	31-74132	0.30
74LS133	31-74133	0.26
74LS136	31-74136	0.22
74LS138	31-74138	0.33
74LS139	31-74139	0.33
74LS151	31-74151	0.33
74LS153	31-74153	0.37
74LS155	31-74155	0.33
74LS156	31-74156	0.36
74LS157	31-74157	0.30
74LS158	31-74158	0.30
74LS160	31-74160	0.37
74LS161	31-74161	0.40
74LS162	31-74162	0.40
74LS163	31-74163	0.40
74LS164	31-74164	0.44
74LS165	31-74165	0.66
74LS166	31-64166	0.64
74LS170	31-74170	0.69
74LS173	31-74173	0.53
74LS174	31-74174	0.41
74LS175	31-74175	0.44
74LS181	31-74181	0.96
74LS190	31-74190	0.43
74LS191	31-74191	0.43
74LS192	31-74192	0.43
74LS193	31-74193	0.43
74LS194	31-74194	0.43
74LS195	31-74195	0.43
74LS196	31-74196	0.43
74LS197	31-74197	0.53
74LS221	31-74221	0.55
74LS240	31-74240	0.66
74LS241	31-74241	0.66
74LS242	31-74242	0.60
74LS243	31-74243	0.60
74LS244	31-74244	0.66
74LS245	31-74245	1.10
74LS251	31-74251	0.40
74LS253	31-74253	0.40
74LS257	31-74257	0.40
74LS258	31-74258	0.40
74LS259	31-74259	0.56
74LS260	31-74260	0.29
74LS266	31-74266	0.22
74LS273	31-74273	0.77
74LS279	31-74279	0.38
74LS283	31-74283	0.44
74LS298	31-74298	0.59
74LS365	31-74365	0.37
74LS366	31-74366	0.44
74LS367	31-74367	0.33
74LS367	31-74367	0.33
73LS368	31-74368	0.33
74LS373	31-74373	0.79
74LS374	31-74374	0.79
74LS375	31-74375	0.34
74LS377	31-74377	0.66
74LS378	31-74378	0.48
74LS379	31-74379	0.48
74LS386	31-74386	0.30
74LS390	31-74390	0.56
74LS393	31-74393	0.53
74LS399	31-74399	0.71
74LS490	31-74490	0.66
74LS670	31-74670	1.25

FIXED RESISTORS: All E12 values sold in packs of 10 per value only

⅛W 5%	30p/10 pack
¼W 5%	15p/10 pack
¼W 1%	35p/10 pack

Order by value & type

VARIABLE CARBON TYPES

Supplied with PC/wire on tags. Round shafts 6mm dia. with 7mm bush. M8 × 0.75 washer and fixing nut supplied.

VM10R Style (K16110)

Value	Stock No.	1-24	25-99	100+
500R Lin	48-50113	0.33	0.30	0.27
1k Lin	48-10213	0.33	0.30	0.27
5k	48-50213	0.33	0.30	0.27
10k Lin	48-10313	0.33	0.30	0.27
20k Lin	48-20313	0.33	0.30	0.27
50k Lin	48-50313	0.33	0.30	0.27
100k Lin	48-10413	0.33	0.30	0.27
500k Lin	48-50413	0.33	0.30	0.27
1M Lin	48-10513	0.33	0.30	0.27
5k Log	48-50214	0.33	0.30	0.27
10k Log	48-10314	0.33	0.30	0.27
50k Log	48-50314	0.33	0.30	0.27
100k Log	48-10414	0.33	0.30	0.27
500k Log	48-50414	0.33	0.30	0.27
1M Log	48-10514	0.33	0.30	0.27

VM11R Style (K15111-5M1222)

Single gang with DPDT rotary switch. Switch rating 1A/16VDC.

Value	Stock No.	1-24	25-99	100+
5k Lin	48-50217	0.67	0.55	0.50
10k Lin	48-10317	0.67	0.55	0.50
25k Lin	48-25317	0.67	0.55	0.50
5k Log	48-50218	0.67	0.55	0.50
10k Log	48-10318	0.67	0.55	0.50
25k Log	48-25318	0.67	0.55	0.50
50k Log	48-50318	0.67	0.55	0.50
100k Log	48-10418	0.67	0.55	0.50

GM70R Style (K162BO)

Value	Stock No.	1-24	25-99	100+
5k Lin	48-50215	0.60	0.54	0.49
10k Lin	48-10315	0.60	0.54	0.49
25k Lin	48-25315	0.60	0.54	0.49
100k Lin	48-10415	0.60	0.54	0.49
250k Lin	48-25415	0.60	0.54	0.49
1M Lin	48-10515	0.60	0.54	0.49
1k Log	48-10216	0.60	0.54	0.49
5k Log	48-50216	0.60	0.54	0.49
10k Log	48-10316	0.60	0.54	0.49
25k Log	48-25316	0.60	0.54	0.49
50k Log	48-50316	0.60	0.54	0.49
100k Log	48-10416	0.60	0.54	0.49
250k Log	48-25416	0.60	0.54	0.49
1M Log	48-10516	0.60	0.54	0.49

VM13R Style (K161C3—5M3121)

Single gang, pull push DPST switch. Switch rating 3A/30VDC.

Value	Stock No.	1-24	25-99	100+
5k Lin	48-50219	0.94	0.83	0.75
10k Lin	48-10319	0.94	0.83	0.75
25k Lin	48-25319	0.94	0.83	0.75
100k Lin	48-10419	0.94	0.83	0.75
55k Log	48-50220	0.94	0.83	0.75
10k Log	48-10320	0.94	0.83	0.75
25k Log	48-25320	0.94	0.83	0.75
50k Log	48-50320	0.94	0.83	0.75
100k Log	48-10420	0.94	0.83	0.75

GM80ER Style (K162BO)

Dual gang 41 detents primarily for volume controls.

Value	Stock No.	1-24	25-99	100+
10k Log	48-10322	0.68	0.62	0.56
100k Lin	48-10421	0.68	0.62	0.56

GM70ER Style (K162AO)

Dual gang with click, for tone and balance controls.

Value	Stock No.	1-24	25.99	100+
50k Lin	48-50323	0.65	0.59	0.53
100k Lin	48-10424	0.65	0.59	0.53
100k Balance	48-10425	0.65	0.59	0.53

AB47

Miniature preset 100k diode low, 22 turn.

Knob	Stock No.	1-24	25-99	100+
20mm	48-10405	0.50	0.40	0.30
20mm thumb	48-10407	0.50	0.40	0.30

3W Rated Ten Turn Pot — 534

A high quality ten turn 3W potentiometer, rated at 3W/40°C. Tolerance 5% 0.25" diameter shaft.

Value	Stock No.	1-24	25+
10k	48-10310	4.45	4.05

Low Cost Carbon Track Multiturn — MB20

A low cost alternative multiturn pot. Based on a 300° pot with a 5:1 epicyclic reduction drive built into the shaft. Tolerance 20%. Rated at 0.33W at 50"C.

Value	Stock No.	1-24	25+
20k	48-22326	1.06	0.96

Additional Data:
Mounting hole required for VM, GM series 7mm, for MB, 534 series 10mm. All ports are supplied C/W one washer and fixing spindle size VM, GM 23mm log × 6mm dia.

CAPACITORS

ULTRA MINIATURE ELECTROLYTICS

Value	Voltage	Stock No.	Price Pk of 4
1uF	50V	05-10514	0.32
2u2	50V	05-22514	0.32
4u7	35V	05-47514	0.32
10u	16V	05-10613	0.32
10u	35V	05-10614	0.32
22u	6.3V	05-22612	0.32
22u	16V	05-22613	0.36
22u	35V	05-22614	0.40
47u	10V	05-47612	0.40
47u	16V	05-47613	0.40
100u	6.3V	05-10712	0.40
100u	16V	05-10713	0.48
220u	6.3V	05-22712	0.48

ULTRA LOW LEAKAGE ELECTROLYTICS

Value	Voltage	Stock No.	Pk of 5
0.1uF	50V	05-10210	0.40
0.22uF	50V	05-10404	0.40
0.47uF	50V	05-47404	0.40
1uF	50V	05-10504	0.40
2u2	50V	05-22504	0.40
4u7	50V	05-47504	0.48
10uF	25V	05-10604	0.40
22uF	25V	05-22604	0.48
33uF	16V	05-33604	0.48
47uF	10V	05-47603	0.48
47uF	16V	05-47604	0.56
100uF	10V	05-10703	0.64

SUB MINIATURE CERAMIC PLATE

Working voltage 63V

Value	Stock No.	Pk of 10
2.2pF	04-22901	0.40
2.7pF	04-27901	0.40
3.3pF	04-33901	0.40
3.9pF	04-39901	0.40
4.7pF	04-47901	0.40
5.6pF	04-56901	0.40
6.8pF	04-68901	0.40
8.2pF	04-82901	0.40
10pF	04-10001	0.40
12pF	04-12001	0.40
15pF	04-15001	0.40
18pF	04-18001	0.40
22pF	04-22001	0.40
27pF	04-27001	0.40
33pF	04-33001	0.40
39pF	04-39001	0.40
47pF	04-47001	0.40
56pF	04-56001	0.40
68pF	04-68001	0.40
82pF	04-82001	0.50
100pF	04-10101	0.50
120pF	04-12101	0.50
150pF	04-15101	0.50
180pF	04-18101	0.50
220pF	04-22101	0.50
270pF	04-27101	0.50
330pF	04-33101	0.50

MEDIUM K CERAMIC PLATE

Working voltage 63V

Value	Stock No.	Price Pk of 10
390pF	04-39102	0.50
470pF	04-47102	0.50
560pF	04-56102	0.50
680pF	04-68102	0.50
820pF	04-82102	0.50
1000pF	04-10202	0.50
1200pF	04-12202	0.50
1500pF	04-15202	0.50
1800pF	04-18202	0.50
2200pF	04-22002	0.50
2700pF	04-27202	0.50
3300pF	04-33202	0.50
4700pF	04-47202	0.50

MONOLITHIC CAPACITORS

Value	Stock No.	Price Pk of 3
1n	04-10204	0.39
4n7	04-47204	0.42
10n	04-10304	0.42
47n	04-47304	0.45
100n	04-10404	0.45

LOW VOLTAGE DISC CERAMIC

Value	Stock No.	Pk of 5
1n	04-10203	0.20
10n	04-10303	0.20
22n	04-22303	0.25
47n	04-47303	0.25
100n	04-10403	0.40

LOW VOLTAGE DISC CERAMIC

Value	Stock No.	Price
1nF	04-10212	0.10
10nF	04-10312	0.22

CERAMIC FEEDTHROUGH CAPACITORS

Value	Stock No.	Pk of 5
1000pF	04-10210	0.35

LEADLESS CERAMIC CAPACITORS

Working voltage 50V

Value	Stock No.	Pk of 5
18pF	04-18011	0.40
22pF	04-22011	0.40
180pF	04-18111	0.40
470pF	04-47011	0.45
1nF	04-10211	0.45

MYLAR

Working voltage 100V

Value	Stock No.	Price Pk of 5
1n	04-10206	0.25
2n2	04-22206	0.25
3n3	04-33206	0.25
4n7	04-47206	0.25
6n8	04-68206	0.25
10n	04-10306	0.25
22n	04-22306	0.30
33n	04-33306	0.30
47n	04-47306	0.30
68n	04-68306	0.30
100n	04-10406	0.40
220n	04-22406	0.55
330n	04-33406	0.60
470n	04-47406	0.70

SILVER MICA CAPACITORS

Working voltage 350V

Value	Stock No.	Price Price
2.2pF	04-22908	0.22
4.7pF	04-47908	0.22
10pF	04-10008	0.22
22pF	04-22008	0.22
33pF	04-33008	0.22
47pF	04-47008	0.22
56pF	04-56008	0.22
68pF	04-68008	0.22
100pF	04-10108	0.22
120pF	04-12108	0.22
150pF	04-15108	0.22
220pF	04-22108	0.24
330pF	04-33108	0.36

SEMCO

Working voltage 350V

Value	Stock No.	Price
10pF	04-10014	1.05
22pF	04-22014	1.05
47pF	04-47014	1.05
100pF	04-10114	1.05
220pF	04-22114	1.05
470pF	04-47114	1.05
1000pF	04-10214	1.05

CERAMIC TRIMMER CAPACITORS

5mm Diameter Types

Value	Colour	Stock No.	Pk of 3
1.8-6pF	Red	06-60903	0.42
2.8-12.5pF	None	06-12003	0.42
3.5-20pF	Blue	06-20003	0.42
5-30pF	Yellow	06-30003	0.42
9-50pF	Green	06-50003	0.42

10mm Diameter Types

Value	Stock No.	Pk of 3
5-30pF	06-30005	0.45
8-50pF	06-50005	0.45
16-100pF	06-10005	0.45

ULTRA MINIATURE CERAMIC TRIMMERS

CTZ31 — 3.7mm

Value	Colour	Stock No.	Pk of 3
3-10pF	Brown	06-10007	0.45
4.5-20pF	Red	06-20007	0.45
6.3-30pF	Orange	06-30007	0.45

CTZ51

Value	Colour	Stock No.	Price Pk of 3
2.5-6pF	Blue	06-06008	0.45
3-10pF	Brown	06-10008	0.45
4.5-20pF	Red	06-20008	0.45
5.5-30pF	Orange	06-30008	0.45
7.5-50pF	Green	06-50008	0.45
9-70pF	Purple	06-70008	0.45

TRIMMERS FOIL

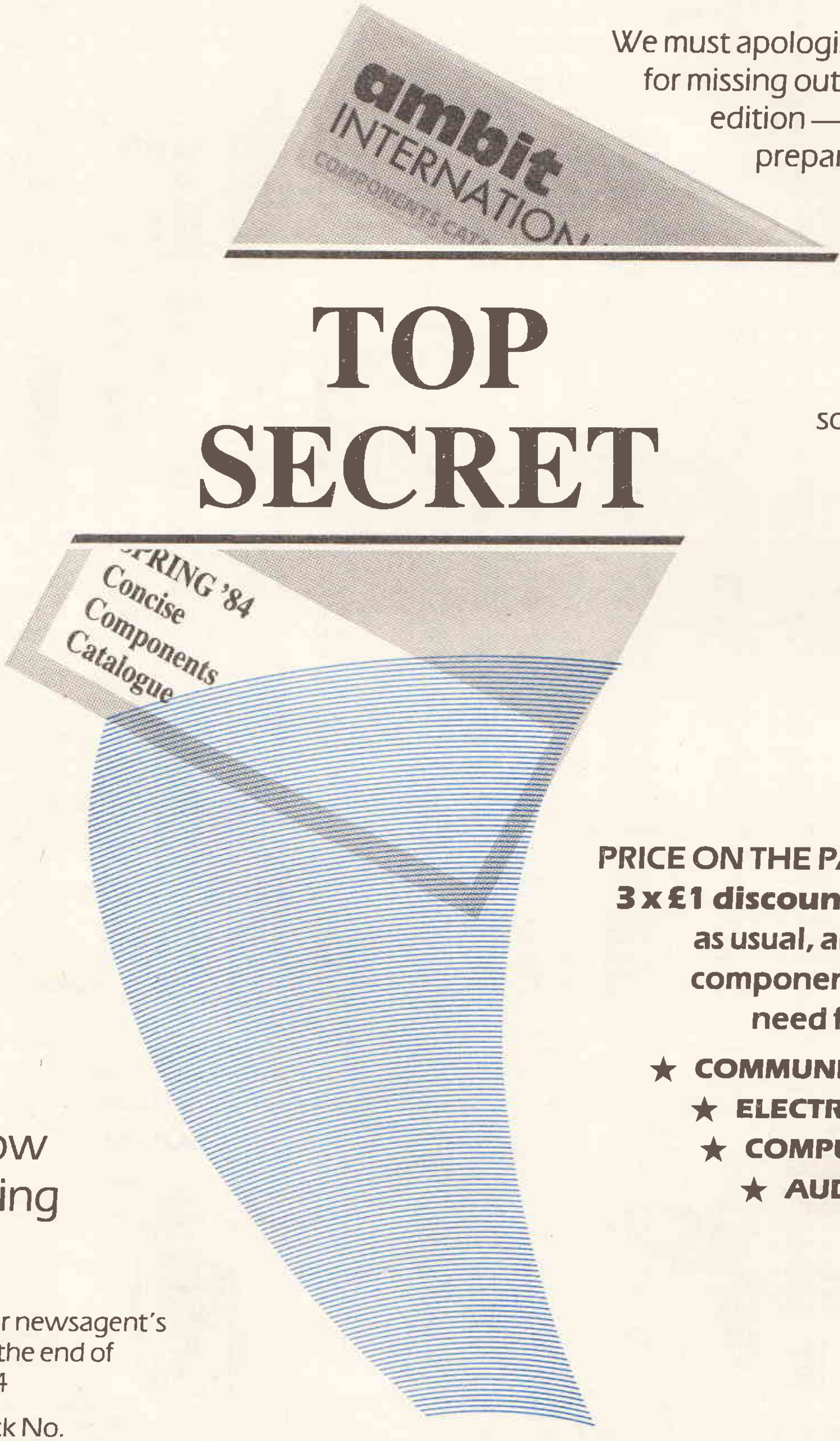
Capacity	Min. Dia	Stock No.	Price Pk of 3
1.5-10pF	7.5	06-10001	0.57
2-22pF	7.5	06-22001	0.57
3-36pF	7.5	06-36001	0.66
5-60pF	10	06-60001	0.66
3-90pF	10	06-80001	0.99

COMPRESSION TRIMMERS

Cap range	Colour	Stock No.	Price
10-80pF	Red	06-08006	0.28
30-140pF	Blue	06-14006	0.28
60-180pF	Yellow	06-18006	0.28

MOST PRICES SHOWN FOR UNIT ITEM OR PACK QTY — SEE CAT FOR VOLUME DISCOUNTS

GET READY FOR THE SPRING EDITION



We must apologise to our readers for missing out with our Winter edition — but we've been preparing something a little special to tempt you out of your Winter hibernation and back to the soldering iron........

PRICE ON THE PAGE as usual, 3 x £1 discount vouchers as usual, and the components you need for

- ★ **COMMUNICATIONS**
- ★ **ELECTRONICS**
- ★ **COMPUTING**
- ★ **AUDIO**

Book now by sending **80p**

or watch your newsagent's shelf around the end of January 1984

Order as Stock No.

02-00009

The complete range of Swiss precision knobs. The Ambit stock range are for 0.25″ shafts (will also fit 6mm)

RITEL

FULL MANUFACTURERS CATALOGUE 50p
Stock No: 02-21300

STOCK TYPES ARE MATT BLACK FINISH: COLLET AND PUSH FIT TYPES

	10mm		15mm		21mm		28mm		36mm	
	 NB 4mm shaft				 Standard  Short		 Standard  Short		 Standard  Short	
COLLET STANDARD	**Stock No**	**Price**	**Stock No.**	**Price**	**Stock No.**	**Price**	**Stock No.**	**Price**	**Stock No.**	**Price**
Plain	21-30000	**0.30**	21-30091	**0.34**	21-30781	**0.42**	21-30280	**0.49**	21-30381	**0.51**
With line	21-30001	**0.35**	21-30092	**0.40**	21-30184	**0.47**	21-30281	**0.56**	21-30382	**0.65**
Wing + line	21-30003	**0.35**	21-30094	**0.41**	21-30187	**0.49**	21-30283	**0.59**	21-30384	**0.69**
COLLET SHORT										
Plain					21-30190	**0.43**	21-30300	**0.50**	21-30390	**0.60**
With line					21-30194	**0.48**				
STANDARD PUSH FIT										
Plain			21-30100	**0.15**	21-30200	**0.20**	21-30310	**0.30**		
With line			21-30102	**0.20**						
Nut covers	21-30060	**0.06**	21-30160	**0.06**						
plus pointer	21-30102	**0.20**								
CAPS SEE BELOW FOR COLOURS										
Plain	21-300XX	**0.05**	21-301XX	**0.05**	21-302XX	**0.05**	21-303XX	**0.06**	21-304XX	**0.08**
With line	21-300XX	**0.08**	21-301XX	**0.08**	21-302XX	**0.09**	21-303XX	**0.11**	21-304XX	**0.12**
Prismatic	21-300XX	**0.05**	21-301XX	**0.05**	21-302XX	**0.05**	21-303XX	**0.06**	21-304XX	**0.08**
Intermediate (Black only)					21-30260	**0.08**	21-30370	**0.08**	21-30450	**0.10**
ACCESSORIES										
Collet Box Spanner	21-30500	**£2.30**								

CAPS

NUT COVERS

'PRISMATIC CAP'

PUSH FIT CAPS

Colours:	**Grey**	**Black**	**Red**	**Blue**	**Yellow**	**Green**	
Plain	21-XXX12	XXX13	XXX14	XXX15	XXX16	XXX17	Plain
with line	21-XXX22	XXX23	XXX24	XXX25	XXX26	XXX27	with line
Prismatic	21-XXX32	XXX33	XXX34	XXX35	XXX36	XXX37	Prismatic

e.g. 10mm plain cap, blue = 21-30015
28mm line cap, red = 21-30324

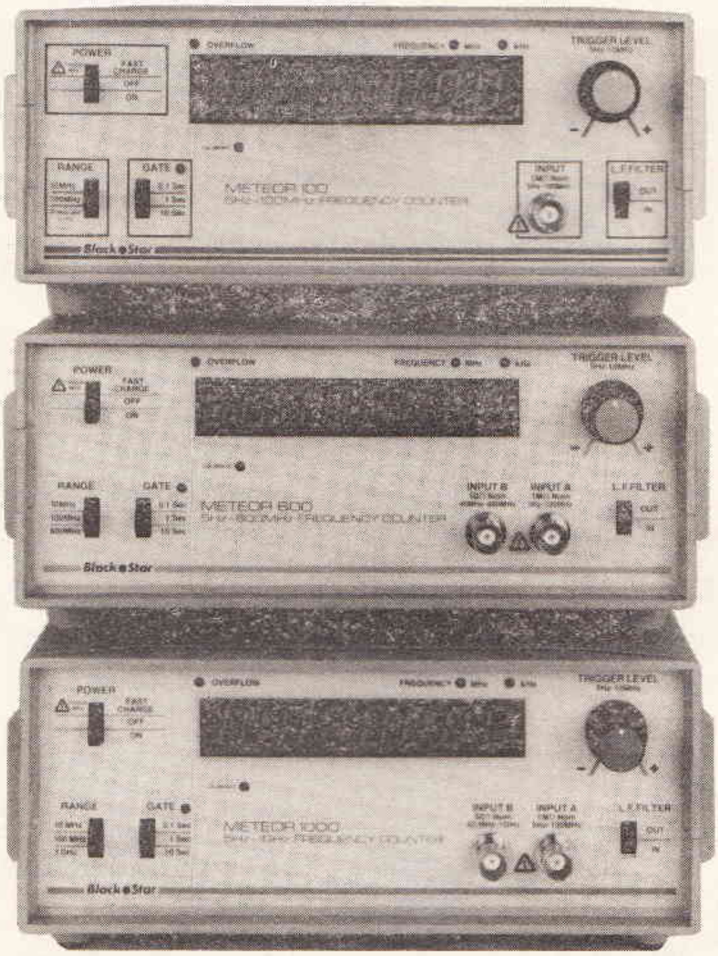
SHAFT LOCKING PLATES

¼″ Shaft Clamp	21-30504	**0.06**
6mm Shaft Clamp	21-30503	**0.06**

THE BIGGEST RANGE, THE BEST QUALITY, THE LOWEST PRICES!

FROM AMBIT'S INSTRUMENTATION DIVISION:

New Frequency Counters that set the standards for price & performance



100MHz
£89.00 ex
56-00100

600MHz
£115.00 ex
56-00600

1000MHz
£159.00 ex
56-01000

- ★ Designed and made in England
- ★ Portable operation
- ★ Switchable Low pass filter
- ★ Input sensitivity
  Low Frequency:
  <5mV 5Hz-10MHz
  <10mV 10-50MHz
  <25mV 50-100MHz
  High Frequency:
  <25mV 40-600MHz
  <50mV up to 1GHz
- ★ Input Impedance
  Low Frequency up to 100MHz: 1MΩ
  High Frequency: 50Ω
- ★ 340mA fast recharge
- ★ 8 digit 0.5" LED display
- ★ Timebase set to ±0.5ppm

★ BATTERY OR MAINS OPERATION
— MAINS PSU CHARGER **INCLUDED** IN THE PRICE

ACCESSORIES: TELESCOPIC ANTENNA WITH BNC CONNECTOR	56-21717	£6.50 ex
6 off NICAD C-CELLS (2.2Ah)	6 off 01-12024	£14.10 ex
SERVICE MANUAL (all models)	56-00101	£5.00 ex

FOR CABLES, PROBES & CONNECTORS CHECK THE COMPLETE CATALOGUE

CRICKLEWOOD ELECTRONICS LTD.
40 CRICKLEWOOD BROADWAY LONDON NW2 3ET
1

AUDIO DESIGN

Few areas of electronics have accumulated as much superstition and hype as the design of power amplifiers — here is John Linsley Hood's attempt to cut through the muddle.

A considerable amount of mystique surrounds the whole field of audio amplifier design, particularly in regard to the part which actually delivers electrical power to the loudspeakers, and a vast amount of effort is spent in laboratories, listening rooms and editorial offices in sorting the good from the not-so-good. How much of this mystique is justified is a speculative question, a source of pleasure for those whose efforts have been received with acclaim, and a source of indignation for those whose designs have been ignored by the cognoscenti or impugned by the pundits.

My own feelings in this matter, particularly in respect of the hi-fi devotees, are highly ambivalent. On the one hand, I am convinced that much of stock in trade of the hi-fi journals, their 'subjective' reviewers, and the manufacturers and dealers who follow in the train of their approval, is built upon the identification and exaggeration of differences which are, in reality, fairly small. On the other hand, I know that there are sound differences between differing designs, some of which are easy to live with and render their inputs to the listener in a pleasing — and sometimes exciting — light, others have the capability to make everything they handle sound rather drab and second-rate, and others may appear fine at first hearing and yet, after a day or two, make one not wish to listen further.

Some of this is simply a matter of incompatibility between the separate parts of the audio system: I still remember, very clearly, paying a visit to a hi-fi fanatic of my temporary acquaintance, who had spent many thousands of pounds in assembling a set of gear which included all the most expensive and exotic bits of hardware that had received rave reviews in the magazines. His wife would not stay in the same room with it. After listening to it for half an hour, I didn't blame her. So one of the basic requirements of an audio power amplifier must be that it should be highly tolerant of the type of LS load applied to it.

Other components of the sound quality characteristics of the power amplifier relate to quite clearly definable design aspects, which one hopes that the designer will have given due thought to. Yet other contributing factors undoubtedly reside in a grey area of technology as yet not very clearly defined, where one may more surely say that this or that is a good thing to do — because one knows from experience that this is the case — but one cannot be so certain that something else, as yet untried, will be equally good, or give sound engineering reasons for this belief.

So — this is the scene; now to the engineering.

Output Power

Because of the nature of the sensitivity of the human ear, and of the physical principles of acoustics on which hearing is based, doubling the amount of electrical power fed to a loudspeaker does not make the resultant sound appear twice as loud. In reality, this is a logarithmic relationship, in which apparent increases in sound loudness are related to power by the equation $W = k.\log_{10} P2/P1$. While precision in this field is difficult because of the subjective nature of the thing being measured, and because apparent loudness is related to frequency anyway, one can say, roughly, that 3W, 30W and 300W are increments in amplifier power which would correspond to doublings in sound loudness at maximum volume. One can see from this that some very big steps in amplifier power are needed to get significant gains in sound level. The converse is also true, that microscopic amounts of sound power, like the buzzing of a fly's wings, or the LS output from the noise voltage of a well designed low-noise amplifier, are still quite audible!

As we have seen earlier, power output is related to output (RMS) voltage and load impedance by the equation $P = V^2/R$ or $P = I^2R$ in the case of output current. If an output of 100W is required into an LS load of a nominal 8 ohm impedance, an RMS output voltage swing of $\sqrt{800}$ (28.28 V) is required. This corresponds to a peak-to-peak voltage swing of 80 V. Allowing for voltage drops in the various output stage components a potential between +ve and −ve HT lines of 120 V is probably needed. Now, let us suppose that the LS impedance drops to 2 ohms at 15 kHz. 100 W will then correspond to a peak current of $\sqrt{50} \times \sqrt{2}$ amps, or 10 A. (Fortunately we don't have to cater for a peak-to-peak current!) So, our amplifier, to meet this spec. with this load, would need to be able to deliver 28.82 V RMS and 10 A peak current, but not simultaneously, normally. Powerful amplifiers need big, and expensive, power supplies. They also need transistors and capacitors which are capable of withstanding these high working voltages. Apart from this, and the bigger heat sinks, they are not much different in design from their smaller brothers.

Power Bandwidth

The audio spectrum is assumed to lie between 20 Hz and 20 kHz. With average listening rooms, average good quality LS systems, average listeners, and averagely good quality programme material, 45 Hz — 15 kHz is a more realistic assessment. Happily, there isn't much programme energy in the part of the audio spectrum above 10 kHz, or we wouldn't stay around very long to listen to it, so — being realistic — we don't need to cater for maximum power output in this region unless the equipment is going to be reviewed. There is also not much VLF output from either progamme material or LS units. Unfortunately, in this case, if the amplifier cannot operate well below 30-40 Hz it will sound 'thin', and will probably overload on spurious signal inputs (record rumble and the like) which is disastrous sonically.

Some of the more acute listeners can undoubtedly hear the difference when HF response is curtailed, even though this is above their ear's frequency response — because of the absence of beat-note effects due to the interaction of high frequency sounds within the nonlinearities of their own ears. A better HF response may not make things sound better, but it can make them sound different.

This is where the first of the needs to compromise occurs. With typical power junction transistors, which are fairly sluggish devices, increased HF power bandwidth can only be obtained at the expense of loop stability in a negative feedback amplifier (though feed-forward systems avoid this snag). If loop stability is poor, the amplifier transient response is bad, and this can introduce some pretty drastic distortions into pulse type signals, such as drum beats or cymbal clashes. An amplifier with a good loop stability is usually much more pleasant to listen to, and will certainly be less fussy about the LS load characteristics.

Negative Feedback And Loop Stability

Negative feedback — the instantaneous electronic comparison between the signal at the output of an amplifier, and the signal at its input, and the generation of a corrective adjustment to the effective input signal to make sure that these input and output signals are closely identical — remains the major tool in the hands of the circuit designer. However, there are snags!

We have seen earlier in this series that we need to use enough NFB. Too little may just make matters worse, by substituting less pleasant forms of distortion for the ones we have reduced. We also need to make sure that our use of NFB does not make the whole system unstable, and this is particularly the case for audio power amplifiers which have to drive LS loads, since these are notoriously complex in their impedance and delayed response characteristics. It is also essential to remember that a feedback path is just what it's name suggests, a means by which signal components, both wanted and unwanted, can be fed back from the LS load to the input of the amplifier. Since LS units can and do generate electrical signals of their own (as a result of internal cabinet echoes, and as a consequence of inadequately damped reflections along the LS diaphragm) we need to watch this point.

With regard to loop stability, this field was investigated by Bode and Nyquist very many years ago, in respect of the parallel field of closed-loop servo-mechanisms. Personally, I find the Bode diagram, of Fig. 1, the easiest to follow and to explain. In this diagram, the gain and phase-shift of the amplifier is shown simultaneously as a function of frequency. If the amplifier has a gain of 1 (or more) at a frequency where the feedback is in phase with the input (an NFB phase shift of 180°) it will oscillate. The reason for this is simple, it is that the feedback path is itself providing an input signal of the right size and phase to generate the actual output, without the need for any other input signal at all! If the gain is more than unity at this frequency, the signal output will continue to increase until some other effect, such as clipping, reduces the gain to unity.

Unfortunately, it isn't sufficient merely to ensure that the amplifier doesn't oscillate on load, there must be an adequate margin of gain, or phase, at the −180°, or unity gain, points to make sure that the amplifier isn't triggered into some form of misbehaviour during transients in the input signal, or during temporary overload. In particular, the 'settling time', the time which is required following a sudden input voltage excursion before the system settles at the new level, depends solely on the system speed and stability margin, as shown in Fig. 2. I would very much like reviewers of audio amps. to measure, and quote, this value for a square-wave, or step input, with a real live LS load, since this is one of the areas where the pursuit of low THD values, at the top end of the audio spectrum, can lead to circuit design characteristics which are bad for the transient handling qualities of the amplifier, and may make it very fussy about the LS units with which it is used. As a comment on this, it does seem pointless to try to reduce 0.1% THD at 20 kHz, which is inaudible, and swamped by the distortions on the input signal, (if there is any, at this frequency) to 0.01% THD, which is just as inaudible, if the price one has to pay is a very bad transient response, and some 20-50% distortion on transient signals — which is very clearly audible!

By and large, in a typical audio amplifier, the major factor which dominates the gain and HF phase-shift characteristics is the relative sluggishness of the output transistors. The faster the response of these, the easier it is to design a good, stable, amp. The snag is that fast output junction transistors are also more fragile, and need more restrictive protection circuitry to prevent them from damage in use. This in turn makes the amp. less good at driving low impedance LS loads, and so on . . . Valves, of course, would be faster, were it not that a very sluggish and awkward output transformer is then needed. The answer, and a virtually complete one too, is to use power MOSFETs. Some of the recent ones of this type have a virtually instantaneous response, and are more linear in their characteristics than either valves or junction transistors. They too have snags, of which the

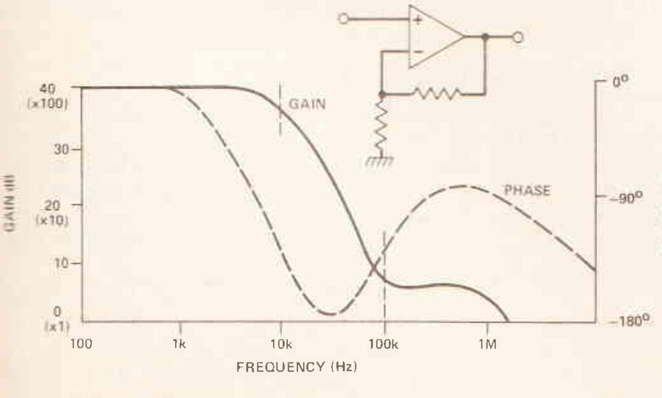


Fig. 1 Gain/phase or Bode diagram for conditionally stable feed-back amplifier (a change of load might make this amplifier oscillate at 30-50 kHz).

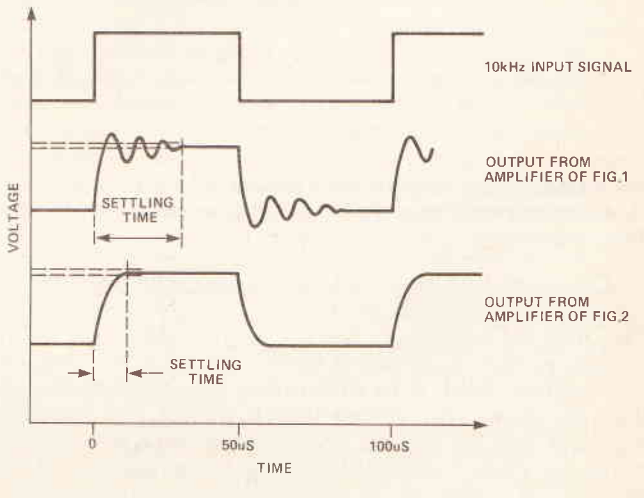


Fig. 2 Influence of gain and phase margins of NFB amplifiers and settling time.

main one is that they are fussy about the phase characteristics of their loads, but there is a simple design answer to this. So, with power MOSFETs, and some reasonably straightforward design, it is practicable to design audio power amps. which are a good ten times better, technically, than their possible forerunners.

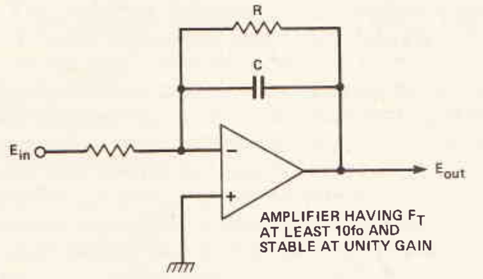


Fig. 3 Feedback amplifier having good gain and phase margins.

Distortion — And NFB

We have seen earlier that not all distortion types are equal in their unpleasing effects, and also that the character of a distortion can be greatly influenced by the relative phases of the signal components (clipping and crossover types differ mainly in the relative phase of the discontinuity, but sound very different). This effect has relevance to the behaviour of multi-driver LS systems, which can jumble up he phases of the signal (= time of arrival to the ear) and thereby alter the nature of amplifier nasties. So our efforts in the design exercise should be aimed at removing components of distortion which can be so transformed.

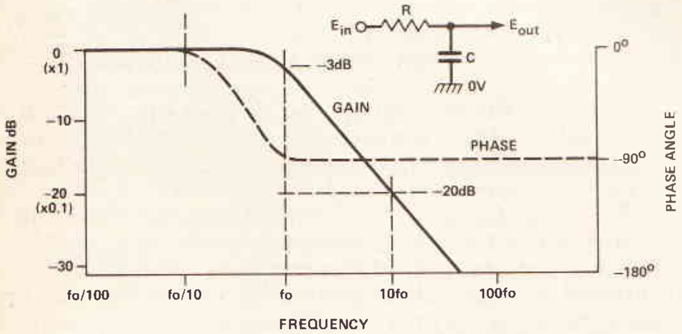


Fig. 4 Gain/phase diagram for a simple RC attenuator; the characteristics of the amplifier in Fig. 2 would be similar to this.

Obviously it is helpful if we can keep the distortion of the amplifier as low as possible before NFB is applied, in that low NFB leads to better loop stability. A useful design yardstick, cribbed from the servo-mechanism engineering field, is to determine the 'time constants' (the RC integrator values which would, for example, simulate the HF roll-off characteristics of the components or circuit elements being investigated) of the several bits of the circuit, and then make one of these — perhaps deliberately added — ten times the size of the rest. This isn't quite as arbitrary as it seems, since if we wish to end up with the fairly ideal Bode diagram for the amplifier shown in Fig. 3, we must remember that a phase shift due to an RC element begins one decade, in frequency, below the −3dB 'turn-over' point of that network, shown in Fig. 4. In this way, the system will tend to behave as though it had only a single phase-shifting component.

A further useful design approach is to try to design the system so that there are not more than two signal handling 'gain' stages within the NFB loop, using more loops if necessary. This approach isn't easily possible with power amps. so other approaches may be necessary, including the useful phase-lead generating 'step network'. However, one can always put in an internal NFB loop, operating only at HF (the place where in transistorised amplifiers trouble is likely to arise) and including only two gain stages. This is a helpful technique which leads to good-sounding amplifiers.

The aim of the designer should be to produce an amplifier in which the harmonic distortion is as low as possible, and the gain bandwidth as high as possible, before the application of any NFB, so that the NFB can be used mainly to control and stablise the gain and output impedance characteristics, rather than as a way of lowering the distortion.

So far as the feedback path itself is concerned, it is probably better not to employ a parallel HF compensation capacitor across the NFB resistor, in that this can make the amplifier sound less well on some LS units. It is also helpful in the task of making the amplifier as widely load-compatible as possible, if a small resistor, in the range 0.15-0.33 ohms, is connected in the output circuit of the amp. to act as the input limb of an attenuator, against the much lower output impedance of the amplifier itself, to assist in attenuating signals originating in the LS units themselves, and preventing these from getting back to the amplifier inputs.

A final thought, with regard to amplifier 'sound', G. King[1] some years ago pointed out that the human ear is not a very good judge of performance in respect of distortion, in that of a number of randomly chosen people, all reasonably competent judges of sound quality, either preferred the presence of some 0.3% even order harmonic distortion (deliberately added after the signal sources) or had no specific preference. Similar work has been done by other investigators. This tends to cast doubt on the value of such judgements, where the listener may actually prefer an inferior performance, because of attractive colouration added to the sound, and think the equipment is therefore better (i.e. more faithful to the original output). One cannot, unfortunately, design for this — and whatever its sonic merits, distortion will always make clear sounds somewhat more muddled.

A Practical Design Approach

Earlier in this series, I referred to the need to prevent intrusion of signals from the supply lines into the signal path, and to the ways of linearising gain stages. I have also urged the quality benefits which can be gained by the use of stabilised power supply lines, in a previous article[2], so let us now add this information together in a practical design exercise.

My preference for power MOSFETs as the output devices is definite, but not just as simple source-followers where they require an output inductor in the LS lead in order to prevent VHF oscillation due to the devices own small source lead inductance. If the power MOSFET is used in combination with a bipolar small-signal transistor, in the output stage layout shown in Fig. 6, this small inelegance can be avoided, without

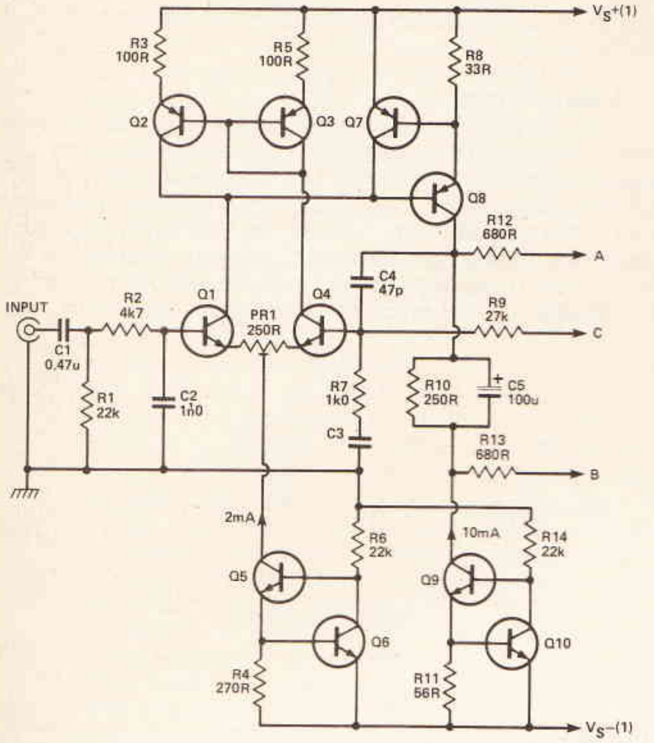


Fig. 5 Power amp. driver stage.

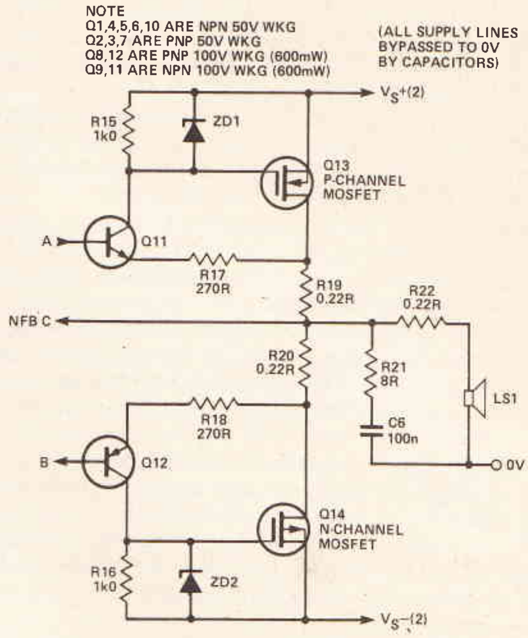


Fig. 6 MOSFET output stage.

degradation of the fast response of the Mosfet. The only necessary device protection can then be an output circuit fuse, or better still, a current limited DC power supply, since the circuit resistance of fuse-holders (and LS connectors) is finite and non-linear!

A typical small signal voltage amplifier to drive this output stage is shown in Fig. 5. Because small-signal bipolar transistors are cheap, I have been fairly lavish in my use of these, where they can confer some practical benefit in the operation of the circuit. Starting from the beginning, there is an input DC isolation capacitor C1, and a resistor R1 to define the '0V' DC level of the input. R2 and C2 are an HF roll-off circuit, to prevent very fast HF transients being applied to the power amplifier. A time constant of 4.7 μS (4k7 and 1nF) will give an HF −3dB point at 33kHz, which is adequately outside the audio band, but not so high as to be ineffective.

In order to preserve the DC symmetry of the input stage, which is a long tailed pair in the interests of low distortion, the total resistance path should be the same for Q1 and Q4 bases, which fixes R1 at 22k. Q5 and Q6 are a two-transistor constant-current source, of the kind we have already met, with the value of R4 chosen to give a collector current of 1 mA through each of the input transistors. PR1 is a preset trimmer which allows the DC output level of the power amp. to be adjusted precisely to 0V. Because the Q5, Q6 type of constant-current source has a very high dynamic resistance, it helps to prevent unwanted AC rubbish from getting into the input circuit from the −ve supply line.

I have chosen to use a simple current mirror, Q2 and Q3, as the load for the input long-tailed pair, in order to combine the signals from the two input transistors and optimise the input stage gain. From this, the signal is fed to the second stage amplifier — a medium power PNP transistor in the interests of gain linearity — again loaded by a two transistor constant-current source, to ensure high AC gain and low distortion (if the current change through Q8 were zero, the distortion due to Q8 would also be zero). In this case, the value of R11 is chosen to give a collector current of 10mA, in order to lessen the effect of the variable drive current into the output stage input transistors, and in orde to push the maximum slewing rate possible with C4 up to a high value.

R11, bypassed by C5, provides the necessary 1.2 V potential drop to bias he output stage to a 100mA quiescent current.

Under overload conditions, Q9 and 10 limit the current which can be drawn from the −ve line to 10 mA. Q7 and R8 provide a similar anti-destruction protective function in respect of Q8 and the +ve line.

R9, R7 and C3 provide the negative feedback path from the output stage to stabilise the AC gain to 27, which is a convenient value since it allows maximum output (in this case 50W) from a '0VU' (0.77 V RMS) input signal level. C4 provides HF stabilisation by means of an internal HF NFB loop just enclosing the two gain stages Q1/4 and Q8, which gives a good, well-damped, transient response, especially under the critical reactive load conditions. LS units most definitely do not behave like 8 ohm load resistances!

R12 and R13 serve the useful function of preventing temporary latch-up if the amplifier is driven into clipping; in their absence clicks and bangs are prolonged, and sound louder. Also, clipping will sound more objectionable without them.

The output stage which will join on to this amplifier, and which I have shown in Fig. 6, with component numbers appropriately labelled to follow on, is unusual in that it uses the MOSFETs in a compound emitter follower configuration, with Q11 and Q12 as the input devices. Because the LS load is then connected to the drains of the power MOSFETs, the need for the series output inductor is removed. Excess voltage across the gate-source junctions of the MOSFETs is prevented by ZD1 and ZD2, while R15/17 and R16/18 limit the AC gain of the output stage to 5.

R22 is the resistor which attenuates signals returned from the LS unit, and R21/C6 is the so-called Zobel network which prevents the output stage seeing an open-circuit at HF if the LS unit is disconnected.

I have labelled the DC supplies to the AC gain and output stages VS+(1) and VS+(2), and VS−(1) and VS−(2). This is because it is then possible, and advantageous, to operate these from two separate DC supply sources, which prevents intrusion of high powered nasties from the output stage supply lines into the sensitive earlier stage circuitry. This gives most of the advantages of a system operated from stabilised DC supplies, but at a much lower cost. Also, if one wishes, one can operate the gain stage (Fig. 5) from a stabilised source — after all, one has to supply only 12 mA per channel, which doesn't make it too dear — and then operate the output stage from really large, low equivalent series resistance, DC supply electroylitics, and gain the benefits of both, though one would then need fuse protection in the LS lines.

So, this is how one gathers together the requirements in the design of an audio amplifier. Now while this is a very good amplifier, of the best modern standards and with an excellent technical and audible performance, I am not, at this stage, going to fill in all the small details, power supplies, PCB and component layout, etc, because this amplifier is strictly conventional in its design approach, and we can do some rather more crafty tricks in this type of design, to give us just a little extra. So, regard this as a design exercise, the sort of thing which the circuit designer of some amplifier manufacturing firm will do when his boss tells him they need a new up-market design to go with the magnificent advertising promotional blurb, which the Ad. agency have already come out with. (Though, in reality, the designer will always have to do a bit of 'fine tuning' to the circuit, to make sure that it is as good as possible in all the various conflicting requirements of the system.)

I will show a final, 'improved', version of this, with a very high quality preamplifier — again, already outlined in form in a preceding part of this series — and appropriate power supplies, in a later article. Meanwhile, may I round off this part of the series with a look at some of the possible 'amplifier types'.

Class Distinctions?

Although, as I have indicated above, I have an ambivalent attitude to the razzmatazz of the hi-fi scene, as an audio circuit designer I cannot escape from contact with it, and I read with interest, surprise, concern or dismay, the comments and thoughts of my peers in this field. A large aspect of this, which has been continuously explored, and argued about, ever since transistors appeared on the scene, has been the debate valves vs. transistors, and class A vs. class-AB (or w.h.y.). Since I originally stuck my nose into this field as the author of a simple class-A design (which I valued because it was simple, rather than because it was class-A and which is as good as any amplifier I have designed or obtained from other sources since then) I cannot simply say, with my friend Reg Williamson, that class-A is the lazy man's solution, a simple 'sweeping of design problems under the carpet'.

I have, in consequence both of my original involvement and the subsequent, continuing debate, spent many hours in thought and experiment on these points, and have come slowly to conclusions which I am prepared to defend.

Valve Amps

These are not usually very good, technically. Even the best of them will not compare well, in performance, with a good transistor unit. However, they do have some useful advantages. The first of these is that they are pretty well unburstable; the second is that they overload gracefully, with a rounded-off clipping, which allows the loud-noise brigade to drive them closer to the permanent clipping level without driving the dog mad. This

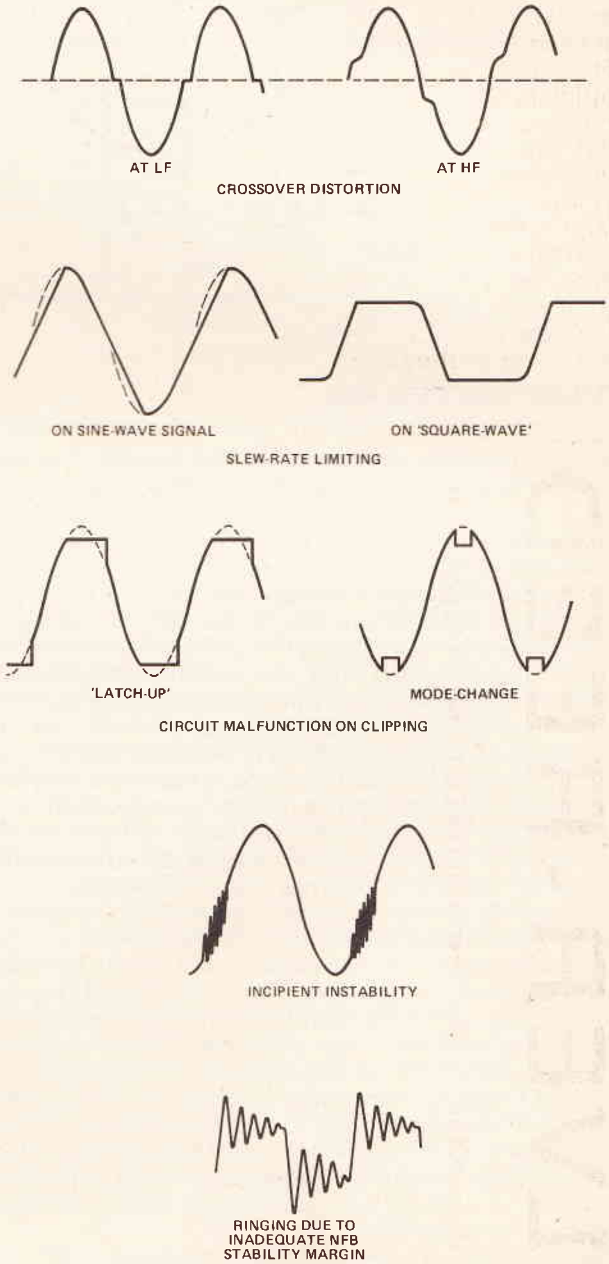


Fig. 7 Oscilloscope waveforms of some power amplifier circuit malfunctions.

allows the legitimate claim that they sound 'louder' for the same wattage. However, distorted sounds also sound louder than undistorted ones. The third advantage is that their distortion products, of which there are usually quite a lot, are of a kind to which the ear does not object too strongly. Fourthly, because they don't usually use much NFB (they can't because of the o/p transformer phase shifts) they are tolerant of LS loads. Finally, they look pretty, and make the Joneses jealous. The snags start with the price!

If one wants to, one can build 'soft clipping' into the preamp. for one hundredth of the price.

Class-A vs. Class-B

If one must use junction transistors, there is little doubt that they will work better in class-A (where the quiescent current is that which is needed for full output). They will have a better, and more uniform HF response and much lower distortion for the same amount of NFB — and hence a better transient response. Class 'A' amplifiers do, however, chuck out an awful lot of heat if any large amount of power is needed. Remember that at 20% efficiency a 100W/channel amp. would generate 1kW of heat, and need to get rid of this with the amp. at less than 100°C. If you can be content with 10W/channel, then class-A is an excellent choice.

So far as class-B (or more strictly AB) is concerned, where the amplifier operates at a quiescent current significantly lower than the operating one, cross-over distortion is inevitably present where one output device hands over to the other. Good circuit design, and the judicious use of adequate NFB, will reduce this to less than the background noise level, especially if the output devices are power MOSFETs, rather than the more sluggish junction devices whose limitations begin to show in the 10-20kHz region. I do not, honestly, think that the differences between these types are anywhere near as big as the differences between different FM channels, or between different pressings of the same LP disc.

Feed-forward techniques, as in the 'Quad' current dumping amplifier, where a small, low powered class-A amplifier is used to fill in the missing bits in a straight class-B output stage, give results which are comparable to other good design approaches using similar output devices. Variations in the feed-forward technique, which is, itself, of considerable age, have allowed the Japanese publicity agents scope for much exaggeration.

For the record, I have shown in Fig. 7, the 'scope waveforms of some typical power amplifier defects, which, one hopes, the designer will have removed before manufacture starts.

In my next part of this series I propose to look at the field to tape recoding and cassette systems, an area which has developed enormously in the past few years.

References

1. King. Gordon J., Hi-Fi News, May 1978, pp 77-79.
2. Linsley Hood. J. L., Electronics Today International, May 1983, pp 18-22.

ETI

COMPUTER WAREHOUSE

1000's OF BARGAINS FOR CALLERS

THE 'ALADDIN'S' CAVE OF COMPUTER AND ELECTRONIC EQUIPMENT

HARD DISK DRIVES

Fully refurbished **DIABLO/DRE** series 30 2.5 Mb disk drives. **DEC RK05, NOVA, TEXAS** compatible.
Front load. Free stand or rack mount **£550.00**
Exchangeable type (via lid removal) **£295.00**
me3029 PSU unit for 2 drives **£125.00**
DIABLO/DRE 44-4000A/B 5+5 ex stock from **£995.00**
1000's of spares for S30, 4000, 3200, HAWK ex stock. Plus in house repair, refurbishing service. Call for details or quotation.

HOT LINE DATA BASE

DISTEL©

THE **ORIGINAL FREE OF CHARGE** dial up data base. 1000's of stock items and one off bargains. **ON LINE NOW** – 300 baud, full duplex CCITT tones, 8 bit word, no parity.
01-679 1888

COMPUTER 'CAB'

All in one quality computer cabinet with integral switched mode PSU, Mains filtering, and twin fan cooling. Originally made for the famous **DEC PDP8** computer system costing thousands of pounds. Made to run 24 hours per day the PSU is fully screened and will deliver a massive +5v DC at 17 amps, +15v DC at 1 amp and –15v DC at 5 amps. The complete unit is fully enclosed with removable top lid, filtering, trip switch, 'Power' and 'Run' LEDs mounted on Ali front panel, rear cable entries, etc. etc. Units are in good but used condition – supplied for 240v operation complete with full circuit and tech. man. **Give your system that professional finish** for only £49.95 + Carr. Dim. 19" wide 16" deep 10.5" high. Useable area 16"w 10.5"h 11.5"d. Also available **LESS PSU**, with FANS etc. Internal dim. 19"w. 16"d. 10.5"h. **£19.95.** Carriage & insurance £9.50.

CALCOMP PLOTTERS

936 3 colour digital incremental, 37" drum, parallel interface and accessories **£2,500.00**
718 4 colour digital 8 x 5 **FEET** flat bed & controller (cost 25,000) 1 only at **£1,950.00**
Viewing by appointment.

MAINS FILTERS

Cure those unnerving hang ups and data glitches caused by mains interference.
SD5A As recommended by **ZX81** news letter, matchbox size up to 1000 watt load **£5.95**
L2127 compact completely cased unit with 3 pin fitted socket. Up to 750 watts **£9.99**

COOLING FANS

Keep your hot parts COOL and RELIABLE with our range of **BRAND NEW** professional cooling fans.
ETRI 99XUOI Dim. 92 x 92 x 25 mm. Miniature 240 v equipment fan complete with finger guard. **£9.95.**
GOULD JB-3AR Dim. 3" x 3" x 2.5" compact very quiet running 240 v operation. **NEW £6.95**
BUHLER 69.11.22. 8-16 v DC micro miniature reversible fan. Uses a brushless servo motor for extremely high air flow, almost silent running and guaranteed 10,000 hr life. Measures only 62 x 62 x 22 mm. Current cost £32.00. **OUR PRICE ONLY £12.95 complete with data.**
MUFFIN-CENTAUR standard 4" x 4" x 1.25" fan supplied tested EX EQUIPMENT 240 v at £6.25 or 110 v at £4.95 or BRAND NEW 240 v at £10.50. 1000's of other fans Ex Stock. Call for Details. Post & Packing on all fans £1.60

SCOOP!

BRAND NEW CASED WORD PROCESSOR KEYBOARDS

Made by the famous 'KEYSWITCH' corporation, for a well known computer company's top of the range word processor at a price of **over £200.00**!! Constructed around an internal **INTEL 8048** cpu this superbly styled 106 key keyboard was intended to interface with a main computer via a TTL serial interface. Standard **HALL EFFECT** long life switches are utilised on an XY matrix, buffered by 74 series TTL ic's to the eight bit CPU port enabling simple modification to your own custom decoding logic via an EPROM etc. Many other features for the most exacting user include: **numeric keypad, cursor control pad, ten clear top function keys, LED indicators, single 5v supply** on-off lock switch etc. Supplied **BRAND NEW** and boxed with circuit diagram. **ONLY £49.95 + £2.00 P&P**

DRE 7100

8" Disk Drives
New **£225** + VAT

VIDEO MONITORS

12" CASED. Made by the British KGM Co. Designed for continuous use as a data display station, unit is totally housed in an attractive brushed aluminium case with ON-OFF, BRIGHTNESS and CONTRAST controls mounted to one side. Much attention was given to construction and reliability of this unit with features such as, internal transformer isolated regulated DC supply, all components mounted on two fibre glass PCB boards – which hinge out for ease of service, many internal controls for linearity etc. The monitor accepts standard 75 ohm composite video signal via SO239 socket on rear panel. Bandwidth of the unit is estimated around 20 Mhz and will display most high def graphics and 132 x 24 lines. Units are secondhand and may have screen burns. However where burns exist they are only apparent when monitor is switched off. Although unguaranteed all monitors are tested prior to despatch. Dimensions approx. 14" high x 14" wide by 11" deep. Supplied complete with circuit. 240 volt AC operation. **ONLY £45.00 PLUS £9.50 CARR.**

24" CASED. Again made by the KGM Co with a similar spec as the 12" monitor. Originally used for large screen data display. Very compact unit in lightweight alloy case dim. 19" H x 17" D x 22" W. All silicon electronics and composite video input make an ideal unit for schools, clubs, shops etc. Supplied in a used but working condition. **ONLY £55.00 PLUS £9.50 CARR & INS.**

SAVE £250 SUPER PRINTER SCOOP

CENTRONICS 739-2

The "Do Everything Printer" at a price that will NEVER be repeated. Standard Centronics interface, full graphics, 4 type fonts with **high definition & proportional spacing for word processor applications**, 80-132 columns, single sheet, roll or sprocket paper handling plus much more. Available only from DISPLAY ELECTRONICS at a ridiculous price of only **£199.00**
Options: carriage & insurance **£10.00**
Interface Cable **£10.00**

TELETYPE ASR33 I/O TERMINALS

FROM £195 + CAR. + VAT
Fully fledged industry standard ASR33 data terminal. Many features including ASCII keyboard and printer for data I/O auto data detect circuitry. RS232 serial interface. 110 baud. 8 bit paper tape punch and reader for off line data preparation and ridiculously cheap and reliable data storage. Supplied in good condition and in working order.
Options: Floor stand **£12.50** + VAT
KSR33 with 20ma loop interface **£125.00** +
Sound proof enclosure **£25.00** + VAT

SOFTY 2

The amazing SOFTY 2. The complete "toolkit" for the open heart software surgeon. Copies, Displays, Emulates ROM, RAM and EPROMS of the 2516, 2532 variety. Many other features include keyboard, UHF modulator, Cassette interface etc. Functions exceed capabilities of units costing 7 times the price! Only **£169.00** pp £1.95 *Data sheet on request*

QUALITY INTERFACE CABLES & CONNECTORS

18/3B D25S to 10ft 18 way **£4.90**	22/2C D25S to 16ft 22 way **£6.50**
22/2A D25S to 3ft 22 way **£2.90**	22/3C D25S to D25P 15ft 22 way **£11.50**
22/3B D25S to D25P 9ft 22 way **£8.50**	1014B D15P to 12ft 15 way (BBC) **£2.90**
25/08 25 way cable 5ft long **95p**	12/15 10 way cable 12ft long **£1.00**
D25S ex equip **60p** D25S socket new **£1.25**	D25 split shells **£1.00**

DATA MODEMS

Join the communications revolution with our range of EX TELECOM data modems. Made to most stringent spec and designed to operate for 24 hrs per day. Units are made to the CCITT tone spec. With RS232 i/o levels via a 25 way 'D' skt. Units are sold in a tested and working condition with data. Permission may be required for connection to PO lines.
MODEM 2B "Hackers Special" fully fledged up to 300 baud full duplex, ANSWER or CALL modes. Data i/o via standard RS232 25 way 'D' socket. Just 2 wire connection to comms line. Ideal networks etc. Complete with data, ready to run **£85.00**
MODEM 20-1 Compact unit for use with **MICRONET, PRESTEL** or **TELECOM GOLD** etc. 2 wire direct connect. 75 baud transmit 1200 baud receive. Data i/o via RS232 'D' socket. Guaranteed working with data **£49.95**
MODEM 20-2 same as 20-1 but 75 baud receive 1200 baud transmit. **£130.00**
MODEM 20-3 Made for data rates up to 1200 baud in full duplex mode over 4 wire circuit or half duplex mode over 2 wires. **£130.00**
MODEM 13A compact, async, same size as telephone base. Up to 300 baud, full duplex over 2 wires, but call mode only **£75.00**
DATA PUMP MODEM compact unit up to 1200 baud full duplex over 4 wires or half duplex over 2 wires. BELL specification with data i/o via RS232 25 way D socket, remote test etc. 240 v operation. Supplied complete with data **£65.00** carr. £4.50.
For more information or details of other types of ex. stock modems contact sales office.

Carriage 13A £4.50. 2B/C & 20 £9.50.

SUPER DEAL? NO — SUPER STEAL!!

The FABULOUS 25CPS TEC Starwriter Daisy wheel printer at a fraction of its original cost.

BRAND NEW AT ONLY £499 + VAT

Made to the very highest spec the **TEC Starwriter** FP1500-25 features a heavy duty die cast chassis and DIABLO type print mechanism giving superb registration and print quality. Micro-processor electronics offer full DIABLO/QUME command compatability and full control via CPM Wordstar etc. Many other features include bi directional printing, switchable 10 or 12 pitch, full width 381 mm paper handling with upto 163 characters per line, friction feed rollers for single sheet or continuous paper, internal buffer, standard RS232 serial interface with handshake. Supplied absolutly **BRAND NEW** with 90 day guarantee and **FREE** daisy wheel and dust cover. Order **NOW** or contact sales office for more information. Optional extras: RS232 data cable £10.00. Tech manual £7.50. Tractor feed **£140.00**. Spare daisy wheel £3.00. Carriage & Ins. (UK Mainland) £10.00.

SEMICONDUCTOR 'GRAB BAGS'

Mixed Semis amazing value contents include transistors, digital, linear, I.C.'s triacs, diodes, bridge recs., etc. etc. All devices guaranteed brand new full spec. with manufacturer's markings, fully guaranteed, 50+ **£2.95** 100+ **£5.15.**
TTL 74 Series A gigantic purchase of an "across the board" range of 74 TTL series I.C.'s enables us to offer 100+ mixed "mostly TTL" grab bags at a price which two or three chips in the bag would nnormally cost to buy. Fully guaranteed all I.C.'s full spec. 100+ **£6.90** 200+ **£12.30** 300+ **£19.50**

DEC CORNER

MOSTEK CRT 80E Brand new dual eurocard, Z80 based VT100 PLUS emulator with graphics etc	**£499.00**
BALL-MB 3.5" Box, LTC, PSU	**£385.00**
RK05-J 2.5 Mb disk drives	**£650.00**
PDP1105 Cpu, Ram, i/o.	**£450.00**
DILOG DO100 RK05 LSI 4 x RK05 disk controller	**£450.00**
LAXX-NW LA180 RS232 serial interface and buffer option	**£230.00**
LAX34-AL LA34 tractor feed	**£85.00**
LA34 Keyboard assembly	**£75.00**
BC05W-15 interface cables	**£28.00**
H317B interface adaptor	**£295.00**

1000's of spares EX STOCK for DEC **PDP8 PDP11 PDP15** + peripherals call for details.
ALL types of Computer equipment and spares wanted for prompt **CASH PAYMENT**

66% DISCOUNT ELECTRONIC COMPONENTS EQUIPMENT

Due to our massive bulk purchasing programme which enables us to bring you the best possible bargains, we have thousands of I.C.'s, Transistors, Relays, Cap's, P.C.B.'s, Sub-assemblies, Switches, etc. etc. surplus to our requirements. Because we don't have sufficient stocks of any one item to include in our ads. we are packing all these items into the *"BARGAIN PARCEL OF A LIFETIME"*. Thousands of components at giveaway prices! Guaranteed to be worth at least *3 times* what you pay. Unbeatable value!! Sold by weight.
2.5kls **£4.25** + pp £1.25 — 5kls **£5.90** + £1.80
10kls **£10.25** + pp £2.25 — 20 kls **£17.50** + £4.75

ALL PRICES PLUS VAT

All prices quoted are for U.K Mainland, paid cash with order in Pounds Stirling PLUS VAT. Minimum order value **£2.00**, Minimum Credit Card order **£10.00**. Minimum BONA FIDE account orders from Government depts., Schools, Universities and established companies **£20.00** Where post and packing not indicated please ADD **60p + VAT** Warehouse open Mon-Fri 9.30 — 5.30. Sat. 10.15 — 5.30. We reserve the right to change prices and specifications without notice. Trade, Bulk and Export enquiries welcome.

DISPLAY -ELECTRONICS-

32 Biggin Way, Upper Norwood, London SE19 3XF
Telephone 01-679 4414 Telex 27924

TECH TIPS

Semi-Switchless Switch

Ian Sherlock
Preston

Designed to alleviate the persistent use of a wall light switch, this circuit could also be of use in households with elderly or disabled members. The circuit turns on the light when anyone enters the room (which must have a single entrance), counts the number of people entering or leaving, then turns off the light again when the room is empty.

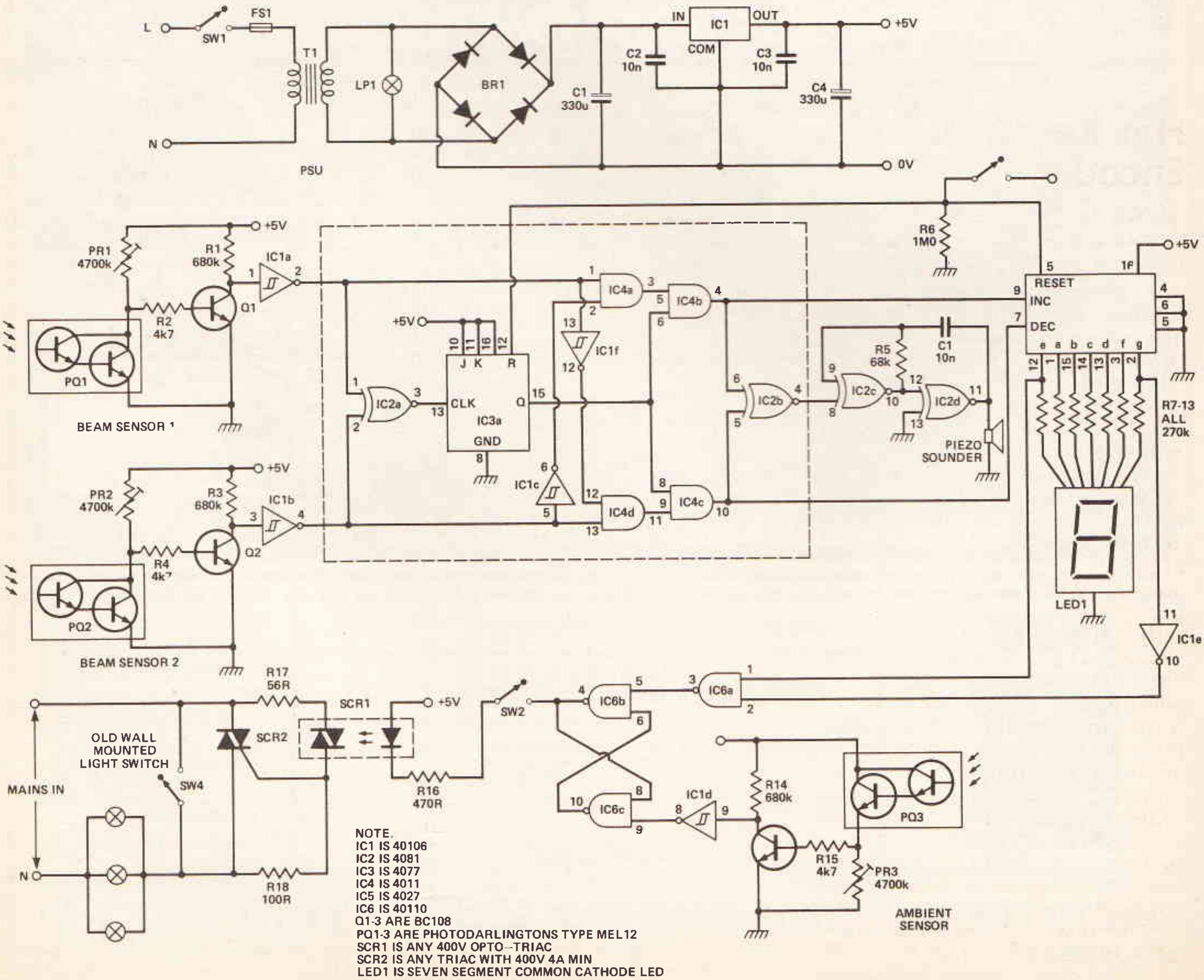
The phototransistors each give a positive-going long pulse when the light to them is blocked; they should be about 5 to 10 cm apart, so that both beams are cut for much of the period of time it takes someone to enter. These pulses are amplified by Q1 and 2 and IC1a and b.

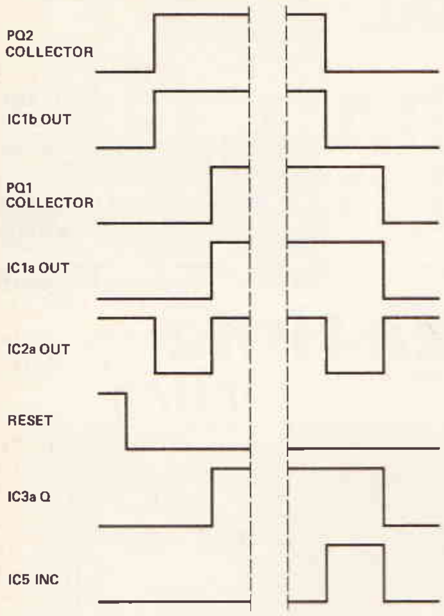
The figure opposite shows the timing of these signals; only in the final section, where the pulse from PQ2 has gone low again, do the conditions for the increment pulse to reach IC5 occur, which is when Q from IC3a and the output from IC1a are both high and the output from IC1b is low.

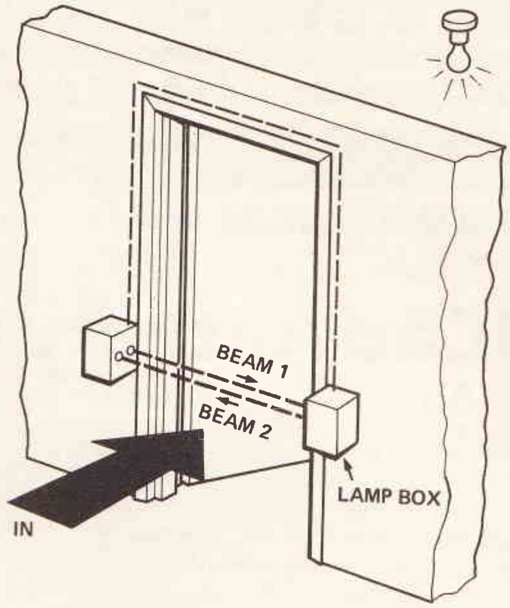
IC5 is an up/down counter seven-segment driver which counts the number of entries and exits from the room. IC1e and IC6a detect a zero on the display. The latch formed around IC4b and c ensures that the light will only come on if there is no light falling on the ambient light detector, PQ3, but will then stay on until the room is vacated. The remaining circuitry for driving the triac via an opto-triac is quite straightforward.

SW2 is an auto/manual switch; SW3 is the reset switch, which should be used at switch-on and whenever the house-hold children set about trying to confuse the unit.

A suggested method of construction is shown in the diagram. Standard three-core mains cable can be used to link the unit to the existing switch-plate (the cable carrying live, neutral and triac return) but note that the unit should be powered from a separate supply, and that it must be earthed to be safe. A metal box can be used to house all the phototransistors and the circuit







SUGGESTED MOUNTING

board and transformer; the beam sensors will need light-shielding tubes (sawn off felt tip pens could be used or something similar) which can be directed at a single light-source fitted on the opposite side of the door frame.

The ambient light sensor may need to be mounted separately, as the box may have to be mounted outside the room, depending on the direction that the door opens. The ambient light detector must be arranged so that it picks up light from only the room being monitored.

An alternative to visible light beams would be to use modulated infra-red beams, but this involves extra complexity, which is why visible light was chosen.

Hex Keyboard Encoder

Adam Strange
Carrickfergus

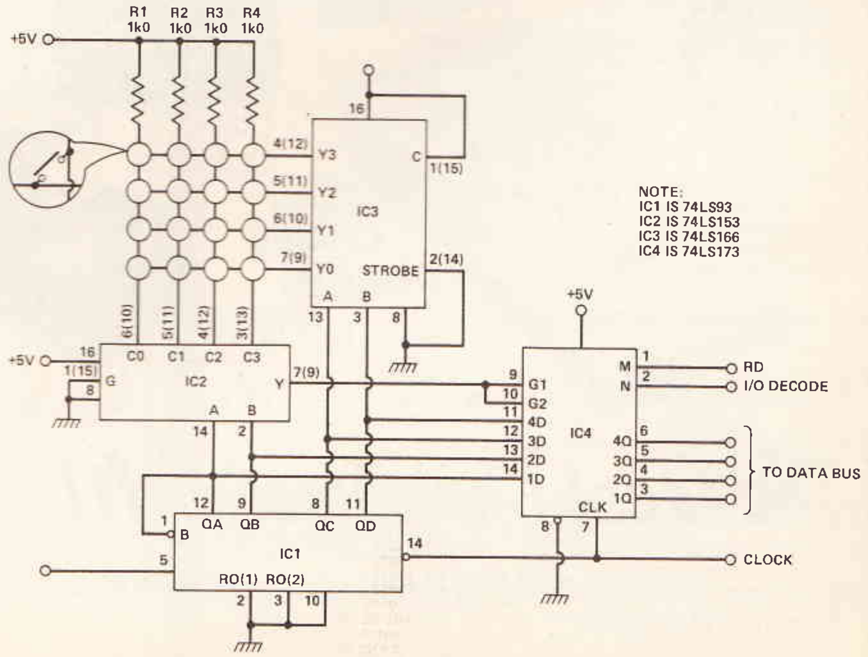
While designing a micro system, I had to decide between using a software or a hardware hex keyboard encoder, and settled on the latter. Out came the good old Texas bible and the scratch pad. Some time later I came up with this little circuit which, even though I do say it myself, works rather well.

The heart of the circuit is ICI ('LS93), a four-bit binary counter, which addresses IC2 and 3, which in turn scan the keyboard. IC3 ('LS156) is a two-to-four line decoder with open collector outputs. The two-bit address, A,B, selects which of the four outputs is low. IC2 ('LS173)) is a four-to-one-line data selector; the two-bit address, A,B, selects which line is tested, the output Y going low when the selected input is low. So the address on the outputs of ICI when output Y of IC2 is low is the address of the key pressed. (IC2 and 3 are dual devices, only one half of either being used here and alternative pin numbers are given where these are applicable on the circuit diagram).

The next step was to capture or latch this address. This is accomplished by IC4 ('LS173) which is a four-Bit D-type register with tri-state outputs (handy for CPU data bus). When the clock pulse goes from high to low the address from IC1 is incremented. This address is clocked into IC4 only if output Y and IC2 is low, this occuring on the low-to-high clock transition. Thus IC4 will hold the code of the last key to be pressed.

All that remains is for the CPU to read the data from IC4. This occurs when the I/O decode and the RD inputs are low.

A cheap way to make the keyboard is to use an old calculator, replacing the original PCB with the one for the encoder. Suitably designed, the PCB for the encoder could be made to fit inside the calculator case — and if the display is still working, this too could be pressed into service.



ambit INTERNATIONAL

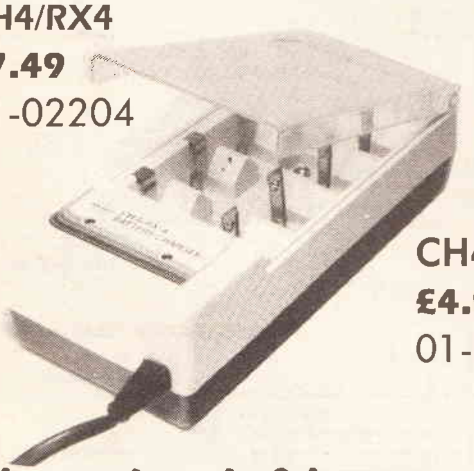
A topical selection from the current ambit parts and equipment catalogue — 148 pages plus 3 £1 discount vouchers! Send 80p for your copy now!
★ mix quantity prices apply for callers to our sales counters

NiCad battery bonanza time

	AA	C	D	PP3
	0.5Ah	2.2Ah	4.0Ah*	0.11Ah
1-9	80p	£2.35	£3.05	£3.70
10-49	74p	£1.99	£2.65	£3.50
Stockcode	01-12004	01-12024	01-12044	01-84054

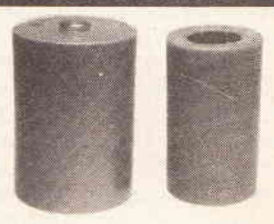
CHARGERS

CH4/RX4
£7.49
01-02204



CH4/50
£4.95
01-00409

BATTERY ADAPTORS 01-12001



A unique battery sleeve adaptor set that converts AA to C or D dimensions, and C to D. Ideal for emergencies.

1-9	10-24
96p	65p

The ideal Christmas Gift!

200 North Service Road, Brentwood, Essex CM14 4SG
Tel: (0277) 230909

CALL AT OUR SALES COUNTERS AT
SOLENT COMPONENT SUPPLIES,
53 Burrfields Road, Portsmouth, Hants
BROXLEA ELECTRONICS, Park Lane,
Broxbourne, Herts.
& at Brentwood, of course!

REMEMBER** to add 15% VAT & 60p postage to all orders — **THANKS!

FREE CAREER BOOKLET

Train for success in Electronics Engineering, T.V. Servicing, Electrical Engineering—or running your own business!

ICS have helped thousands of ambitious people to move up into higher paid, more secure jobs in the fields of electronics, T.V., electrical engineering—now it can be your turn. Whether you are a newcomer to the field or already working in these industries, ICS can provide you with the specialised training so essential to success.

Personal Tuition and 80 Years of Success

The expert and personal guidance by fully qualified tutors, backed by the long ICS record of success, is the key to our outstanding performance in the technical field. You study at the time and pace that suits you best and in your own home.

You study the subjects you enjoy, receive a formal Diploma, and you're ready for that better job, better pay.

TICK THE FREE BOOKLET YOU WANT AND POST TODAY

ELECTRONICS ENGINEERING
A Diploma Course, recognised by the Institute of Engineers & Technicians as meeting all academic standards for application as an Associate.

T.V. & AUDIO SERVICING
A Diploma Course, training you in all aspects of installing, maintaining and repairing T.V. and Audio equipment, domestic and industrial.

ELECTRICAL ENGINEERING
A further Diploma Course recognised by the Institute of Engineers & Technicians, also covering business aspects of electrical contracting.

RUNNING YOUR OWN BUSINESS
If running your own electronics, T.V. servicing or electrical business appeals, then this Diploma Course trains you in the vital business knowledge and techniques you'll need.

Name ....

Address ....

....

ICS ICS Dept O265 160 Stewarts Road, London SW8 4UJ

01-622 9911 (all hours)

Electronic Brokers
Test Equipment DISTRIBUTORS

"For detailed specifications of our complete range send for our new catalogue."

PHILIPS

◄ Philips PM 2517X Handheld DMM £172 Multi-function, 4 digit autoranging with manual override. True RMS to 10Amp. Battery operation. Optional accessories extend measurement capabilities.

Philips PM 3207 15MHz Oscilloscope £385 ► Tough light-weight portable for field service work with big screen. Dual trace, TV triggering, X-Y operation, add and invert.

◄ Philips PM 5107 Function Generator £295 Designed for audio and educational applications. Low distortion LF generator 10Hz to 100kHz, sine and square waveforms. TTL output.

Philips PM5503 Pattern Generator ► £139 Small, light-weight for TV servicing. Five different test patterns for colour and monochrome. Tone for audio checking. Video output.

◄ Philips PM 6667/01 Frequency Counter £290 High resolution 7 digit computing counter from 10Hz to 120MHz. Auto ranging on all waveforms. PM 6668/01 [£425] performs to 1GHz.

FLUKE

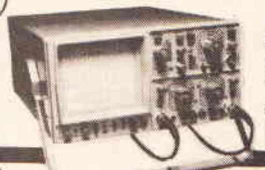
New Fluke 70 series Analog/Digital Handheld Meters All meters have 3 year warranty, all feature measurement functions of volts, ohms, amps and diode test.

JF 73 £65 DC accuracy 0.7% Autoranging
JF 75 £75 DC accuracy 0.5% Auto/manual ranging
JF 77 £95 DC accuracy 0.3% Touch hold function
Multi purpose holster

HAMEG

◄ Hameg HM 103 10MHz Oscilloscope £158 Single trace, suitable for field service or home constructor. Two year warranty applies to this and all Hameg instruments.

Hameg HM 203-4 20MHz Oscilloscope £264 ► Dual trace for general purpose applications in industry and education. X-Y operation, TV triggering, add/invert and component tester.



◄ Hameg HM 204 20MHz Oscilloscope £365 High performance instrument with sweep delay. Versatile triggering to 50MHz, variable hold off control, Z modulation and internal illuminated graticule.

ICE

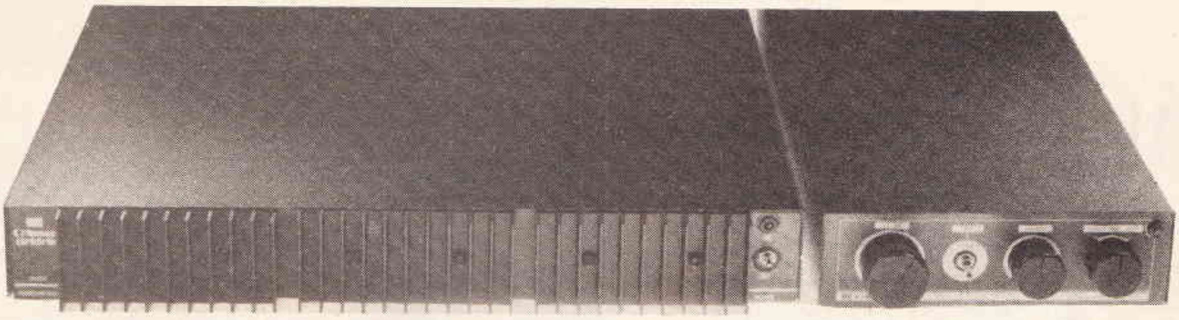
I.C.E. Microtest 80 Multimeter £19 Compact meter in robust case. 40 ranges of measurement with high sensitivity and accuracy. Large range of inexpensive accessories.

ADD 15% VAT TO ALL PRICES Carriage and Packing extra

Electronic Brokers Ltd., 61/65 Kings Cross Road, London WC1X 9LN. Tel: 01-8331166. Telex 298694

Electronic Brokers

BUILD A BETTER AMPLIFIER!



How can you own a top class HiFi amplifier, of comparable standard to Naims, Meridians, Quads etc., for an outlay of less than £250? — Simple! Build it yourself — with a Crimson kit.

It is not necessary to spend a small fortune to obtain true Hifi performance. Crimson Kits offer all the features and sound quality of the most esoteric amplifiers available and their ease of assembly ensures that they work first time and continue to do so. Not only do Crimson Kits offer outstanding value, but they also have the flexibility to adapt to any users needs. All the P.C.B.'s are ready assembled and tested (they are **not** "potted" as we believe disposable modules are rather extravagant!) therefore constructing a kit is pleasurable in itself and, once built, will give years of untroubled service. So, whether you use a simple record player or a compact disc, you can be sure to get the most from your system. E.T.I. said, in their review of the CK1010/1100: "I can say no more than that for £250 it is a bargain and one that will become the reference point for kit amplifiers from now on." Need we say more?

PRICES

CK1010 — STEREO PRE-AMPLIFIER (moving magnet, tape, tuner input) takes power from any CK power amp or separate p.s.u. type P.S.K. **£92.00**
CK1040 — STEREO POWER-AMPLIFIER 40 watts R.M.S./Chanel **£121.00**
CK1080 — STEREO POWER-AMPLIFIER 80 watts R.M.S./Chanel **£134.00**
CK1100 — STEREO POWER-AMPLIFIER 100 watts R.M.S./Chanel **£151.00**
MC2K — Moving coil add on kit for CK1010 **£25.00**
P.S.K. — power supply for CK1010 (if not used with a CK power amp) **£20.00**
CRIMSON also supply power amp, pre amp and electronic crossover modules, power supplies and hardware — too much to list here — but on receipt of an S.A.E. we will be happy to supply full details.

TO ORDER Send C.W.O. or quote your access card no (phone orders accepted) Crimson Products are also available from Bradley Marshall Ltd, 325 Edgeware Road, London.

CES CRIMSON ELEKTRIK STOKE

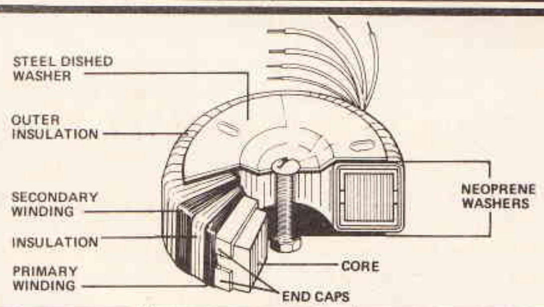
MANUFACTURERS OF PROFESSIONAL, DOMESTIC & INDUSTRIAL AMPLIFICATION

PHOENIX WORKS, 500 KING STREET, LONGTON, STOKE-ON-TRENT, STAFFORDSHIRE. ST2 1EZ ☎ 0782 330520

TOROIDALS

The toroidal transformer is now accepted as the standard in industry, overtaking the obsolete laminated type. Industry has been quick to recognise the advantages toroidals offer in size, weight, lower radiated field and, thanks to I.L.P., PRICE.

Our large standard range is complemented by our SPECIAL DESIGN section which can offer a prototype service within 7 DAYS together with a short lead time on quantity orders which can be programmed to your requirements with no price penalty.



15 VA — 62 x 34mm — 0.35Kg — Regulation 19%

SERIES No	SECONDARY Volts	RMS Current
0x010	6+6	1.25
0x011	9+9	0.83
0x012	12+12	0.63
0x013	15+15	0.50
0x014	18+18	0.42
0x015	22+22	0.34
0x016	25+25	0.30
0x017	30+30	0.25

(encased in ABS plastic)

30 VA — 70 x 30mm — 0.45Kg — Regulation 18%

1x010	6+6	2.50
1x011	9+9	1.66
1x012	12+12	1.25
1x013	15+15	1.00
1x014	18+18	0.83
1x015	22+22	0.68
1x016	25+25	0.60
1x017	30+30	0.50

50 VA — 80 x 35mm — 0.9Kg — Regulation 13%

2x010	6+6	4.16
2x011	9+9	2.77
2x012	12+12	2.08
2x013	15+15	1.66
2x014	18+18	1.38
2x015	22+22	1.13
2x016	25+25	1.00
2x017	30+30	0.83
2x028	110	0.45
2x029	220	0.22
2x030	240	0.20

80 VA — 90 x 30mm — 1Kg — Regulation 12%

3x010	6+6	6.64
3x011	9+9	4.44
3x012	12+12	3.33
3x013	15+15	2.66
3x014	18+18	2.22
3x015	22+22	1.81
3x016	25+25	1.60
3x017	30+30	1.33
3x028	110	0.72
3x029	220	0.36
3x030	240	0.33

120 VA — 90 x 40mm — 1.2Kg — Regulation 11%

4x010	6+6	10.00
4x011	9+9	6.66
4x012	12+12	5.00
4x013	15+15	4.00
4x014	18+18	3.33
4x015	22+22	2.72
4x016	25+25	2.40
4x017	30+30	2.00
4x018	35+35	1.71
4x028	110	1.09
4x029	220	0.54
4x030	240	0.50

160 VA — 110 x 40mm — 1.8Kg — Regulation 8%

5x011	9+9	8.89
5x012	12+12	6.66
5x013	15+15	5.33
5x014	18+18	4.44
5x015	22+22	3.63
5x016	25+25	3.20
5x017	30+30	2.66
5x018	35+35	2.28
5x026	40+40	2.00
5x028	110	1.45
5x029	220	0.72
5x030	240	0.66

225 VA — 110 x 45mm — 2.2Kg — Regulation 7%

6x012	12+12	9.38
6x013	15+15	7.50
6x014	18+18	6.25
6x015	22+22	5.11
6x016	25+25	4.50
6x017	30+30	3.75
6x018	35+35	3.21
6x026	40+40	2.81
6x025	45+45	2.50
6x033	50+50	2.25
6x028	110	2.04
6x029	220	1.02
6x030	240	0.93

300 VA — 110 x 50mm — 2.6Kg — Regulation 6%

7x013	15+15	10.00
7x014	18+18	8.33
7x015	22+22	6.82
7x016	25+25	6.00
7x017	30+30	5.00
7x018	35+35	4.28
7x026	40+40	3.75
7x025	45+45	3.33
7x033	50+50	3.00
7x028	110	2.72
7x029	220	1.36
7x030	240	1.25

500 VA — 140 x 60mm — 4Kg — Regulation 4%

8x016	25+25	10.00
8x017	30+30	8.33
8x018	35+35	7.14
8x026	40+40	6.25
8x025	45+45	5.55
8x033	50+50	5.00
8x042	55+55	4.54
8x028	110	4.54
8x029	220	2.27
8x030	240	2.08

625 VA — 140 x 75mm — 5Kg — Regulation 4%

9x017	30+30	10.41
9x018	35+35	8.92
9x026	40+40	7.81
9x025	45+45	6.94
9x033	50+50	6.25
9x042	55+55	5.68
9x028	110	5.68
9x029	220	2.84
9x030	240	2.60

Why a Toroid?
* Smaller size & weight to meet modern 'slimline' requirements.
* Low electrically induced noise demanded by compact equipment.
* High efficiency enabling conservative rating whilst maintaining size advantages.
* Lower operating temperature.

Why ILP?
* Ex-stock delivery for small quantities.
* Gold service available. 21 days manufacture for urgent deliveries.
* 5 year no quibble guarantee.
* Realistic delivery for volume orders.
* No price penalty for call off orders.

Prices including P&P and VAT

VA	Size	£	VA	Size	£
15	0	7.43	160	5	12.90
30	1	8.08	225	6	16.30
50	2	10.10	200	7	18.55
80	3	10.81	500	8	25.73
120	4	11.73	625	9	31.63

For 110V primary insert "O" in place of "X" in type number.
For 220V primary (Europe) insert "1" in place of "X" in type number.
For 240V primary (UK) insert "2" in place of "X" in type number.
IMPORTANT: Regulation - All voltages quoted are FULL LOAD.
Please add regulation figure to secondary voltage to obtain off load voltage.

Mail Order — Please make your crossed cheques or postal orders payable to ILP Electronics Ltd.

Trade — We will open your credit account immediately upon receipt of your first order.

Access VISA

Post to: ILP Electronics Ltd., Dept. 5
Graham Bell House, Roper Close,
Canterbury, Kent. CT2 7EP
Tel: (0227) 54778 Telex: 965780

ILP ELECTRONICS LTD.

MODULAR PREAMPLIFIER PART TWO

Some people are not happy unless they have a mass of controls not dissimilar to Concorde's flight deck on their side-board. The circuits here can help to extend the basic design, built using the modules featured last month, to include parametric tone controls, balanced output stage and a headphone amplifier.

A block diagram of the extended preamp is shown in Fig. 1, and apart from the increased circuitry, the main difference between this and the 'basic' design is that the volume control is no longer at the input. This obviously means that consideration has to be given to the possibility of overload. In Part 1, it was shown that the disc overload margin could be maintained at an adequate 32dB if the output level of the disc input stage was 200mV for its rated input. In order that this margin is not reduced, no gain may be introduced before the volume control, and the gain necessary to give a 1.0V output should be made up by the output stage.

The input switching and tape buffer remain the same as in the simpler unit, but after the monitor switch, a unity gain buffer amplifier presents a high input impedance to the line inputs, and provides a low impedance drive to the tone control circuitry. The attenuator on the compact disc input is not to avoid overload, as the input and tone control circuits will easily handle the output of any CD player. Its purpose is to limit the signal level so that the volume control is not operated at a setting where its inter-track balance is not likely to be better than 3 or 4dB.

Tone Controls

Although fully paid-up members of the Flat Earth Society would have us believe that any form of signal processing is guaranteed to make a pig's ear of the emotional experience of listening to a group of musical morons twanging guitars and wailing in voices more suited to Billingsgate than Covent Garden, it should be remembered that most recordings are subject to considerable amounts of 'equalisation', usually to satisfy the producer's requirement for a particular type of sound. No allowance is made for the introduction of random phase shifts, or that the intricate

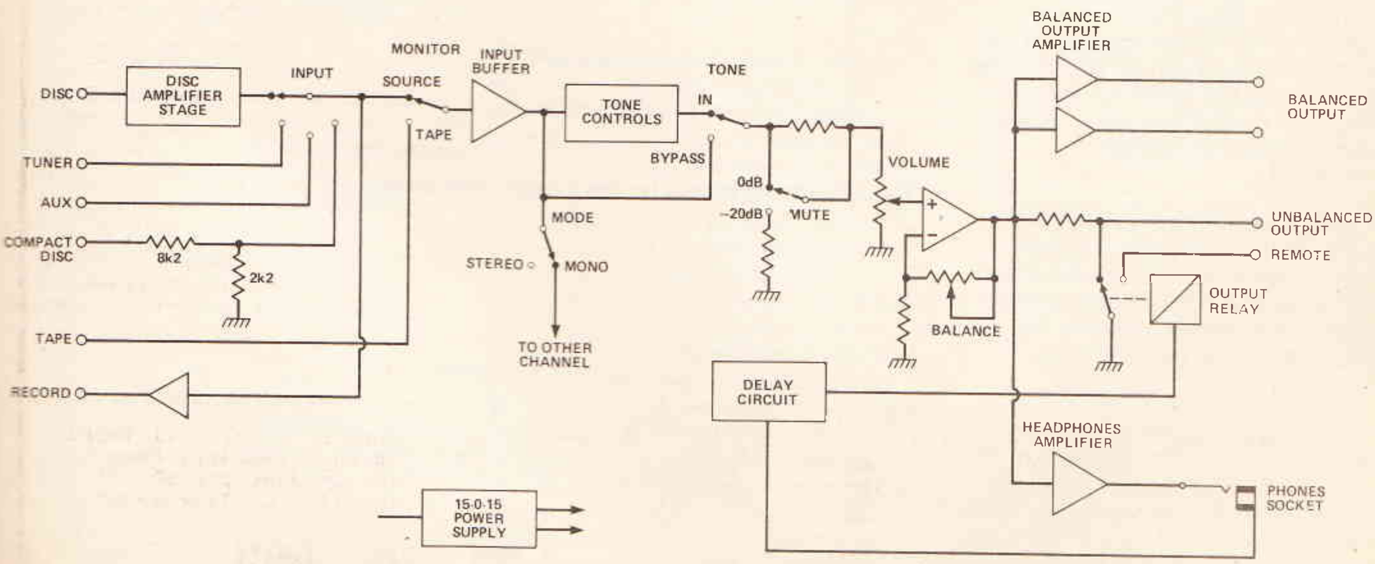


Fig. 1 Block diagram of the extended preamp.

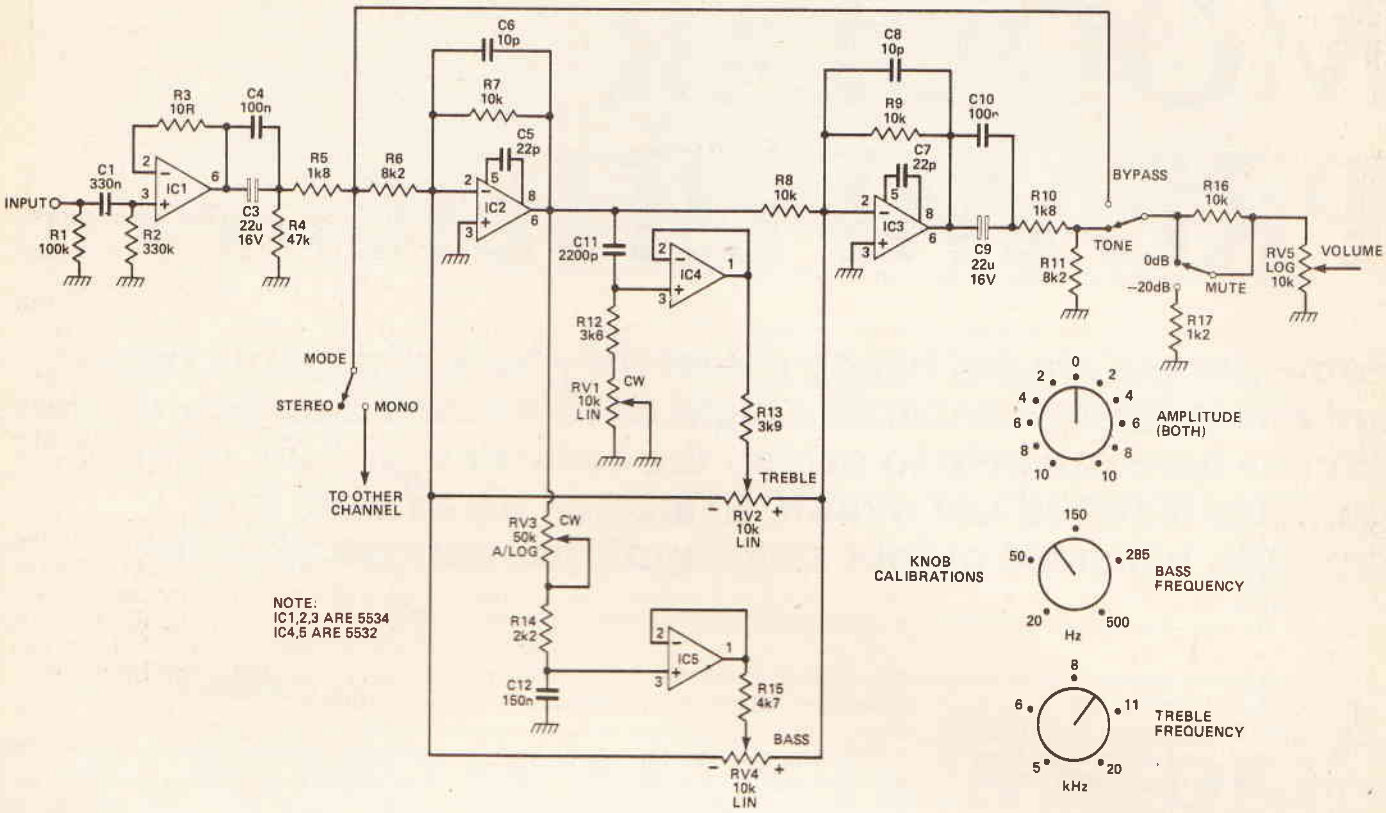


Fig. 2 Circuit diagram of the tone control module.

relationship of harmonics is sent on a one way trip to the cleaners. The object is to change the sound to make it more satisfactory, and if tone controls are used in the replay process for exactly the same purpose, surely no-one has the right to complain?

The type of tone control fitted to most hi-fi equipment is far from ideal, usually being much too dramatic in operation — for example, if it is required to lift frequencies below about 100 Hz, the effect is usually to lift, by varying amounts, everything up to at least 1 kHz, and even higher.

The circuit shown in Fig. 2 is somewhat more sophisticated than usual, possessing in addition to the normal lift and cut controls, adjustment of the turnover frequencies of the two sections.

Operation of the circuit is quite straightforward. IC1 acts as an input buffer, presenting an input impedance of approximately 100k ohms to the line inputs of the preamplifier. The input of IC1 is AC coupled by C1, which together with R2 fixes the −3dB point at

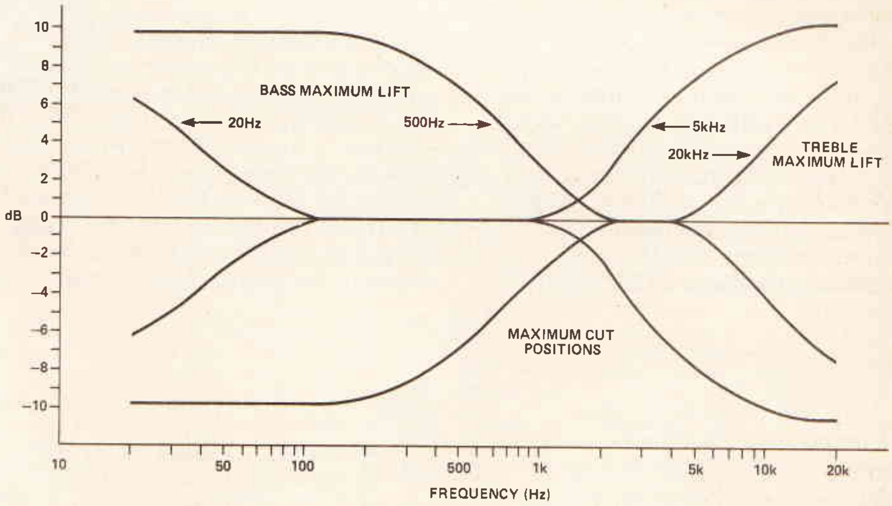


Fig. 3 Response curves for the tone control module.

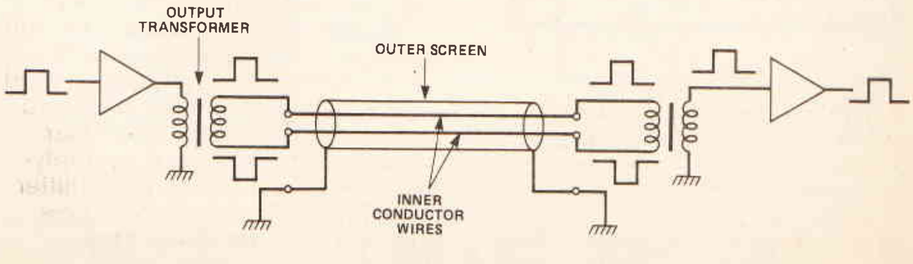


Fig. 4 The basic principle of balanced line operaton.

about 1.5 Hz — low enough to prevent objectionable low frequency phase shift. The output of IC1 drives the pair of inverting stages formed by IC2 and IC3, the input resistor to IC2 being split to allow mono summing of the two channels. The signal path is maintained at unity gain by the equal input and feedback resistors of the two stages.

The output of IC2 feeds two single-pole filters which are buffered by IC4 and IC5. The filter formed by C11, R12 and RV1 has a high pass characteristic with its −3dB point adjustable by VR1 from 5.3 kHz to 20 kHz. Operation of the treble control, RV2, decides the destination of the high frequencies that emerge from the output of IC4 — in the "cut" position they are applied as negative feedback to IC2, and in the "lift" position they bypass R8 giving additional gain to IC3. The amount of lift and cut is controlled by R13, the value specified giving a ±10dB variation.

The bass control works in the same way, except that a low pass filter comprising C12, R14 and RV3 selects the low frequency range which is variable between 20 Hz and 480 Hz.

This type of tone control is characterised by shelving response curves with no interaction between the bass and treble sections. The curves are shown in Fig. 3 which illustrates the range of the variable frequency controls.

As the tone control section is non-inverting from input to output, it can readily be bypassed as shown. To ensure that there is no change in level when the bypass switch is operated, the 2.9dB attenuator formed by R5, R6 and the volume control is duplicated by the addition of R10 and R11 at the output of IC3.

The mute switch has been added, as much for convenience as anything. When changing records or when the 'phone rings it is very useful to be able to reduce the overall gain without disturbing the volume control setting.

Output Stage

The volume control is followed by the unbalanced output stage, already described in part 1. However, in order to give an additional 2.9dB of gain (to counteract the loss in the tone control circuit) the values of R4 and R6 should be changed to 133R and 300R respectively. The balance control characteristics are very slightly changed by this, as shown in Table 1, but they will still remain accurate to the calibrations.

In normal circumstances, the unbalanced output stage is all that will be needed. The main advantage of using a balanced output stage is realised when the signal output from the preamp has to run more than a metre or two, where the balanced output will give a much better noise immunity, or in an intrinsically noisy situation, eg disco systems, where the lighting controller can interfere with the audio signal.

As far as the user is concerned, the only difference between balanced and unbalanced lines is that balanced ones use a three-wire connection per channel instead of the usual two. Balancing has been standard with professional audio equipment since the days of 2LO and the cat's whisker (and Angela Rippon?), where it is used to ensure reliable, hum-free connections over long distances.

The basic principle is shown in Fig. 4; the signal is carried along two wires with the outer screen acting as an earth connection. The signal is inverted in one wire with respect to the other, but any hum and noise picked up from external signal sources by the cable will have the same phase in both wires. The balanced input accepts the differential signal, but rejects the externally introduced common mode signal. The normal method of balancing has traditionally relied upon the use of special input and output transformers, but similar results can be obtained by applying standard operational amplifier techniques — after all, the common op-amp has differential inputs.

Control Callibration	Channel Imbalance
2	1.87dB
4	3.78dB
6	5.79dB
8	7.96dB
10	10.39dB

Table 1 Balance control performance when used with tone control.

A balanced output consists of two outputs of identical levels but with one signal phase-inverted with respect to the other. Fig. 5 shows three ways that this could be achieved, and any one of these methods would be quite adequate provided it was connected to a balanced input. It may be seen that in each case, attenuation is introduced to ensure that half the input voltage appears at each output, but with opposite polarities. Thus a 1 volt input would result in outputs of +0.5 V and −0.5 V, giving the required 1 volt between conductors.

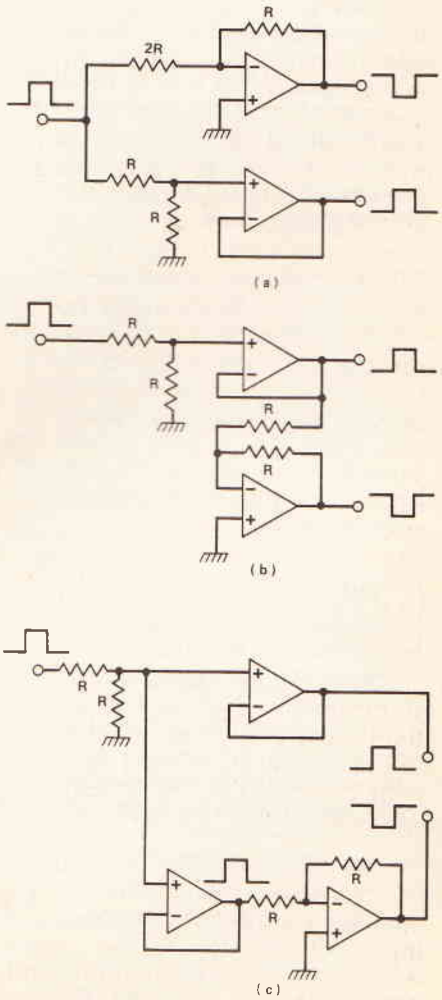


Fig. 5 Possible balanced output arrangements.

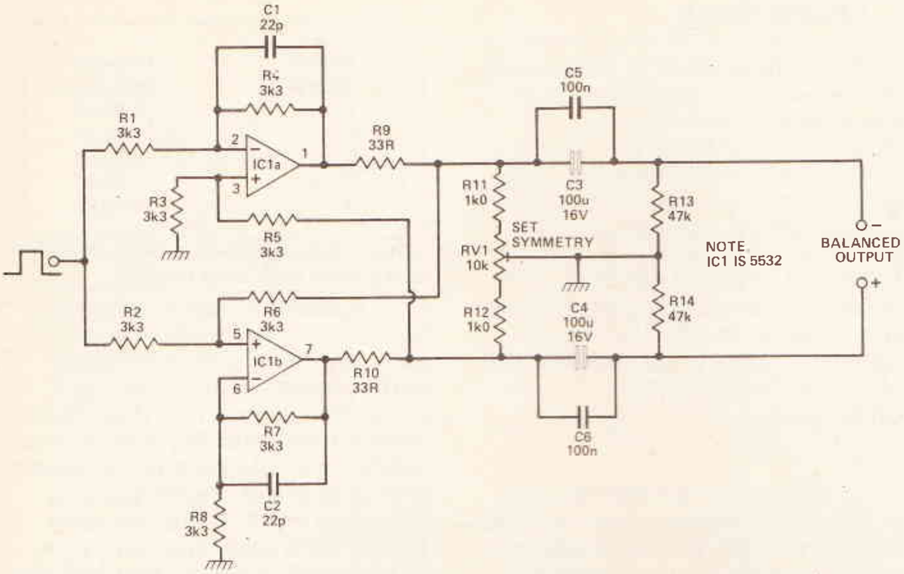


Fig. 6 Circuit diagram of the balanced output stage.

This is fine until the output is connected to an unbalanced input, when one of the balanced feeds gets shorted to earth, leaving a single output of 0.5 V. A difference of 6dB appears between balanced and unbalanced operation, which is not really acceptable. What is required is a method of increasing the gain of either output amplifier by 6dB whenever the other output is grounded, and such a circuit is illustrated in Fig. 6.

Here, the cross feed-back fixes the gain of each side at 0.5, but shorting either output to earth will remove this feedback, increasing the gain of the unshorted side to unity. As the balance condition of the circuit is extremely critical, the pre-set potentiomenter is used to set the two outputs equal with respect to earth.

The whole object of the balanced output is that it should be connected to a balanced input. As these are not common in domestic equipment, a suitable circuit is given in Fig. 7, which is similar to the line input stages common in professional studio equipment (alternatively, see ETI may 1983 — Editor). This stage should be included in any equipment that is driven by the balanced output of the preamplifier while placed a considerable distance from it — active speakers and speaker-located amplifiers being the obvious cases in domestic systems.

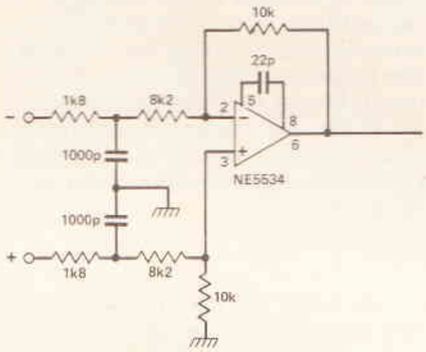


Fig. 7 A possible balanced input arrangement.

As shown in Fig. 1, the unbalanced output from the balanced line output stage is taken to the rear panel via the delay relay. This output will therefore be shorted to earth for about five seconds when power is first applied, and will also be cut off whenever a pair of headphones is plugged into the front panel-mounted jack socket.

Headphone Amplifier

Although most moving coil headphones have impedances in the 150 to 600 ohms range, the odd maverick pair are around that are as low as 8 ohms, so to be universal a headphone amplifier needs to be able to supply somewhat more current than a normal op-amp can manage. Various power ICs have been tried, but they all draw rather high quiescent current, causing the power supply regulators to get a bit too warm for comfort.

The circuit given in Fig. 8 uses an NE5534 to drive a pair of complementary transistors which are turned on by the voltage drop across R8. When the amplifier is in its quiescent state, the output stage is turned off, so minimum standing current is drawn. The transition point of the output devices does introduce some cross-over distortion, but this is kept within reasonable limits by negative feedback action, and the performance is more than adequate for headphone listening. The output resistor, R11, may be changed to suit the type of headphones in use, possibly requiring an increase to about 200 ohms with some medium impedance models.

Constructional details, overlay diagrams, etc for these modules will be given next month along with further information on the mother board. We will also be giving details of a series of kits of the hard-to-find parts, but in the meantime PLEASE don't ring us — just try to hold out a little longer, OK?.

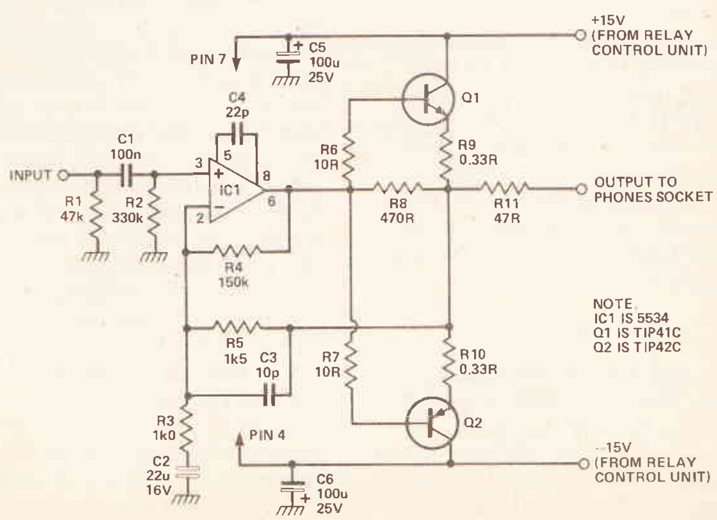
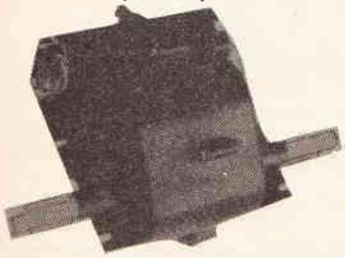
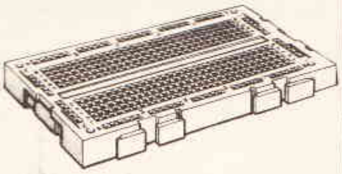
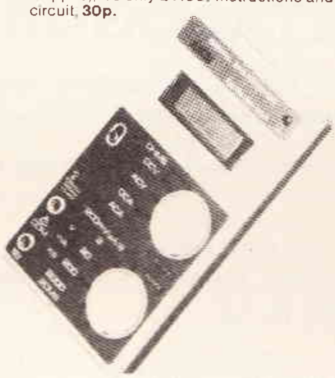


Fig. 8 Circuit diagram of the headphone amplifier module.

ETI







LB ELECTRONICS

FRUSTRATED EXPORT ORDER BRAND NEW & BOXED. EPSON FX80 PRINTERS £350.00 + VAT (carriage £12 tnt)

GOULD MMG 5-10 switched mode PSU 5 volts 10 amp 220 Volt input size approx 6½"x2¾"x3½" weight 1 kilo **£25 p/p £3.**
MAINS FILTER 8 amp 250 vac 2¼"x2½"x3¼" with built in IEC mains plug **£3.50 p/p £1.50.**
PRESTEL monitors 6" green phosphor screen 12 digit keyboard printer port, cassette port, keyboard port (for full qwerty keyboard) Brand new and boxed **£175** + VAT.

At the time of going to press we are attempting to modify these units into a computer terminal with built in modem. Please phone for details.

DISC DRIVE BONANZA

TEAC FD-55F ½ Height DSD 80 track/ 40 track selectable at our new low price **£199** + VAT
PAPST 3" Box Fan 220 volts 50hz require 1uf capacitor **£7.95** p/p £1.00

Just arrived full qwerty keyboard plus numeric pad completely cased (x equipment) believed to be RS232 **£16.95** (callers only)
25 WAY 'D' Types, plugs **£1.85,** sockets **£1.85** (solder tail) p&p 30p. Telephone for bulk prices.
Brand New Vero Card racks 3u 24 slot £12.00 (callers only).
Twin 5" Cabinets with power supply £40.00 + VAT (providing a disc drive is purchased from us, if drives purchased elsewhere £50.00 + VAT).
9" Green Phosphor Monitors Brand New and Cased Composite Video Input 18mhz band width £80 + VAT each (carriage cost)
Brand New 13" Colour monitor fully cased. Full warranty 540 x 236 pixel. RGB TTL Input plus apple Input £220 + VAT (carriage at cost).
BNC Lead Bonanza coax lead with BNC plug at one end, 2 metres plus £1.00 p&p 30p and 10 metres plus £2.50 p&p 75p

Buy it with Access — American Express — VISA

LB ELECTRONICS
11 HERCIES ROAD, HILLINGDON, MIDDLESEX UB10 9 LS, ENGLAND
TEL: UXBRIDGE 55399

MRL

FREE delivery

Printers

STAR DP510 (100 CPS)	£235
EPSON FX80 (160 CPS)	£370
JUKI Daisywheel (18CPS)	£375

Paper, Ribbons & Refills etc.

Disk Drives

5¼" SS/DD	£150
8" SS/DD	£230
APPLE compatible cased	£200
Controller card	£40
CPM card	£49
TANDY Mod III/4 Drive Kit complete with power & fittings	£375

INTERFACES for most MICROS
SPECTRUM to Pllel Printer **£30** FREE cable & WORDMANAGER. ATARI to Pllel Printer **£40** FREE cable.
MANY MORE AVAILABLE

TANDY Mod I or III Hi-Res Graphics & Colour Board, ready built with power supply of Extended 'Colour' Basic **£200**

FLOPPIES 10-5¼" in Library Case **£15**
Lockable case for 100 disks **£19**

Please add 15% VAT

MICRO RESEARCH LTD.
Industrial Unit 6, Knightsridge East, LIVINGSTONE, West Lothian, Scotland
Tel: 0506 31605

PARNDON ELECTRONICS LTD.

Dept. 23, 44 Paddock Mead, Harlow, Essex. CM18 7RR. Tel: 0279 32700

RESISTORS: ¼ Watt Carbon Film E24 range ± 5% tolerance
Bandoliered and colour coded. Full Range 1RO-10M.
£1.00 per hundred mixed (Min 10 per value) **£8.50** per thousand mixed (Min 50 per value)
Special stock pack 60 values. 10 of each **£5.50**

RECTIFIERS

	1 Amp	3 Amp
50V	3p	14p
100V	4p	14p
200V	5p	14p
400V	6p	19p
600V	8p	20p
1000V	9p	25p

3½ Digit LCD Display: 1 colon, 3 decimal points plus/minus sign and lo bat indicator.
Complete with low power 7106 A/D converter display driver.
Driver set **£8.95**
Display £3.50 Driver **£6.50**

DIODES: IN4148 **£1.60** per hundred

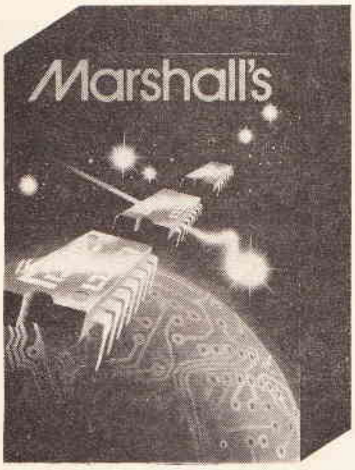
DIL SOCKETS 8 pin – **10p.** 14 pin – **11p.** 16p pin – **12p.** 18p pin – **19p.** 20p pin – **21p** 22 pin – **23p.** 24 pin – **25p.** 28 pin – **27p** 40 pin – **42p.**

Full List Available — Send SAE
ALL PRICES INCLUDE V.A.T. & POST & PACKING — NO EXTRAS
MIN ORDER — UK £1.00 OVERSEAS £5 CASH WITH ORDER PLEASE
Same Day Despatch

Marshall's

A. MARSHALL (LONDON) LTD

A. Marshall (London) Ltd.
Electronic Component Distributors
85 WEST REGENT STREET
GLASGOW G2 2QD
TELEPHONE: 041 332 4133



1984 CATALOGUE NOW OUT

The new Marshalls 1984 catalogue is now available — one of the biggest and best catalogues ever produced by Marshalls.

56 pages crammed from back to front with components, accessories and testgear

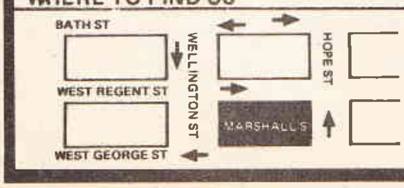
New products include I.D.C. plugs & sockets, "D" plugs & sockets, DIL Headers, Ribbon Cable, Kits, Toroidal transformers, I.C.'s, Capacitors, test probes, and lots more.

Something for Everyone

Trade, Export, Retail and Mail Order Supplied

75p to callers, £1.00 post paid Europe, £1.50 rest of the world.

WHERE TO FIND US



CALL IN AND SEE US
9-5.30 MON TO FRI
9-5.00 SAT
EXPRESS MAIL ORDERS
ACCESS/BARCLAYCARDS
WELCOME
SAME DAY
SERVICE

MAIL ORDER
WE REGRET WE CANNOT ANSWER MAIL ORDER/ STOCK ENQUIRIES WITHOUT AN S.A.E.
SAME DAY SERVICE
TRADE AND EXPORT ENQUIRIES WELCOME

TELEPHONE
MAIL ORDER
041-332-4133
SHOP AND STOCK ENQUIRIES
041-332-4133
TRADE
041-332-4135

UNIVERSAL EPROM PROGRAMMER Revisited

We really started something with our Universal EPROM Programmer in the August and September issues. Requests for the assembler listing and for advice on how to modify the program to run on other machines continue to pour in. In an attempt to stem the tide, Mike Bedford offers a few further thoughts and the listing itself.

As mentioned in the 2nd part of the Universal EPROM Programmer article, the software has been written in such a way as to make it compatible with all 6502 based computers with the absolute minimum of changes. However, it is inevitable that some slight modifications will be required when transferring software, however similar the two machines may be. A large proportion of the software package is written in BASIC which, being a high level languge, means that it should be possible to transfer it directly to another machine without any changes at all. This isn't quite the case as there are a number of dialects of BASIC, generally differing in those areas which are extensions to the original BASIC. Possible areas in which the BASIC program might need modifying have already been mentioned and it is now appropriate to indicate how the assembler subroutine may be modified to run on different machines.

Since all the keyboard and display I/O is carried out in the BASIC program hence camouflaging any hardware differences in these areas, the only changes which may be required to the assembler routine are due to differences in the memory maps and the clock speeds of the various machines. Apart from users wishing simply to transfer the software to another machine, others may be interested in enhancing the package to carry out additional functions, for example, implementing the intelligent programming algorithm or adding new devices such as the 27256, 68732 and 68764 EPROMS which the hardware could support. It is therefore quite likely that a number of readers will require a much greater insight into the workings of the assembler routine than could be glimpsed from the hexadecimal dump given in the second part of the article. For this reason it is the intention here to reproduce a full assembler listing together with a simple "guided tour" to give some idea of how it works, hence enabling changes to be carried out without too much of the anguish often associated with trying to understand someone else's assembler program.

A few comments about the assembler are appropriate before going on to describe the structure of the program. Although all assemblers carry out essentially the same task there are often slight differences in the syntax. This program was written on a PDP-11 computer using a cross-assembler:

a). The .PROCESSOR directive on line 13 is used to inform the assembler of which processor is in use. For 6502 only assemblers this line should be omitted.

b). The .ORG directive on line 14 sets the start address of the code. Syntax on other assemblers may be ★=IC00H or .=IC00H.

c). This assembler uses a suffix of H to indicate a hexadecimal number. Some other assemblers use a prefix of $. Ie IC00H may need replacing by $IC00.

d). In this assembler the .DEFINE directive is used to equate values to literals. In many other assemblers the word .DEFINE should be omitted to leave an equation (eg IC1PIA = OBC20H) and in others the EQU directive is used.

e). The .BYTE directive reserves a byte of memory and assigns an initial value to it. The more common version of this directive is DFB or DEFB.

The assembler syntax having been clarified, we can now go on to investigate the workings of the assembler subroutine and we shall make a start by looking at the parameter storage and data areas.

LOADR and HIADR are initialised by the BASIC program to one less than the first RAM address to be accessed. On exiting from the subroutine these locations will contain one more than the last address accessed. LOADE and HIADE are a similar address pair for the EPROM address. LOADF and HIADF are an address pair which are set by the BASIC program to one more than the last RAM address which should be used. RDATA is used to pass the value of the data read from the EPROM back to the calling program, this being required in verify mode. MODE is set by the BASIC program to indicate whether read, verify, test or program function is required. Finally TYPE is set up by the main program to indicate the type of EPROM in use and will contain a number in the range 0 for 2758 to 8 for 27128.

As we now start to consider the data tables we shall be directing our attention to lines 47 to 64 of the program. In each of the seven lists here, there are 9 values of which one will be selected according to the value of TYPE. READS3 and READS6 contain the initial values of IC1CRB and IC2PIB respectively prior to which toggling bit 3 of IC2CRA would cause a read of the EPROM. PROGS5 and PROGS6 are similar tables of data for setting initial values of IC2CRA and IC2PIB prior to programming. PTBIT and PTBYTE indicate which bit of which PIA register requires to be toggled in order to carry out the programming of an EPROM. As a matter of interest, the reason that there are not tables of initial conditions for program and read for all PIA registers which connect to control pins on the EPROM is that some are set to the same initial value independently of EPROM type and some are set to the same value for both read and program. Finally A11A12 indicates whether the particular EPROM has A11 on pin 23 and A12 on Pin 2 or A11 on pin 20 and A12 on pin 23, these being the two options for the 27-series and 25-series devices.

Having described the parameter storage and data areas it should be relatively straightforward to see how the assembler routine works. The value of MODE is used to select one of the two main routines either READ for reading, verifying or testing or PROG for programming. In either of these two

Table 1 The assembler listing. Note that:–

1). All pound signs (£) in this listing should be read as hash signs (#). It is purely a function of the printer used that these have been reproduced incorrectly.

2). The assembler listing refers to the two 6821 PIA's as IC1 and IC2 as was the case on the first prototype. IC1 should now be read as IC9 and IC2 as IC8. This in no way alters the operation of the software.

```
1                     ;*******************************************************
2                     ;*                                                     *
3                     ;* EPROM PROGRAMMER SUPPORT PACKAGE                    *
4                     ;* READ/PROGRAMME ROUTINE                              *
5                     ;* M. D. BEDFORD   MARCH 1983                          *
6                     ;* THIS ROUTINE IS CALLED FROM A MAIN BASIC PROGRAM    *
7                     ;* AND WILL SUPPORT 2758, 2716, 2516, 2732, 2732A      *
8                     ;* 2532, 2764, 2564 AND 27128 DEVICES.                 *
9                     ;*                                                     *
10                    ;*******************************************************
11                    ;
12                    ;
13                             .PROCESSOR      R6500
14                             .ORG            1C00H
15                    ;
16                    ;ZERO PAGE LOCATIONS USED
17                    ;
18                             .DEFINE         ZPLOAD=35H
19                             .DEFINE         ZPHIAD=36H
20                    ;
21                    ;ADDRESSES OF 6821 REGISTERS USED
22                    ;
23                             .DEFINE         IC1PIA=0BC20H
24                             .DEFINE         IC1CRA=IC1PIA+1
25                             .DEFINE         IC1PIB=IC1PIA+2
26                             .DEFINE         IC1CRB=IC1PIA+3
27                             .DEFINE         IC2PIA=IC1PIA+4
28                             .DEFINE         IC2CRA=IC1PIA+5
29                             .DEFINE         IC2PIB=IC1PIA+6
30                             .DEFINE         IC2CRB=IC1PIA+7
31                    ;
32                    ;
33    1C00  4C4C1C             JMP      START
34                    ;
35                    ;
36    1C03  00        LOADR:   .BYTE    0        ;LO RAM START ADDRESS
37    1C04  00        HIADR:   .BYTE    0        ;HI RAM START ADDRESS
38    1C05  00        LOADE:   .BYTE    0        ;LO EPROM START ADDRESS
39    1C06  00        HIADE:   .BYTE    0        ;HI EPROM START ADDRESS
40    1C07  00        LOADF:   .BYTE    0        ;LO EPROM FINISH ADDRESS
41    1C08  00        HIADF:   .BYTE    0        ;HI EPROM FINISH ADDRESS
42    1C09  00        HIADM:   .BYTE    0        ;HI ADDRESS EPROM MASKED
43    1C0A  00        RDATA:   .BYTE    0        ;DATA READ FROM EPROM
44    1C0B  00        MODE:    .BYTE    0        ;0-R,FFH-V,80H-T,2-P
45    1C0C  00        TYPE:    .BYTE    0        ;0-2758 ... 8-27128
46                    ;
47                    ;INITIAL CONDITIONS FOR READ - IC1CRB,IC2PIB
48                    ;
49    1C0D  3C        READS3:  .BYTE   3CH,3CH,3CH,3CH,3CH,3CH,34H,34H,34H
50    1C16  18        READS6:  .BYTE   18H,18H,18H,10H,10H,18H,12H,10H,12H
51                    ;
52                    ;INITIAL CONDITIONS FOR PROG - IC2CRA,IC2PIB
53                    ;
54    1C1F  3C        PROGS5:  .BYTE   3CH,3CH,3CH,34H,34H,3CH,3CH,3CH,3CH
55    1C28  08        PROGS6:  .BYTE   8,8,8,5,25H,8,22H,0,22H
56                    ;
57                    ;BITS OF BYTES TO TOGGLE FOR PROGRAMME
58                    ;
59    1C31  01        PTBIT:   .BYTE   1,1,1,1,1,8,2,8,2
60    1C3A  06        PTBYTE:  .BYTE   6,6,6,6,6,5,6,5,6
61                    ;
62                    ;PIN POSN OF A11/A12   1 : A11-PIN 23, A12-PIN 2
63                    ;                      0 : A11-PIN 20, A12-PIN 23
64    1C43  01        A11A12:  .BYTE   1,1,1,1,1,0,1,0,1
65                    ;
66                    ;
67    1C4C  20871D    START:   JSR      ZPSWAP      ;SWAP RAM ADDR/ ZERO PGE
68    1C4F  AD0B1C             LDA      MODE        ;
69    1C52  C902               CMP      £2          ;PROGRAMME ?
70    1C54  D003               BNE      READ        ;NO - MUST BE READ ETC.
71    1C56  4CBC1C             JMP      PROG        ;IF SO JUMP
72                    ;
73                    ;READING CODE
74                    ;
75    1C59  A930      READ:    LDA      £30H        ;CONFIGURE
76    1C5B  8D25BC             STA      IC2CRA      ;IC2PIA
77    1C5E  A900               LDA      £0          ;AS
78    1C60  8D24BC             STA      IC2PIA      ;INPUT
79    1C63  A934               LDA      £34H        ;FOR
80    1C65  8D25BC             STA      IC2CRA      ;READ
81    1C68  AE0C1C    LOOPR:   LDX      TYPE        ;DEVICE TYPE INDEX
82    1C6B  BD0D1C             LDA      READS3,X    ;SET
83    1C6E  8D23BC             STA      IC1CRB      ;UP
84    1C71  A900               LDA      £0          ;INITIAL
85    1C73  8D20BC             STA      IC1PIA      ;CONDITIONS
86    1C76  A93C               LDA      £3CH        ;FOR
87    1C78  8D25BC             STA      IC2CRA      ;READ
88    1C7B  BD161C             LDA      READS6,X    ;
89    1C7E  8D26BC             STA      IC2PIB      ;
90    1C81  209C1D             JSR      DELAY       ;SHORT DELAY
91    1C84  20621D             JSR      INCADD      ;NEXT RAM/EPROM ADDRESS
92    1C87  D003               BNE      CONTR       ;IF NOT LAST - CONTINUE
93    1C89  4C131D             JMP      EXIT        ;ELSE GO AWAY
94    1C8C  20171D    CONTR:   JSR      SETADD      ;PUT ADDRESS ON PINS
```

```
95   1C8F  AD25BC            LDA   IC2CRA       ;SET
96   1C92  4908              EOR   £8           ;CHIP ENABLE
97   1C94  8D25BC            STA   IC2CRA       ;LOW
98   1C97  209C1D            JSR   DELAY        ;SHORT DELAY
99   1C9A  AD24BC            LDA   IC2PIA       ;GET DATA FROM EPROM
100  1C9D  8D0A1C            STA   RDATA        ;AND STORE IT
101  1CA0  A200              LDX   £0           ;ZERO INDEX REGISTER
102  1CA2  AC0B1C            LDY   MODE         ;READ, TEST OR VERIFY ?
103  1CA5  F010              BEQ   RR           ;READ
104  1CA7  3007              BMI   VV           ;VERIFY
105  1CA9  C9FF              CMP   £0FFH        ;MUST BE VERIFY  - FF ?
106  1CAB  F0BB              BEQ   LOOPR        ;IF SO ROUND AGAIN
107  1CAD  4C131D            JMP   EXIT         ;ELSE NOT ERASED - EXIT
108  1CB0  C135      VV:     CMP   (ZPLOAD,X)   ;COMPARE WITH RAM
109  1CB2  F0B4              BEQ   LOOPR        ;IF OK LOOP
110  1CB4  4C131D            JMP   EXIT         ;ELSE BAD EPROM-EXIT
111  1CB7  8135      RR:     STA   (ZPLOAD,X)   ;STORE DATA IN RAM
112  1CB9  4C681C            JMP   LOOPR        ;ROUND AGAIN
113                  ;
114                  ;PROGRAMMING CODE
115                  ;
116  1CBC  A930      PROG:   LDA   £30H         ;CONFIGURE
117  1CBE  8D25BC            STA   IC2CRA       ;IC2PIA
118  1CC1  A9FF              LDA   £0FFH        ;AS
119  1CC3  8D24BC            STA   IC2PIA       ;OUTPUT
120  1CC6  A934              LDA   £34H         ;FOR
121  1CC8  8D25BC            STA   IC2CRA       ;PROGRAMME
122  1CCB  AE0C1C    LOOPP:  LDX   TYPE         ;EPROM TYPE
123  1CCE  BD0D1C            LDA   READS3,X     ;SET
124  1CD1  8D23BC            STA   IC1CRB       ;UP
125  1CD4  A900              LDA   £0           ;INITIAL
126  1CD6  8D20BC            STA   IC1PIA       ;CONDITIONS
127  1CD9  BD1F1C            LDA   PROGS5,X     ;FOR
128  1CDC  8D25BC            STA   IC2CRA       ;PROGRAMME
129  1CDF  BD281C            LDA   PROGS6,X     ;
130  1CE2  8D26BC            STA   IC2PIB       ;
131  1CE5  209C1D            JSR   DELAY        ;SHORT DELAY
132  1CE8  20621D            JSR   INCADD       ;NEXT RAM/EPROM ADDRESS
133  1CEB  F026              BEQ   EXIT         ;IF LAST THEN EXIT
134  1CED  20171D            JSR   SETADD       ;PUT ADDRESS ON PINS
135  1CF0  A200              LDX   £0           ;ZERO INDEX REGISTER
136  1CF2  A135              LDA   (ZPLOAD,X)   ;GET DATA FROM RAM
137  1CF4  8D24BC            STA   IC2PIA       ;PUT DATA ON PINS
138  1CF7  AE0C1C            LDX   TYPE         ;EPROM TYPE
139  1CFA  BC3A1C            LDY   PTBYTE,X     ;BYTE TO TOGGLE
140  1CFD  B920BC            LDA   IC1PIA,Y     ;LOAD IT
141  1D00  5D311C            EOR   PTBIT,X      ;TOGGLE BIT
142  1D03  9920BC            STA   IC1PIA,Y     ;PUT IT BACK AGAIN
143  1D06  A01D              LDY   £1DH         ;CARRY
144  1D08  A2FF              LDX   £0FFH        ;OUT
145  1D0A  CA        DEL:    DEX                ;50 MS
146  1D0B  D0FD              BNE   DEL          ;DELAY
147  1D0D  88                DEY                ;FOR
148  1D0E  D0FA              BNE   DEL          ;PROGRAMME
149  1D10  4CCB1C            JMP   LOOPP        ;ROUND AGAIN
150                  ;
151  1D13  20871D    EXIT:   JSR   ZPSWAP       ;SWAP BACK ZERO PAGE
152  1D16  60                RTS                ;EXIT BACK TO BASIC
153                  ;
154                  ;
155                  ;ROUTINE TO PUT ADDRESS ON APPROPRIATE EPROM PINS
156                  ;
157  1D17  AD051C    SETADD: LDA   LOADE        ;WRITE LOW ORDER BYTE
158  1D1A  8D22BC            STA   IC1PIB       ;STRAIGHT TO EPROM
159  1D1D  BD431C            LDA   A11A12,X     ;25 OR 27 SERIES ?
160  1D20  F009              BEQ   ADD25        ;BRANCH IF 25-SERIES
161  1D22  AD061C            LDA   HIADE        ;GET HI ORDER BYTE
162  1D25  8D20BC            STA   IC1PIA       ;WRITE STRAIGHT TO EPROM
163  1D28  4C521D            JMP   ADD13        ;JUMP TO A13 CODE
164  1D2B  AD20BC    ADD25:  LDA   IC1PIA       ;GET IC1PIA
165  1D2E  0D091C            ORA   HIADM        ;OR IN MASKED HI BYTE
166  1D31  8D20BC            STA   IC1PIA       ;PUT IT BACK AGAIN
167  1D34  AD061C            LDA   HIADE        ;GET HI ORDER BYTE
168  1D37  2910              AND   £10H         ;TEST A12
169  1D39  F008              BEQ   ADD11        ;IF UNSET GO TO A11 CODE
170  1D3B  AD20BC            LDA   IC1PIA       ;A12 IS SET - GET IC1PIA
171  1D3E  0908              ORA   £8H          ;OR IN A12
172  1D40  8D20BC            STA   IC1PIA       ;AND PUT IT BACK AGAIN
173  1D43  AD061C    ADD11:  LDA   HIADE        ;GET HI ORDER BYTE
174  1D46  2908              AND   £8H          ;TEST A11
175  1D48  F008              BEQ   ADD13        ;IF UNSET GO TO A13 CODE
176  1D4A  AD26BC            LDA   IC2PIB       ;A11 IS SET - GET IC2PIB
177  1D4D  0901              ORA   £1H          ;OR IN A11
178  1D4F  8D26BC            STA   IC2PIB       ;PUT IT BACK AGAIN
179  1D52  AD061C    ADD13:  LDA   HIADE        ;GET HI ORDER BYTE
180  1D55  2920              AND   £20H         ;TEST A13
181  1D57  F008              BEQ   ADDEXT       ;IF NOT SET RETURN
182  1D59  AD23BC            LDA   IC1CRB       ;A13 IS SET - GET AC2PIB
183  1D5C  0908              ORA   £8H          ;OR IN A13
184  1D5E  8D23BC            STA   IC1CRB       ;PUT IT BACK AGAIN
185  1D61  60        ADDEXT: RTS                ;RETURN
186                  ;
187                  ;
188                  ;INCREMENT ADDRESS FOR BOTH RAM AND EPROM, WRITE
```

routines the initial conditions are set up and a loop is executed for each address to be read or programmed. Each time round the loop the appropriate PIA bit is toggled to carry out the required function to the EPROM. In the case of testing the read data is compared with FF (the expected value for an erased EPROM) and in verifying the read data is compared with data in RAM. In either of these two modes, if the test fails the subroutine exits and this is detected in the BASIC program by the fact that the address returned in LOADR and HIADR is less than the expected final RAM address.

The general overview being complete, a few specific points on the tailoring of the assembler routine to suit other machines will now be covered.

a). The origin of the routine should be selected so as not to conflict with the area of RAM used by the BASIC program and the area to be used for data storage (as selected by the BASE command). The origin is set on line 14.

b). The address of the EPROM programmer hardware as selected by the on board links should be equated to IC1PIA on line 23. It should be noted that the addresses in a). and b). must agree with the addresses of the M/C code routine and hardware as assigned in the BASIC program.

c). Lines 143 to 148 are a couple of nested loops which implement the 50ms pulse required for programming EPROMs. These loops will only generate a 50ms delay when running on a processor with a 750 kHz clock such as the Tangerine Microtan. For different clock frequencies the value of 1D loaded into register Y on line 143 would require to be changed proportionally. For example, if the subroutine were to be run on a machine with a 1MHz clock a value of 1D (hex) ★ 1000/750 = 27 (hex) should be used.

As a final point, although the assembler routine has been written for a 6502 processor and as such will not run on any other processor, the hardware is compatible with the increasing number of computers using the 6809 processor. For this reason, some owners of 6809 based machines may like to try their hand at converting this routine to 6809 code. Although, it wouldn't result in the most efficient 6809 code, the easiest way to do this would be to translate it virtually on an instruc- ▶

tion by instruction basis, a task which shouldn't be beyond the capabilities of those with a moderate knowledge of 6809 programming.

The following list contains all those errors which have come to light since the project was published.

On the circuit diagram (page 46, August 1983), C6 is 100μ and C9 is 100n, not the other way round as given. Some bars were omitted from note three of Table 1 on page 48: it should have read "$\overline{CE}$/PGM (27 series) is equivalent to PD/PGM (not PD/$\overline{PGM}$) (25 series)." The penultimate sentence of the first paragraph on page 50 should read "... adjust RV1 for a potential of +25 V at *IC10* output." On the overlay, IC7 is between SK2 and SK1, IC6 is beteen SK1 and C10, IC11 is between R7 and R10, R3 is between R2 and Q2, and Q7 is between Q6 and Q8. A link is missing between IC7 and SK1, and the unidentified pins at the right hand end of SK3 are the +5V line. Finally, C10 appears twice in the parts list but only the first entry is correct, and the second DIL socket should of course, be 8, not 80, way.

Table 1 continued (see notes overleaf).

```
                  ;HIADM -IE HIADE WITH A11 AND A12 MASKED OUT
                  ;AND SET Z CONDITION CODE IF LAST ADDRESS DONE
                  ;
1D62  E635        INCADD: INC   ZPLOAD    ;LO ORDER RAM ADDRESS
1D64  D002                BNE   INCROM    ;SKIP IF NO CARRY
1D66  E636                INC   ZPHIAD    ;ELSE INC HI RAM ADD
1D68  EE051C      INCROM: INC   LOADE     ;LO ORDER EPROM ADDRESS
1D6B  D003                BNE   INCEXT    ;SKIP IF NO CARRY
1D6D  EE061C              INC   HIADE     ;ELSE IN HI EPROM ADD
1D70  AD061C      INCEXT: LDA   HIADE     ;GET HI ORDER EPROM
1D73  29E7                AND   £0E7H     ;MASK OUT A11, A12
1D75  8D091C              STA   HIADM     ;STORE IT
1D78  AD051C              LDA   LOADE     ;GET LO EPROM ADDRESS
1D7B  CD071C              CMP   LOADF     ;LAST ADDDRESS ?
1D7E  D006                BNE   INCRTS    ;IF NOT EXIT
1D80  AD061C              LDA   HIADE     ;ELSE TEST HI ORDER
1D83  CD081C              CMP   HIADF     ;LAST ADDRESS ?
1D86  60          INCRTS: RTS             ;RETURN
                  ;
                  ;
                  ;THIS ROUTINE SWAPS ZPLOAD WITH LOADR
                  ;AND ZPHIAD WITH HIADR
                  ;
1D87  A635        ZPSWAP: LDX   ZPLOAD    ;GET LO ZERO PAGE
1D89  A436                LDY   ZPHIAD    ;AND HI ZERO PAGE
1D8B  AD031C              LDA   LOADR     ;GET LO RAM
1D8E  8535                STA   ZPLOAD    ;WRITE TO LO ZERO PAGE
1D90  AD041C              LDA   HIADR     ;GET HI RAM
1D93  8536                STA   ZPHIAD    ;WRITE TO HI ZERO PAGE
1D95  8E031C              STX   LOADR     ;ZERO PAGE TO LO RAM
1D98  8C041C              STY   HIADR     ;ZERO PAGE TO HI RAM
1D9B  60                  RTS             ;RETURN
                  ;
                  ;
                  ;SHORT DELAY TO ACCOUNT FOR CAPACITOR SLOWING
                  ;SIGNALS ON PIN 22 (20)
                  ;
1D9C  A080        DELAY:  LDY   £80H      ;LOOP COUNTER
1D9E  88          DELAY1: DEY             ;DECREMENT
1D9F  D0FD                BNE   DELAY1    ;LOOP IF NOT ZERO
1DA1  60                  RTS             ;RETURN
                  ;
                          .END
```

ETI

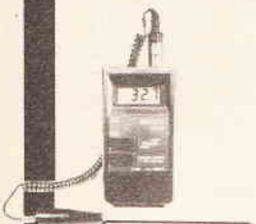
p-t-m elektronik

£145 Kit £110
+ VAT (p & p £2.50)

£220 Kit £160
+ VAT (p & p £4.50)

£79 Kit £49
+ VAT (p & p £2.50)

£49 Kit £36
+ VAT (p & p £1.50)



£145 Kit £110
+ VAT (p & p £1.50)

NTL04 POWER SUPPLY

0-30V, 0-2.5A ● voltage setting with 10T pot giving 0.1V resolution ● fully protected floating output ● selection of current limiting or current foldback mode ● 3 digit displays for voltage & current with 0.1% FSD accuracy ● automatic dissipation control ● line stability 0.01% for ± 10% mains voltage change ● load regulation 0.02% for 100% load change ● ripple 2mV typ. ● transient response < 50us

NTL05 POWER SUPPLY

0-50V, 0-3A ● voltage setting with 10T pot giving 0.1V resolution ● fully protected floating output ● automatic changeover from constant voltage to constant current mode ● 3 digit displays for voltage & current can be used for external measurement range -9.9V to 99.9V, 0.1V resolution; 0 to 5A 0.01A resolution, meter accuracy 0.01% FSD ● automatic dissipation control ● line stability 0.01% for ± 10% mains voltage change ● load regulation 0.01% for 100% load change ● ripple 1mV typ. ● current stability with current control 0.1% +1mA typ ● transient response <50us ● LED function indicators

XR2206 FUNCTION GENERATOR

frequency range 10Hz to 220Hz ● linear setting over 8 ranges ● waveforms: sine, triangle, square ● sawtooth & negative pulse at approx. twice the set frequency available ● distortion of the sine wave <1% at 1KHz ● output AC for all waveforms adjustable: 0-10mV, 0-100mV, 0-1V, impedance approx. 5 ohms ● output SYNC square or negative pulse TTL compatible

DT155 DIGITAL THERMOMETER

alternate reading of 2 measuring points ● temperature range -55°C to +100°C ● resolution 0.1°C ● 3 digit 18mm red LED display ● automatic changeover of the probes at 10 sec interval with LED indication ● sensor probes can be located at a distance of up to 100m from the instrument ● mains supply for permanent operation ● brushed anodised alum. enclosure 136 x 47 115mm (W x H x D) ● choice of 3 sensor probes

LM 135	-55°C to +100°C	£10	Kit £8
LM 235	-40°C to +100°C	£ 8	Kit £6
LM 335	-10°C to +100°C	£ 6	Kit £4

DT600 DIGITAL THERMOMETER

precision thermometer with one Pt100 platinum film probe to BS1904 grade 11 covering -70°C to +600°C in 2 ranges: -70°C to +199.9°C, resolution 0.1°C; -70°C to +600°C, resolution 1°C ● lineariser circuit guarantees accuracy of 0.2% ±1 digit over entire range ● measuring rate 3/sec ● response time 10sec to 99% in moving water ● memory switch ● 3 wire probe connection allows measurement over extension cable up to 25m ● probe with handgrip, 1.5m spiral cable & 5pole DIN socket ● battery 9V PP3 for approx. 30h operation ● low battery indicator

Our kits contain all the material required for the assembly including pcb, enclosure, annotated front plate & all electronic parts. A comprehensive assembly manual is provided with step by step instructions & circuit description.

NEW

WOG2206 SWEEP GENERATOR

- **makes easy work of establishing and displaying on the oscilloscope frequency responses of equalisers, active filters, crossover networks, audio amplifiers, etc.**
- **excellent function generator: frequency range 0.2Hz to 200KHz**
- **professional appearance at low cost**
- **save pounds and enjoy assembling kit version**

function generator: 0.2Hz to 200KHz with linear setting over 6 ranges ● waveforms: sine, square, triangle ● sine wave distortion <1% at 1KHz ● sine & triangle continuously adjustable from 1.5mV to 15Vpp; square wave in 4 steps from 12mV to 12V ● DC offset adjustable for sine & triangle waves **sweep generator:** sweep rate of 0.5sec to 10 sec ● internal sweep linear 100:1, logarithmic 500:1 (1000:1 typ.) ● trigger output 5V TTL

Prices are subject to 15% VAT

£115 Kit **£70**
+ VAT (p & p £2.50)

FREL LTD.

ELECTRONIC DESIGN & MARKETING
RW1 HOLMBUSH INDUSTRIAL ESTATE
MIDHURST WEST SUSSEX GU29 9HX
TELEPHONE: MIDHURST (073 081) 2535

MICROTANIC COMPUTER SYSTEMS LTD.

MICROTAN 65 *NO OTHER COMPUTER IS AS PERSONAL!*

For less than £60 you can start building your own Computer that truly suits your needs and, of course, eventually far more superior to any Computer available off-the-shelf.

MICROTAN 65 comes in kit form, complete with manual, full instructions, board with components, (kit form or fully built) our full back-up service, and your own Microtan World Magazine available on subscription.

FLEXIBLE & EXPANDABLE SYSTEM — 1K to 256K!

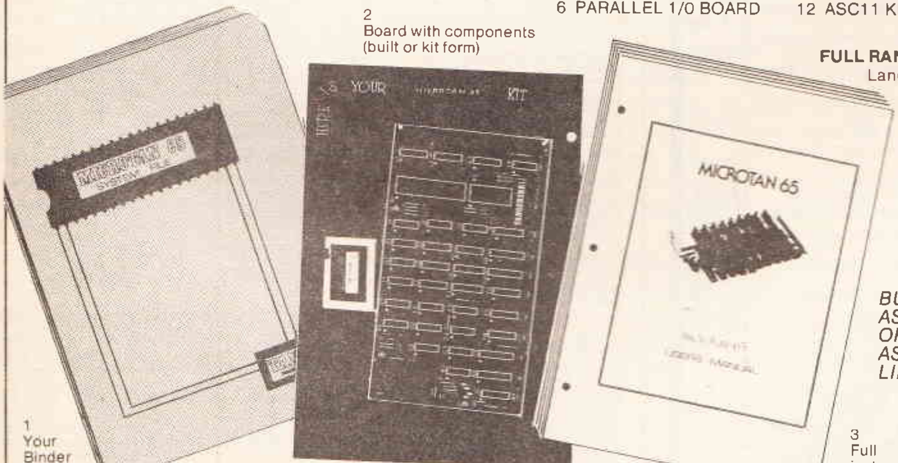
Just look at the options:

1 DISK CONTROLLER
2 REAL TIME CLOCK
3 EPROM PROG. CARD
4 SOUND BOARD
5 SERIAL 1/0 BOARD
6 PARALLEL 1/0 BOARD
7 MASS EPROM STORAGE BOARD
8 INDUSTRIAL CONTROLLER BOARD
9 40K RAM BOARD
10 HIGH RES. GRAPHICS 256x256
11 PRINTER FACE BOARD
12 ASC11 KEYBOARD

Microtan World Magazine

FULL RANGE OF SOFTWARE
Languages available: Machine Code, Assembly, Basic, Forth, and Pilot

2
Board with components (built or kit form)



1
Your Binder

3
Full instructions manual

BUILD AS FAST OR SLOW AS YOU LIKE!

HOW TO ORDER:

Enter details in the coupon below, enclosing your cheque made payable to: Microtanic Computer Systems Ltd. Prices include VAT add £1.50 p&p. Please allow 14 days for delivery.

Post to:
MICROTANIC COMPUTER SYSTEMS LTD
16 UPLAND RD. LONDON SE22
Tel No. 01-693 1137

Please rush me my starter kit:
(Please tick)

☐ kit form — I will build myself £59.95
☐ Fully Built £69.95
☐ Complete system wall chart

I enclose my cheque/P.O. for £

Name ....
Company ....
Address ....
....
....
Tel (Day) ....
Tel (Eve) ....

MICROTAN COMPUTER SYSTEMS LTD
SHOWROOM: 16 UPLAND RD
DULWICH, LONDON SE22
TEL: 01-693-1137

MAIL ORDER:
235 FRIERN RD. DULWICH
LONDON SE22

Also available from:
Waltham Forest Computer Centre
889 Lee Bridge Rd.
Nr Whipps Cross, Walthamstow E7
Tel: 01-520 7747

HENRY'S AUDIO ELECTRONICS

COMPUTERS • COMMUNICATIONS • TEST EQUIPMENT • COMPONENTS

VISIT OR PHONE • OPEN 6 DAYS A WEEK • ALL PRICES INC VAT

THERMAL MATRIX & LINE PRINTER

NEARLY ½ PRICE

COMPLETE WITH FULL HANDBOOK, 3 ROLLS PAPER **£99.95** INC VAT

£86.91 + VAT (UK post etc £1.05) (List approx £187)

150 to 160 LPM • Full 96 CH ASC II • 40 CPL • 280 Dots P/L Auto-underline • 50 Graphic Symbols • Back Space • Self Test • VU/HOR TABS • 7 x 10 Matrix • 4.4" Wide Paper Bidirectional • 220/240 V AC • Size Approx 9.8 x 2.8 x 7.2"

SUITABLE FOR: TANDY • BBC • ORIC • NASCOM • GEMINI • ACORN • NEW BRAIN • DRAGON • etc etc.

(Your enquiries invited).

(Interface unit with leads £15 – state model)

PRESTEL ADAPTOR

3 card set with data etc (P/S +/– 12V and +5V) **£69.95** inc. VAT

MODEM CARD

BT approved ready assembled unit with data and accessories. **£39.95** inc. VAT

CHERRY ADD-ON KEYPAD

16 button pad non-encoded

£5.95

SANYO DM2112 HIGH RESOLUTION MONITOR

12" green display:
Composite video:
1280 characters:
Over 15 MHZ B/W:
240V AC 34 w:
16" x 11¼" x 12⁹⁄₁₆":
Alphanumeric and Graphic display: Usually **£89.95 - £99.95**

SAVE £20 TO £30

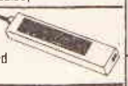
Price **£69.95** incl VAT (UK C/P & ins £2.05)

I.T.T. 2020 CABINET

Complete PROFESSIONAL Case beautifully constructed with cut out for one 'CHERRY' keyboard, plus ample room to house a COMPLETE SYSTEM and power supply. Complete with fittings (Case top detachable). Unit is silver grey in colour. Robust construction. Sloping front with side ventilation. Ideal for NASCOM, ACORN, TANGERINE or your own system. Size 18" x 15" x 4" (front slopes)

£27.50 inc. VAT (UK C/P £2.50)

LOGIC PROBES

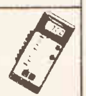


LP10 10 MHZ £26.95
DLP50 50 MHZ with carry case and accessories £49.95

HIGH VOLTAGE METER

Direct reading 0/40 KV.
20K/Volt. **£23.00** (UK C/P 65p)

DIGITAL CAPACITANCE METER (UK C/P 65p)



0.1 pf to 2000 mfd LCD 8 ranges
DM6013 £52.75

TRANSISTOR TESTER

Direct reading PNP, NPN, etc.
TC1 £21.95
(UK C/P 65p)

VARIABLE POWER SUPPLIES

(UK C/P £1.00)

PP241 0/12/24V 0/1A £35.00
PP243 3 amp version £59.95
PS1307S 8/15V 7 amp twin meter £24.95

FREQUENCY COUNTERS

PFM200A 200 MHZ hand held pocket 8 digit LED £77.60
MET100 8 digit LED bench 2 ranges 100 MHZ £102.35
MET600 8 digit LED bench 3 ranges 600 MHZ £132.25
MET1000 8 digit LED 3 ranges 1 GHZ £182.85
TF040 8 digit LCD 40 MHZ Thandar £126.50
TF200 3 digit LCD 200 MHZ Thandar £166.75

DIGITAL MULTIMETERS

■ with case (rotary switches)
+ Side button – case £2.95

KD25C ■ 13 range 0.2A DC 2 meg ohm £23.50
KD305 ■ 16 range 10A DC 2 meg ohm £26.95
KD30C ■ 26 range 1A AC/DC 20 meg ohm £29.50
KD55C ■ 28 range 10A AC/DC 20 meg ohm £33.50
Metex 3000 ■ 30 range 10A AC/DC 20 meg ohm £33.24
6010 + 28 range 10A AC/DC 20 meg ohm £34.40
7030 4+ AS6010 high acc. 0.1% basic £41.30
KD615 ■ 16 range 10A DC 2 meg plus Hfe tester £39.95
SIFAM 2200B 21 range 2A AC/DC 20 meg £29.95

Bench Models

TM355 29 range LED 10A AC/DC 20 meg Thandar £86.25
TM356 26 range LCD 10A AC/DC 20 meg Thandar (Replaces **TM353**) £97.75
TM351 29 range LCD 10A AC/DC 20 meg Thandar £120.75
SIFAM 2500 24 range LCD 2A AC/DC 20 meg £79.95

ALSO IN STOCK Thurlby, Metrix and Beckman. Professional series incl. True Rms. etc.

MULTIMETERS (UK C/P 65p)

C7081 50 K/Volt range doubler 10A DC. Total 36 ranges. Special Offer £12.50
HM102BZ 20K/V 10A DC 22 range & cont. buzzer £13.50
TMK500 23 ranges 30K/V 12A DC plus cont. buzzer £23.95
NH56R 20K/V 22 range pocket £10.95
830A 26 range 30K/V 10A AC/DC overload protection, etc. £23.95
360TR 23 range 100K/V Large scale 10A AC/DC plus Hfe £39.95
AT2100 31 range 100K/V deluxe 12A AC/DC £33.50
AT1020 18 range 20K/V. Deluxe plus Hfe tester £18.95
YN360TR 19 range 20K/V plus Hfe tester £15.95

SIGNAL GENERATORS (220/240V AC)

FUNCTION: All sine/square/triangle/TTL etc.
TG101 0.02HZ-200KHZ £113.85
TG102 0.2HZ-2 MHZ £166.75

PULSE
TG105 Various facilities 5 HZ-5 MHZ £97.75

AUDIO: Multiband Sine/Square
LAG27 10 HZ to 1 MHZ £90.85
AG202A 20 HZ to 200 KHZ (list £94.50) £83.50
LAG 120A 10 HZ-1MHZ Low Distortion £159.85

RF
SG402 100 KHZ to 30 MHZ (list £79.50) £69.50
LSG17 100 KHZ to 150 MHZ £79.35

OSCILLOSCOPES

Full specification any model on request. SAE by post
'HM' Series HAMEG: 'SC' THANDAR: 'CS' TRIO: '3' CROTECH 'V' HITACHI

SINGLE TRACE UK C/P £3.00
3030 15 MHZ 5mV. 95mm tube plus component tester £177.10
SC110A ■ Miniature 10 MHZ battery portable Post free £171.00
■ Optional carry case £6.84 AC adaptor £6.69 Nicads £12.50
HM103 15 MHZ 2mV. 6 x 7 display plus component tester C/P £3.00 £181.70

DUAL TRACE (UK C/P £4.00)
HM203/4 Dual 20 MHZ plus component tester £303.60
CS1562A Dual 10 MHz (List £321.00) £269.50•
3131 Dual 15 MHZ + component tester £276.00
CS1566A Dual 20 MHZ All facilities (List £401.35) £349.50•
HM204 Dual 20 MHZ plus component tester sweep delay £419.75
HM705 Dual 70 MHZ sweep delay £676.00
V212 Dual 20 MHZ £399.25•
V222 Dual 20 MHZ plus extra facilities £391.00•
V422 Dual 40 MHZ portable £586.50•
V203F Dual Trace 20 MHZ sweep delay £408.25•
V134 Dual Trace 10 MHZ storage £1092.50•

All HITACHI, CROTECH & TRIO MODELS AVAILABLE • With probes

OPTIONAL PROBE KITS
X1 £7.95 X10 £9.45 X1 - X10 £10.50

Huge stocks of semicons, components, tools, etc. Large range of CB equipment and telephones in stock.

CALL IN AND SEE FOR YOURSELF.
ORDER BY POST OR PHONE.

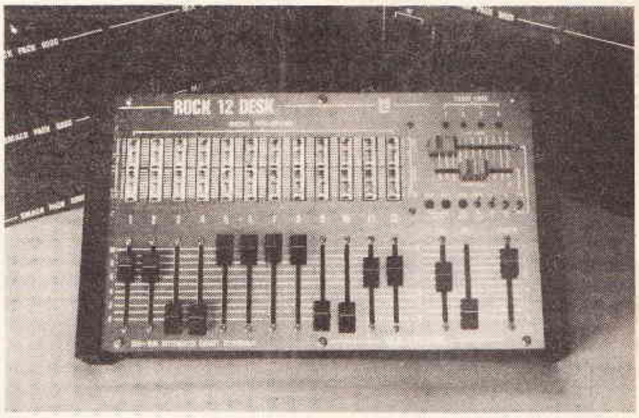
Order by Post with CHEQUES/ACCESS/VISA or you can telephone your orders. All orders despatched within 5 days unless advised.

HENRY'S Cubegate Limited
404-406 Edgware Road, London, W2 1ED
Computer: 01-402 6822. Components: 01-723 1008
Test Equipment & Communications: 01-724 0323

AUDIO ELECTRONICS
301 Edgware Road, London, W2 1BN
01-724 3564 (All mail to this address)

LIGHTING SYSTEMS

FOR BANDS AND THEATRES



Who manufactures a twelve channel desk with sound chase, sound to light, strobe, triple masters, and a powerful 240 switch program matrix, for under £300. Multicore leads from 10 to 50 metres, power packs up to 2400 Watts per channel, (even transformer loads) and a range of modules for custom built rigs and installations? Answer: We do.

13A POWER PACKS £120
30A — £182
60A — £270
12 CHAN DESKS £169
ROCK DESKS £299

Sales Manager
MJL SYSTEMS LTD
45 Wortley Rd.,
W. Croydon, Surrey
CR0 3EB U.K.
01-6894138
(Mon-Fri 9-5)

PAR56 — 300W CANS £25
TRIPODS — £36
PAR64 — 1000W CANS £67

TRANSTEL DOT MATRIX PRINTER. Compact. Serial Interface. 230 Volts. **£65 each.**
9" MONITOR. CASED. Non Standard. With Info **£20 each.**
12" MONITOR. CASED. Non Standard. With Info. **£15 each.**
COSSOR OSCILLOSCOPE CDU150. Dual Trace 35MHZ. Delay Sweep **£195 each.**
SOLARTRON OSCILLOSCOPE CD1400. Dual Beam 15MHZ **£90 each.**
TELEQUIPMENT OSCILLOSCOPE S43 Single Beam 25MHZ **£65 each.**
TELEQUIPMENT OSCILLOSCOPE S54 Single Beam 10MHZ Solid State **£95 each.**
ADVANCE SIGNAL GENERATOR type 62. 150KHZ-220MHZ CW/Mod **£30 each.**
METRIC WOBBULATOR type 210. 5-220MHZ with manual **£25 each.**
AVO TRANSISTOR TESTER type TT169 with leads. As new **£20 each.**

GEARED MOTOR 117/234 V 50HZ Input 4" dia x 5¼" deep ¼" shaft. NEW. **£5 ea.** P&P £4.
240VOLT AC MOTOR (Turntable style) Size 82 x 75 x 76mm. Shaft 43x4mm dia. **£1.50 ea** P&P £2.
MOTOR 12V DC Input 3" dia x 4½" deep ¼" shaft. New **£3.50 each** P&P £3.
SYNCHRONOUS MOTOR 2 Phase 9 volt AC 375 RPM. Good torque (needs 30-40mfd capacitor) Can be used as DC STEPPING MOTOR 8 STEPS PER REV **£1 each.**

STEPPING MOTORS AVAILABLE PLEASE ENQUIRE

GEARED MOTOR 120V 50HZ 4 Watt 1 rpm 2" dia x 1⅜" deep **£1.50 each.**
TORIN SNAIL TYPE BLOWER 230V 22 Watts. Overall size 5 x 1½". **£4 each** P&P £2.
CENTAUR FANS 4½" 115V New **£4.50 ea.**
MUFFIN 115V 4½". Unused **£3 ea.** P&P.
TRANSFORMERS — All Brand New. All 240 Volts input.
Sec 25.5 Volts 2.5A. Size 3⅛ x 2⅝ x 2⅛" **£2.50 each.**
Sec 115V 1A (Auto) — **£1.25 each.**
Sec 6V 1.66A — **£1.50 each.**
Sec 12V 100MA — **50p each.**
TRANSFORMER 0-220 — 240V Input. Sec 0-12V & 0-24V 1 Amp (2 windings) **£2 each.**
TRANSFORMER 120V Input. Sec 10-0-10V 1A — **75p each.**
Sub-Min Transformer 0-120-240V Input Sec 12-0-12V 4VA — 75p ea. 10 off **£6.**
TOROIDAL TRANSFORMER 0-115-230V Input. Sec 13.5-0-13.5V 8VA. **£1.50 each.** 10 off **£12.**
TOROIDAL TRANSFORMER 0-120-240V Input Sec 0-12V; 0-12V 10VA per winding. Encapsulated **£4 each.** 10 off **£35.**
Sub-Min **PULSE TRANSFORMER.** Sec centre tapped. Suitable Thyristor triggering. **20p each** 10 off **£1.80.**
RAPID DISCHARGE CAPACITOR 8 mfd 4KV **£5 each.** P&P £2.
E.H.T. CAPACITORS 200pf 500pf 1000pf 8KV **20p each.** 10 off **£1.80.**
ELECTROLYTIC CAPACITOR 15,000 mfd 25V **20p each.** 10 off **£1.80.**
ILLUMINATED ROCKER SWITCH. 2 pole 250V 8 Amp Orange — **50p each.** 10 off **£4.**
SLOTTED OPTO SWITCH with data — **50p each.** 10 off **£4.**
SPECTRAL RELIANCE TEN TURN POT. 100 ohm; 500 ohm Brand New **75p each.** 10 off **£6.**
SLIDER POTENTIOMETER Twin Gang. 200K. 2M — **35p each.** 10 off **£3.** Swing Gang 10K — **25p each.** 10 off **£2.**
PANEL MOUNTING FUSE HOLDER for 1¼" fuse — **20p each.** 10 off **£1.50.**
BELLING LEE CHASSIS MOUNTING FUSE HOLDER for 1¼" fuse — **15p each.** 10 off **£1.**

I.E.C. MAINS LEAD — 2 metre length. Heavy duty — **60p each.** 10 off **£5.**
4 CORE CURLY WIRE extending to 2 metres — **20p each.** 10 off **£1.80.**
MICROPHONE/EARPIECE INSERTS. Brand New **75p each.** 10 off **£6.**
TOKIN NOISE FILTER VF2 15FU 250VAC 15A 50/60HZ With fixing bracket New — **£2 each.**
CINCH CONNECTOR STRIP 12 way 4BA Screw connection on both sides — **35p each.** 10 off **£3.**
INFRA RED QUARTZ LAMP 230V 620 Watts. Size 13½ x ¼" dia — **£1.50 each.** 10 off **£10.**
FERRANTI PHOTOCELL TYPE MS15 — **50p each.** 10 off **£4.**
VU METER Scaled 0-5. Size 1½ x ⅞" — **50p each.** 10 off **£4.**
I.T.T. LOUD SPEAKER. 2¼" dia. 50 ohm 0.2 Watt. New — 75p each. 10 off **£6.50.**
PCB KEYBOARD PAD. 19 Push Contacts. 0-9, A-F plus 3 optional — **£1.50 each.** 10 off **£12.**
KEYBOARD PAD. 12 Alma Reed Switches. Push to make 0-9; *; & blank. size 3 x 2½ x 2" high — **£4 each.** 5 off **£15.** P&P £3.
VARIAC 2 Amp Ex equipment. Good condition — **£12 each.** P&P £4.
E.H.T. Cable. Overall dia 5mm. — 10p per metre. 100 metre drum **£7.50.** P&P £4.
Multi colour **RIBBON CABLE** 10 way — **50p** per metre. 10 metres **£4**; 14 way — **75p** per metre, 10 metres **£6**; 100 metres **£40.**
LED. type TIL209. Red with holder — **8p each.** 10 off **70p.**
Dual in Line 6 pin **OPTO COUPLER 25p ea.** 10 off **£2.** **I.C. SOCKET** 16 pin **8p ea.** 100 off **£6.**
EPROM. Texas 2564 **£3 each.** **REGULATOR** TYPE 7812 — **30p ea.** 10 off **£2.50.**
MOSPOWER FET type VMP1 (TO 3) **£1.50 each.**
DIODES — 1N3470, 1N3063, 1S44, BAX13 — 100 off **£1.50.** 1000 off **£10.** 1N4002 — **3p**; 1N4003 — **4p.**
TRANSISTORS — 2N3704 — **5p**; 2N3964 — **50p**; 2N5449 — **5p**; BC107 — **8p**; TIP640 — **50p.**
BRIDGE RECTIFIER — CSC type BO5S — **20p each.** 10 off **£1.80.**
TANTALUM BEAD CAPACITORS 0.1mfd 35V. 10 off **£1.** 100 off **£7.50.**
CAPACITORS — 0.047 25V; 0.005 100V; 0.47 12V; 0.001 200V. 10 off **30p.** 100 off **£2.**
TRANSFORMER 240V Input. Sec 2KV 10MA. Size 80 x 70 x 110mm. Ex eq. **£4 each** P&P £2.
BURGESS HEAVY DUTY MICROSWITCH with Lever & arm **75p ea.** 10 off **£6.50.**
HONEYWELL H/DUTY MICROSWITCH with Button **60p each.** 10 off **£5.**
SPECTROL RELIANCE POT 570 ohm. Wire wound **25p each.** 10 off **£2.**
WIREWOUND RESISTOR 11 Watt 2.7 ohm **10p each.** 10 off **80p.**
CABLE TIES White 9cm, Black 12 cm. 50 for **50p.**
CARBON FILM RESISTOR 15 ohm 0.5W. 100 off **50p.** 1000 off **£3.**

EXECUTIVE TELEPHONE-PUSH BUTTON. Functions include 10 number memory; repeat dialing; internal Microphone & Speaker and separate handset etc. Will connect direct to British Telecom System. BRAND NEW. **ONLY £25 ea. P&P £4.**

Minimum Order of Goods £3. Minimum P&P £1.50. VAT at 15% MUST be added to TOTAL OF GOODS & PACKAGING.
Many more components and test equipment available. S.A.E. or telephone for lists.

STEWART OF READING

110 WYKEHAM ROAD, READING, BERKS. RG6 1PL
Tel: 0734 68041
Callers welcome 9 am-5.30 pm Monday to Saturday inclusive

BOOK REVIEWS

So you thought we couldn't read? Just to prove you wrong, the ETI staff has been ploughing through some of the new works in the field — here's what we think of them.

Understanding Digital Logic Circuits

R.G. Middleton
Prentice/Hall International
392 pages/£16.10

According to the preface, this book is aimed at those who are currently working in some area of electronics but who are not familiar with digital techniques. It assumes little or no prior knowledge either of the technology or the maths behind it and covers everything from the simplest of gates through to counters, converters, memories and the more complex devices now in use.

One of the first things one notices on reading through the book is that it is American, and that the illustrative examples used are therefore American also. Instead of the 74 series TTL and 4000 series CMOS familiar to British engineers, the notes and pin-out diagrams refer, with a few exceptions, to the Fairchild 93, 96, and 9N ranges, none of which are very well known in this country. Whilst this may not be a serious shortcoming it must, I feel, reduce the book's value and appeal to those at whom it is ostensibly aimed, that is, beginners in the field of digital electronics.

Another slight annoyance I found was the poor positioning of related text and illustration. This varied throughout the book, but in the worst instances as much as seven pages separated a section of text from the illustration to which it referred. In those places where a passage in the text referred to more than one illustration at a time, I very soon ran out of fingers! Whilst this, too, is perhaps a minor point it does make certain sections far more daunting than they need be, and again might well prove discouraging to those unfamiliar with the material.

On a more positive note, the book covers its ground very thoroughly indeed and has a suitably authoritative feel to it. There would be few, I suspect, who could read through it without learning something of value. I am not at all convinced that it is the best introduction for those new to digital electronics, but it is an excellent reference book for those, like me, who learnt only analogue techniques during their periods of formal study and who have picked up digital theory piecemeal along the way. The index, if not exhaustive, is certainly adequate, and after a week or two I found myself turning to it automatically whenever something on the bench posed a question of a digital nature.

IJP

Microprocessor Technology

David. L. Terrell
Prentice/Hall International
562 pages/£20.65

This is a fairly readable delve into the inner mysteries of the Z80 microprocessor chip and some of its more common support devices. This book covers both the hardware and software aspects of actually using a microprocessor chip, providing numerous examples of each and it even contains a circuit diagram for a basic trainer unit.

On the software side, the book covers not only the Z80 instruction set in reasonable details but proceeds to show how to accomplish some of the more common tasks required of simple computer and control systems. This is backed up on the hardware side by basic interface circuitry and illustrations of how to drive them.

The Z80 processor which is the basis of the book is one of the more complex 8-bit devices generally available. This means that while most of the concepts covered in the book are applicable to other devices, it must be remembered that different approaches may be required when realising systems using them.

Some knowledge of electronics and logic would be an advantage when reading the book as would access to some sort of small computer system and possibly someone with whom to discuss points of interest.

PJW

The Micro Cookbook

Vol. 1
Don Lancaster
Prentice/Hall International
384 pages/£13.55

Don Lancaster's Cookbook series has developed a good reputation for handling complex technical information in a down-to-earth practical way. In my experience, the most widely known is the CMOS cookbook, and this has graced many a lab bookshelf that I've known. So, the Micro Cookbook has a lot to live up to — but I'm afraid that it's blown it.

The first disappointment is that, as you may have already noticed, this is just volume 1 — volume 2, dealing with programming (machine code, of course), I/O, advanced techniques (no, they didn't say what that mean't), and some detailed examples, is still on the rollers. The first volume is just the introduction!

Even so, it hasn't made up it's mind who it's for. The others of the Cookbooks have all assumed that the reader has a firm grasp of the fundamentals but not necessarily the details. This Cookbook seems to be aimed at the *idot savant* played by Richard Prior in 'Superman III' — one moment it's insulting your intelligence with some of the most crass technical writing I've come across (for example, one of the exercises given to readers is

"Show the Exclusive-Or logic involved in having two girl-friends"), the next it's assuming you know far more about micro-processors than it has bothered to explain to you.

This is not to say that the Cookbook has nothing to offer, there is a great deal that's useful, even entertaining in it, and it can be very difficult to put down. However, all this good is burried and difficult to find.

So, I'm afraid, a disappointment, which is a real pity, because I'm sure that done properly, this book could have been at least as useful as others in the series. Let's hope that volume 2 is an improvement.

DJB

The Ground Launched Cruise Missile: A Technical Assessment

Tim Williams
Electronics For Peace
36 pages/75p (£1 inc postage)

Before getting too far into this review, a couple of confessions are in order. First of all, electronics for peace is 'a network . . . to link those working in electronics and computing who share a concern for the military implications of their profession.' Thus it is not a group that one would expect to be that well disposed towards cruise missiles in the first place, secondly, your reviewer is not that well disposed towards cruise missiles, either.

Confessions over, this book is reviewed here because it presents hard information in a subject area normally noteable for the domination of opinion. Not that the author has been lent a GLCM to put through its paces; most of the technical details of the missile system are well-guarded secrets. However, using a very wide range of sources, the author has been able to build up a disquieting picture of the goings on in the GLCM programme.

For instance, it is possible to infer that the reliability of GLCMs is lower than that of other American strategic nuclear weapons becuase there is no independent contractor whose only responsibility is to ensure reliability — contrary to practice in all other strategic weapon programmes.

The booklet catalogues likely technical problems, amongst which is that GLCMs use a very large number of advanced VLSI devices. Very few such devices have yet been approved to military specifications; also, there seems to be a problem in adequately sealing the chip encapsulation.

Another major problem area dealt with is the software. The software contractor is known to have run into difficulties — however, this is far from surprising, as a recent survey of US government software contracts found that only 1.7% of software could be used as delivered.

Whether you are for or against nuclear weapons in general or the stationing of GLCMs in this country in particular, or even if you simply have not made up your mind, this booklet raises questions that demand an answer. It is available from Electronics for Peace, 151 Courthouse Road, Maidenhead, Berks SL6 6HY.

DJB

Reviewers: PJW — Phil Walker; IJP — Ian Pitt; DJB — Dave Bradshaw.

IC UPDATE

This month, an IC for the enthusiast who has everything, including a generous overdraft facility: digital to analogue converter for colour video. Certainly, it's state-of-art; equally certainly, it's expensive.

This hybrid digital to analog converter provides three channels of video output for RGB type video displays with picture element (pixel) rates to 40MHz. The RGB DAC contains three video DACs and three RAM arrays (16 x 4) as well as all control inputs required to generate output waveforms which are compatible with EIA standards RS-170 and RS-343 (see Fig. 1).

The RGB DAC 4T provides four bits of resolution or 16 levels of "gray scale" per color. This gives the user a $(2^4)^3$ or 4096 color palette. The 16 x 4 ram array per colour allows the user a choice of any 16 of the 4096 colours for each sweep. The write speed is also high enough to allow the colour map to be updated during the vertical retrace or even horizontal retrace in some systems. The high update rates and the ability to generate a full 1 volt composite video output across a 75 ohm load makes this DAC ideally suited for colour computer graphics using raster scan technology.

FEATURES

- 4096-colour palette
- Three video DACs
- Update rates to 40 MHz
- Complete composite video capability
- 16 by 4 bit colour map RAM
- TTL compatible
- Direct 75 ohm RGB outputs
- Clean glitch-free output
- Single +5V supply

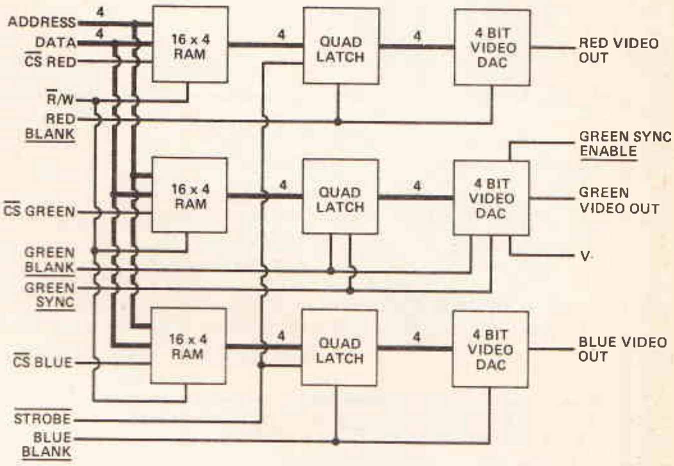


Fig. 1 Block diagram.Fig. 2 RGB DAC 4TD connections.

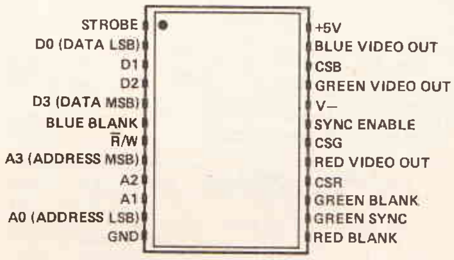


Fig. 2 RGB DAC 4TD connections.

PIN DESCRIPTIONS

STROBE
The transition from Logic 1 to Logic 0 transfers data from RAM outputs to the data register outputs. The strobe is not used for write operations.

GREEN SYNC (composite sync)
A logic 1 sets the registers to all 0s (ref black) and drives the green output to a level 286mV more negative than the reference black level. This signal has priority over blanking and data inputs from the RAMs and is used to synchronize the beam traces in a raster scan type display.

BLANKING (Red, Grn, Blu)
A logic 1 sets the registers to all 0s (ref black) and drives the output to a level 50mV more negative than the reference black level. This signal has priority over the data inputs from the RAMs and is used to shut off the beam for the darkest display possible.

SYNC ENABLE
This input should be connected to +5V to enable the sync signal feature of the green output. If this feature is not desired this input should be connected to ground.

−V
This input should be connected to a stable −3 to −15 volt supply to restore the green output blanking level to 0V absolute if the sync enable is connected to +5V. If it is not necessary to restore the green output blanking level to 0V or if sync enable is grounded this pin should be grounded.

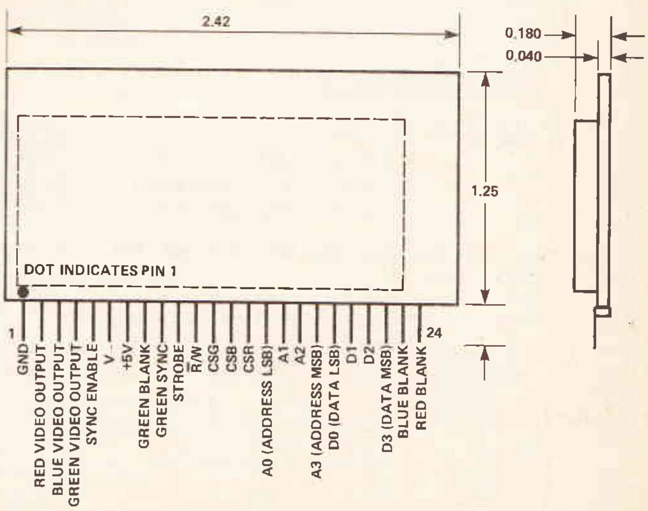


Fig. 3 RGB DAC 4T connections.

ADDRESS — 4 Bits — A0, A1, A2, A3.
Determines read or write address for all RAM arrays. These inputs are used as an address input to load arrays in the write mode and as data inputs during the read (display) mode.

DATA — 4 Bits — D0, D1, D2, D3
Used to load data to all RAM arrays — data loaded will be non-inverted to the DAC during read mode.

R/W
Logic 0 selects read operation
Logic 1 selects write operation
All data to DAC registers will be logic 1 during write mode. If no strobe signal is applied during write operations, the DAC outputs will retain the last read operation level. Otherwise the outputs will rise to REF WHITE level unless composite sync (green output) or blanking signal is applied.

CSR, CSG, CSB
Chip select for each channel (red, green, or blue) A logic 0 selects RAM channel for read or write operations and a 1 deselects RAM for any operation. If deselected, the data to the DAC registers will be logic 1. If no strobe signal is applied while the RAM is deselected, DAC outputs will retain the last read operation level. Otherwise the output will rise to REF WHITE level unless composite sync (green output) or blanking signal is applied. Normally only one input is enabled (logic 0) to write data to its corresponding RAM and all inputs are enabled (logic 0) to read data during display.

SPECIFICATIONS

(Typical @ +25°C, +5V and 75 load unless otherwise stated).

	PARAMETER	UNITS
RESOLUTION	4	bits
PALETTE	4096 (16 colours per sweep)	colours
ANALOG OUTPUTS (each channel)		
Voltage range (1%)	0 to 0.6	volts
Current (75 ohm load)	−17	mA
Impedence (± 5%)	75	ohms
Compliance	±2	volts
OUTPUT — COMPOSITE SYNC		
Green Only (Referred to Blanking Level)	−286	mV (± 5%)
OUTPUT — COMPOSITE BLANKING		
(Referred to Black Level)	−50	mV (± 5%)
ACCURACY (each channel)		
Absolute	±½	LSB
Linearity	±½	LSB
Offset	10	mV
Offset	100	ppm/°C
Gain Tempco	500	ppm/°C
Linearity Tempco	250	ppm/°C
DYNAMIC CHARACTERISTICS (each DAC)		
Settling Time (to 1 LSB)	5	nS
Update Rate	42	MHz
Rise Time	3	nS
Slew Rate	200	V/μs
Glitch Energy	50	pV-S
DATA & ADDRESS INPUTS		
Compatibility	TTL	
Coding	BIN	
CONTROL INPUTS		
STROBE		
Compatibility	TTL	
Set-up Time[1]	25	nS
Hold Time	0	nS
Propagation	12	nS
COMPOSITE BLANKING SYNC.		
Compatibility	TTL	
Settling Time	20	nS
POWER REQUIREMENTS		
Voltage	+4.5 to +5.5V	volts
Current	480	mA
TEMPERATURE RANGE		
(ambient)	0 to 70	degrees C

NOTES:
1. Time from stable "Read Address" to Strobe Hi to Lo Transition

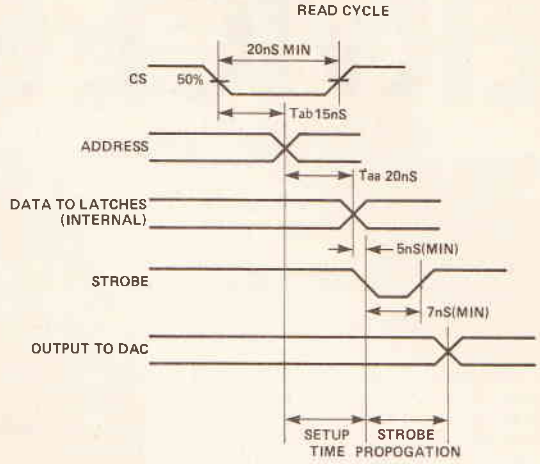


Fig. 4 Read cycle timing diagram.

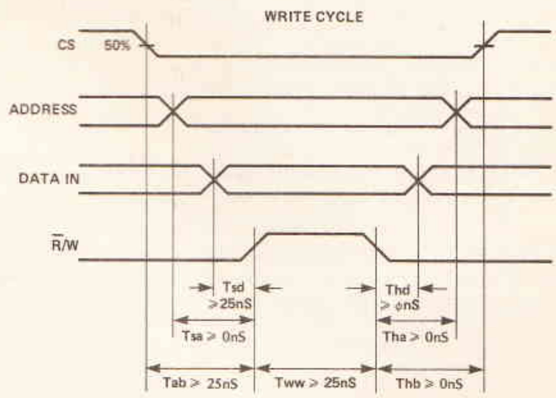
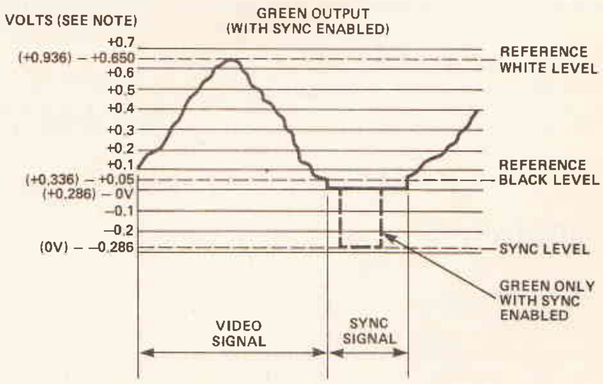


Fig. 5 Write cycle timing diagram.



NOTE:
VOLTAGE LEVELS SHOWN WITH –V PIN CONNECTED TO A –3V TO –15VDC LEVEL OR IN PARENTHESIS ( ) IF –V PIN CONNECTED TO GROUND

Fig. 6 Green composite video output; red and blue do not have the sync signal but are otherwise similar.

Available from: Teknis Ltd, Teknis House, Meadrow, Godalming, Surrey.

ETI

SERVICE SHEET

Enquiries

We receive a very large number of enquiries. Would prospective enquirers please note the following points:

- We undertake to do our best to answer enquiries relating to difficulties with ETI projects, in particular non-working projects, difficulties in obtaining components, and errors that you think we may have made. We do not have the resources to adapt or design projects for readers (other than for publication), nor can we predict the outcome if our projects are used beyond their specifications;
- Where a project has apparently been constructed correctly but does not work, we will need a description of its behaviour and some sensible test readings and drawings of oscillograms if appropriate. With a bit of luck, by taking these measurements you'll discover what's wrong yourself. Please do not send us any hardware (except as a gift!);
- Other than through our letters page, Read/Write, we will not reply to enquiries relating to other types of article in ETI. We may make some exceptions where the enquiry is very straightforward or where it is important to electronics as a whole;
- **We will not reply to queries that are not accompanied by an SAE** (or international reply coupon). **We are not able to answer enquiries over the telephone.** We try to answer promptly, but we receive so many enquiries that this cannot be guaranteed.
- Be brief and to the point in your enquiries. Much as we enjoy reading your opinions on world affairs, the state of the electronics industry, and so on, it doesn't help our already overloaded enquiries service to have to plough through several pages to find exactly what information you want.

Subscriptions

The prices of ETI subscriptions are as follows:

UK:	£13.75
Overseas:	£17.55 Surface Mail
	£36.95 Air Mail

Send your order and money to: ETI Subscriptions Department, 513 London Road, Thornton Heath, Surrey CR4 6AR (cheques should be made payable to ASP Ltd). Note that we run special offers on subscriptions from time to time (though usually only for UK subscriptions, sorry).

ETI should be available through newsagents, and if readers have difficulty in obtaining issues, we'd like to hear about it.

Backnumbers

Below we list the backnumbers that are available from our backnumbers department. Please note that this list will be out of date if you use an old copy of the magazine. Backnumbers cost £1.50 (UK or overseas by surface mail) and are available from: ETI Backnumbers Department, 513 London Road, Thornton Heath, Surrey CR4 6AR (cheques should be made payable to ASP Ltd).

Even if the copy of ETI you need is not listed, all may not be lost, because we run a photocopying service. For £1.50 (UK and overseas) we will photocopy an entire article (note that parts of a series of articles count as separate articles). Your request should clearly state what article you require and the month and year in which it appeared (the index for 1980 and 1981 was published in January 1982, the index for 1982 appeared in December 1982, and the index for 1983 in January 1984). Send your request to ETI Photocopies, Argus Specialist Publications Ltd, 1 Golden Square, London W1R 3AB (cheques should be made out to ASP Ltd).

November 78	June 82
November 79	July 82
April 80	August 82
September 80	September 82
October 80	October 82
November 80	December 82
December 80	February 83
January 81	March 83
February 81	April 83
March 81	May 83
April 81	June 83
May 81	July 83
June 81	August 83
November 81	September 83
December 81	October 83
March 82	November 83
May 82	December 83

Write For ETI

We are always looking for new contributors to the magazine, and we pay a competitive page rate. If you have built a project or you would like to write a feature on a topic that would interest ETI readers, let us have a description of your proposal, and we'll get back to you to say whether or not we're interested and give you all the boring details. (Don't forget to give us your telehone number).

We don't bother with the bureaucracy for Tech Tips — all you do is to send in your idea, stating clearly if you want an acknowledgement of receipt. If possible, please *type* your explanation of why the circuit is different, what it does and how it works, on a separate sheet from the circuit diagram; both sheets should carry your name, address and the circuit title. We'll let you know (within a month or so) if we want to use your Tech Tip.

Trouble With Advertisers

So far as we know, all our advertisers work hard to provide a good service to our readers. However, problems can occur, and in this event you should:

1. Write to the supplier, stating your complaint and asking for a reply. Quote any reference number you may have (in the case of unsatisfactory or incomplete fulfilment of an order) and give full details of the order you sent and when you sent it.
2. Keep a copy of all correspondence.
3. Check your bank statement to see if the cheque you sent has been cashed.
4. If you don't receive a satisfactory reply from the supplier within, say, two weeks, write again, sending your letter recorded delivery, or telephone, and ask what they are doing about your complaint.

If you exhaust the above procedure and still do not obtain a satisfactory response from the supplier, then please drop us a line. We are not able to help directly, because basically the dispute is between you and the supplier, but a letter from us can sometimes help to get the matter sorted out. But please, don't write to us until you have taken all reasonable steps yourself to sort out the problem.

We are a member of the mail order protection scheme, and this means that, subject to certain conditions, if a supplier goes bankrupt or into liquidation between cashing your cheque and supplying the goods for which you have paid, then it may be possible for you to obtain compensation. From time to time, we publish details of the scheme near our classified ads, and you should look there for further details.

OOPS!

We have in the past published small corrections to projects on the letters page, and major corrections separately. From now on corrections will appear on this page, and will be repeated for several months (just to increase our embarrassment). If a correction is too large to fit on here, we will publish it just once, but will note the fact that a correction does exist, and that copies of it can be obtained from us provided you send in an SAE. But please — request copies only if you really do need them; if this service is abused, we may be forced to withdraw it.

Programmable Power Supply (January 1983)
Lascar Electronics have now moved to Module House, White Parish, Salisbury, Wiltshire SP5 2SJ.

Flash Sequencer (July '83)
Q1 should be BC184L; Q2-5 should be BC182L.

Telescope (August 1983)
We had a shower of annotation falling off our diagrams! On Fig. 1, C19 (below IC14) was not labelled nor was Q2 (above R11), and there were two C23s — one should be IC22 and it doesn't matter which. In Fig. 5, IC12 was not labelled. Unfortunately, there was a mistake in the correction (blush!): C14 is the 22μ tant on the −5 V line.

Graphic Equaliser (August 1983)
D2 and D3 are shown the wrong way round in the power supply circuit diagram on page 20.

Universal EPROM Programmer (August 1983)
Corrections to this project are listed in the article "Universal EPROM Programmer Revisited" which appears on page 61.

Z80 Controller Computer (August 1983)
On the overlay, SW1 is the rectangle beside ICs 5 and 6, C6 should be shown between ICs 3 and 7, and a link through has been missed — to the right of pin 18, IC11.

Typewriter Interface (October 1983)
There are two errors in Table 1 on page 24: location 3C should contain E7 and location 3F should contain 5F.

Car Alarm (October 1983)
In the semiconductors section of the parts list, Q1, 2, 5, and 7 should be BC212L, Q3 should be BC182L, and Q4, 6 should be TIP31 or BD131. There was also another (inconsequential) silly but we bet you've already spotted that one!

Tech Tips (October 1983)
Ramped Pulse Generator For Stepper Motors — pin 1 of IC2 should be grounded, the Ramp Up and Ramp Down inputs accept negative, not positive, going pulses, and IC7 should be a 4011 rather than a 4001.

Subscription Order Form

To: ETI Subscriptions Department, 513 London Road, Thornton Heath, Surrey, CR4 6AR, England.

Please commence my subscription to Electronics Today International. I enclose a cheque*/Postal Order*/International Money Order* for the appropriate fee*, made out to ASP Ltd.

Please debit my Access*/Barclaycard* account number*

Signature ....

(* delete as appropriate)

Please indicate subscription required and fee enclosed

UK & Rep of Ireland: UK £13.75 ☐

Overseas surface mail: £17.55 ☐

Overseas air mail: £36.95 ☐

Until further notice, each subscription includes a free binder (normal price £4.25)

PLEASE COMPLETE YOUR NAME AND ADDRESS IN BLOCK CAPITALS

Name ....

Address ....

....

....

PLEASE INCLUDE POSTAL CODE AS APPROPRIATE

Date of order..................

THIS COUPON IS VALID UNTIL: 29th FEBRUARY 1984

Binder Order Form

To: ETI Binders, 513 London Road, Thornton Heath, Surrey CR4 6AR, England.

Please send me..................binder(s) for ETI. I enclose a cheque*/Postal Order*/International Money Order* to the value of £4.25 per binder required, made out to ASP Ltd (* please delete as appropriate).

Total money enclosed £..................

PLEASE COMPLETE YOUR NAME AND ADDRESS IN BLOCK CAPITALS

Name..................

Address ....

....

....

....

PLEASE INCLUDE POSTAL CODE AS APPROPRIATE

Date of order..................

Note that binders cost the same for UK and overseas; overseas orders will be send by surface mail.

THIS COUPON IS VALID UNTIL: 29th FEBRUARY 1984

Backnumber Order Form

To: ETI Backnumbers Department, 513 London Road, Thornton Heath, Surrey CR4 6AR, England.

Please supply me with the following backnumber(s) of ETI

Month .... Year ....

Month .... Year ....

Month .... Year ....

I enclose cheque*/Postal Order*/International Money Order* to the value of £1.50 per magazine ordered, made out to ASP Ltd (* delete as appropriate).

Total money enclosed £..................

PLEASE COMPLETE YOUR NAME AND ADDRESS IN BLOCK CAPITALS

Name..................

Address ....

....

....

....

PLEASE INCLUDE POSTAL CODE AS APPROPRIATE

Date of order..................

Note that the cost is the same for orders from overseas as for UK orders; overseas orders will be sent by surface mail.

PLEASE CHECK THAT THE BACKNUMBER YOU REQUIRE IS AVAILABLE BEFORE ORDERING.

THIS COUPON IS VALID UNTIL: 29th FEBRUARY 1984

Photocopy Order Form

To: ETI Photocopies Department, 1 Golden Square, London W1R 3AB, England.

Please supply me with the following photocopies:

Month..................Year .... Article..................

..................Page No..................

Month..................Year .... Article..................

..................Page No..................

I enclose cheque*/Postal Order*/International Money Order to the value of £1.50 per photocopy ordered, made out to ASP Ltd (* delete as appropriate).

Total money enclosed £..................

PLEASE COMPLETE YOUR NAME AND ADDRESS IN BLOCK CAPITALS

Name..................

Address ....

....

....

....

PLEASE INCLUDE POSTAL CODE AS APPROPRIATE

Date of order..................

Note that the cost is the same for overseas orders as for UK orders; overseas orders will be sent by surface mail.

PLEASE REMEMBER TO INCLUDE MONTH AND YEAR WHEN ORDERING.

THIS COUPON IS VALID UNTIL: 29th FEBRUARY 1984

ADVERTISERS INDEX

ETI PCB SERVICE

The best way to get a really professional finish to your project is to use a professionally made PCB — look no further, here they are!

In order to ensure that you get the correct board, you must quote the reference number when ordering — if you don't, you may get sent the wrong board. The code can also be used to identify the year and month that a particular project was outlined in: the first two numbers are the year, the third is the month and the number after the hyphen indicates the particular project.

Note that these are all the boards that are available — if it isn't listed, we don't have it.

Our terms are strictly cash with order — we do not accept official orders. However, we can provide a pro-forma invoice for you to raise a cheque against, but we must stress that the goods will not be dispatched until we receive payment.

1979

- E/794-1 Guitar Effects Unit 2.64
- E/794-2 Click Eliminator 6.64
- E/796-1 Accented Beat Metronome3.60

1980

- E/803-1 Signal Tracer 2.27
- E/808-1 CMOS Logic Tester 2.64
- E/808-3 Ultrasound Burglar Alarm 2.87
- E/8010-1 Cassette Interface 2.93
- E/8010-2 Fuzz/Sustain Box 3.27
- E/8011-5 RIAA Preamp 1.93
- E/8011-6 Audio Test Oscillator 3.13
- E/8012-1 Musical Doorbell 2.80
- E/8012-3 Four Input Mixer 2.64

1981

- E/811-1 LED Tacho 4.13
- E/811-2 Multi-Option Siren 3.20
- E/812-1 Universal Timer 3.31
- E/812-2 IR Alarm (4 boards) 6.64
- E/812-5Pulse Generator 3.57
- E/813-1 Engineer's Stethoscope 2.65
- E/814-2 Drum Machine (2 boards) 5.60
- E/814-4 Guitar Note Expander 3.20
- E/816-8 Waa-Phase 1.53
- E/816-9 Alien Attack 3.48
- E/817-1 System A-Input (MM or MC) 2.65
- E/817-2 System A — Preamp 5.17
- E/817-3 Smart Battery Charger 1.97
- E/818-3 Hand Clap Synth 3.97
- E/818-5 Watchdow Home Security (2 boards) 5.31
- E/819-1 Mains Audio Link (3 boards) 7.35
- E/819-4 Laboratory PSU 4.53
- E/8110-1 Enlarger Timer 3.40
- E/8110-2 Sound Bender 2.65
- E/8111-1 Voice Over Unit 3.97
- E/8111-2 Car Alarm 2.81
- E/8111-3 Phone Bell Shifter 2.96
- E/8112-1 Alcoholmeter (2 boards) 5.21
- E/8112-3 Bodywork Checker 1.75
- E/8112-4 Component Tester 1.49

1982

- E/821-1 Parking Timer 2.20
- E/821-3 Guitar Tuner (2 boards) ..5.55
- E/822-1 Ripple Monitor 1.92
- E/822-2 Allez Cat Pest Repeller 1.68
- E/822-5 Moving Magnet Stage 3.49
- E/822-6 Moving Coil Stage 3.49
- E/823-4 Capacitance Meter (2 boards) 10.14
- E/824-5 Voltage Monitor 1.86
- E/825-1 DV Meg 2.72
- E/825-2 Analogue PWM 3.06
- E/825-3 Slot Car Controller 4.51
- E/826-1 Ion Generator (3 boards) 8.00
- E/826-4 MOSFET Amp Module 6.78
- E/826-5 Logic Lock 3.06
- E/826-6 Digital PWM 3.34
- E/826-7 Optical Sensor 1.74
- E/826-9 Oscilloscope (4 boards) 11.60
- E/827-7 TV Bargraph Main 4.56
- E/827-3 TV Bargraph Channel 2.28
- E/827-4 Hotwire 2.63
- E/827-5 Bridging Adapter 2.38
- E/828-1 Playmate (3 boards) 7.20
- E/828-4 Kitchen Scales 1.84
- E/828-5 Sound Track 4.25
- E/829-1 Auto Volume Control 1.84
- E/829-2 Dual Logic Probe 1.93
- E/8210-1 Message Panel (2 boards) 10.70
- E/8211-4 Pulse Generator 5.29
- E/8212-1 ELCB 2.41
- E/8212-2 Servo Interface (2 boards) 5.87
- E/8212-4 Spectracolumn 4.82

1983

- E/831-1 Fuel Gauge 3.00
- E/831-2 ZX ADC 2.25
- E/831-3 Programmable PSU 3.00
- E/833-1 SoundBoard 11.16
- E/833-2 Alarm Module 3.15
- E/833-3 ZX81 User Graphics 0.93
- E/833-4 Logic Probe 2.17
- E/834-1 Real Time Clock 7.60
- E/834-2 Thermemeter (2 boards) 8.47
- E/834-4 Stage Lighting — Main ..11.94
- E/834-5 Stage Lighting — Display 3.00
- E/835-1 Compressor/Limiter 5.38
- E/835-2 Single PSU 2.75
- E/835-3 Dual PSU 3.49
- E/835-4.2 NDFL Amp 6.85
- E/835-5 Balance Input Preamp 2.81
- E/835-6 Stage Lighting Autofade 5.38
- E/835-7 Stage Lighting — Triac Board 4.12
- E/836-1 to 3 PseudoROM (3 boards) 3.15
- E/836-4 Immersible Heater 2.00
- E/836-5 Atom Keypad 4.50
- E/837-1 Flash Sequencer 2.32
- E/837-2 Trigger Unit Main Board ..2.32
- E/837-3 Trigger Unit Transmitter ..1.44
- E/837-4 Switched Mode PSU 14.00
- E/838-1 Graphic Equaliser 7.91
- E/838-2 Servo Fail-Safe (four-off) 2.55
- E/838-3 Universal EPROM prog 8.38
- E/839-1 NiCad Charger/Regen 3.28
- E/839-2 Digger 2.96
- E/839-3 64K DRAM 12.24
- E/8310-1 Supply Protector.............1.90
- E/8310-2 Car Alarm.......................3.46
- E/8310-3 Typewriter Interface........3.63
- E/8311-1 Mini Drum Synth............ 2.67
- E/8311-2 Alarm Extender 2.79
- E/8311-3 Multiswitch 3.12
- E/8311-4 Multiple Port 3.77
- E/8311-5 DAC/ADC Filter 2.80
- E/8311-6 Light Pen 4.00
- E/8311-7 Logic Clip 2.18
- E/8311-8 MC Head (JLLH) 2.76
- E/8312-1 Lightsaver 1.61
- E/8312-2 A-to-D Board 11.16
- E/8312-3 Light Chaser (2 bds) 6.56
- E/8312-4 ZX Alarm 5.25
- E/8401-1 Vector Graphics 7.19

Prices valid until 1.1.84.

How to order: indicate the boards required by ticking the boxes and send this page, together with your payment, to: ETI PCB Service, Argus Specialist Publications Ltd, 145 Charing Cross Road, London WC2H 0EE. Make cheques payable to ETI PCB Service. Payment in sterling only please. Prices subject to change without notice.

Total for boards	£....................
Add 45p p&p	0.45
Total enclosed	£....................

PLEASE ALLOW 28 DAYS FOR DELIVERY

Signed ....

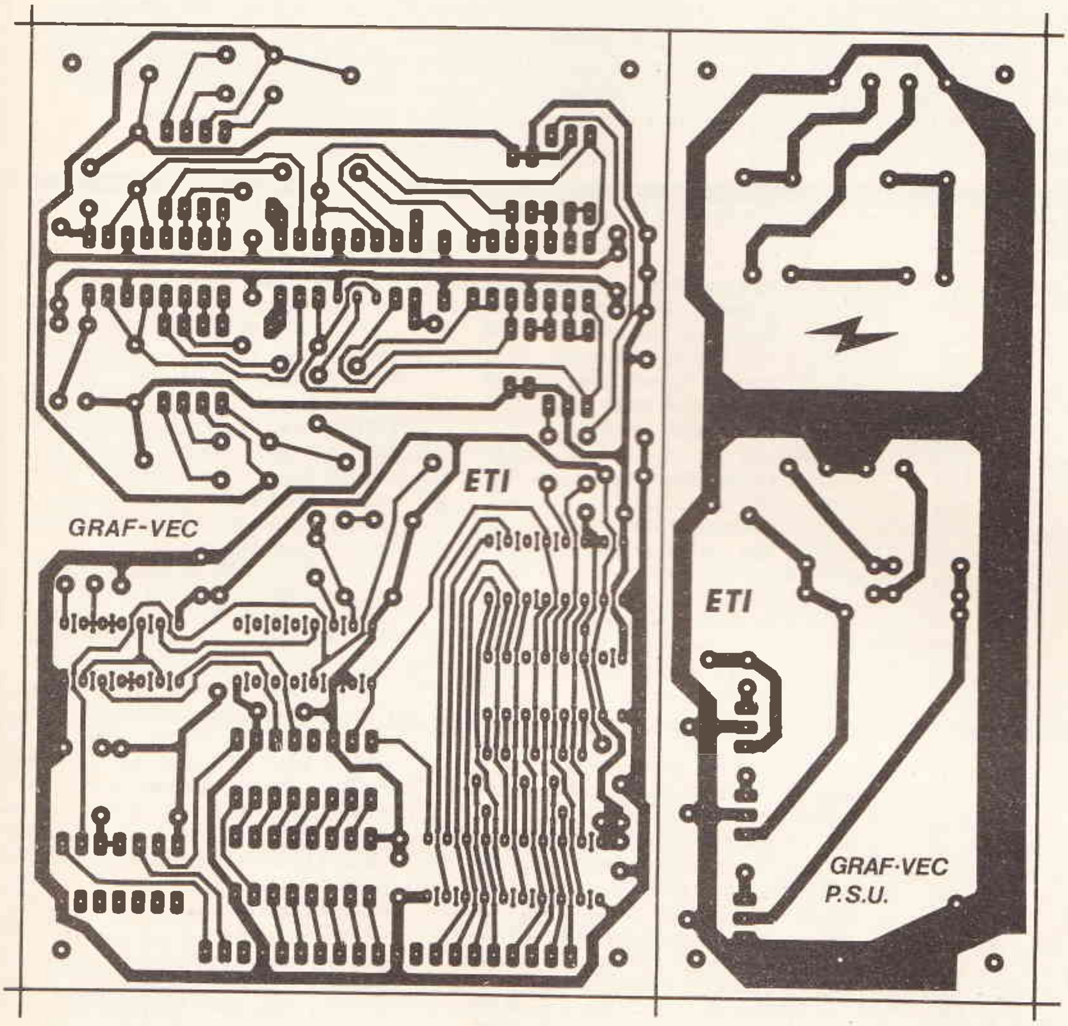
Name ....

Address ....

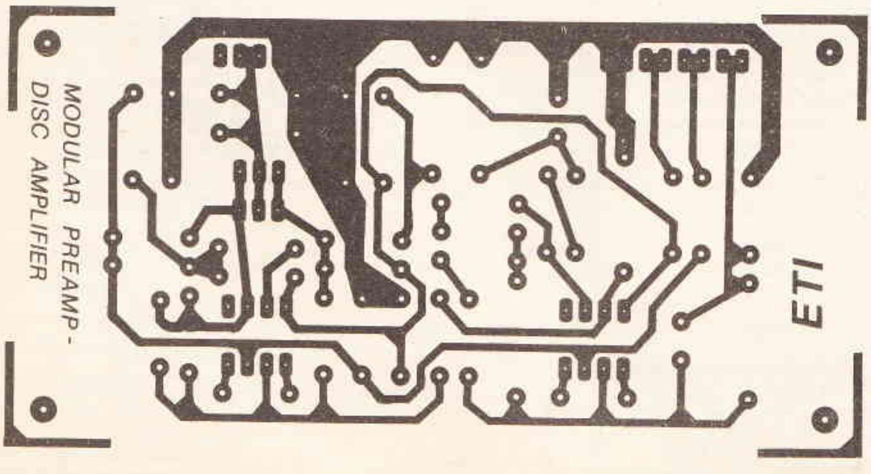
....

....

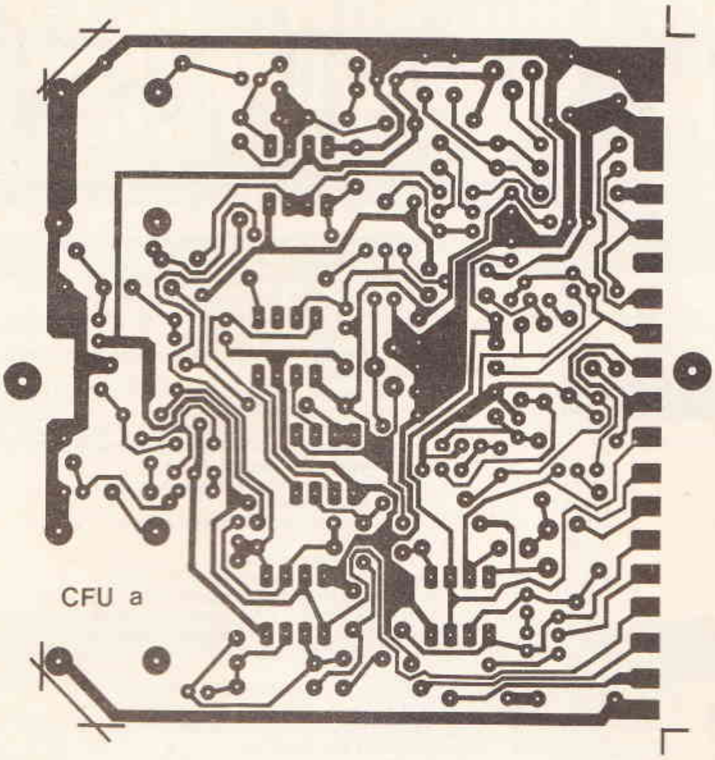
PCB FOIL PATTERNS



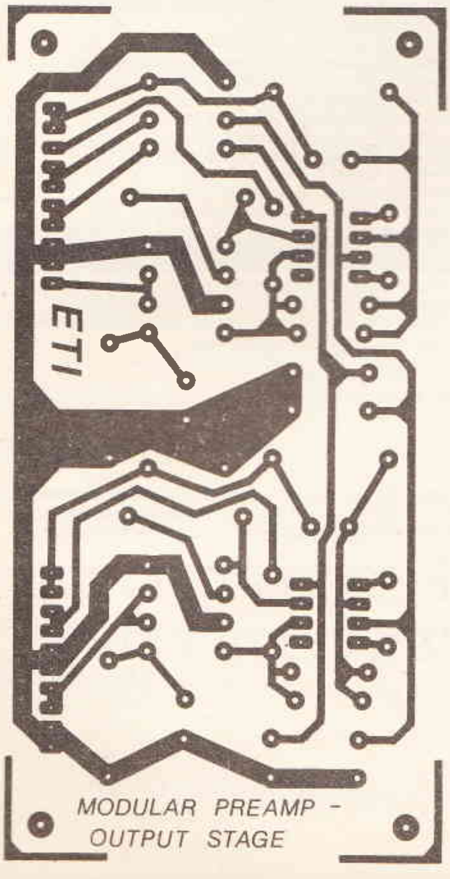
The Vector-Graphics Board

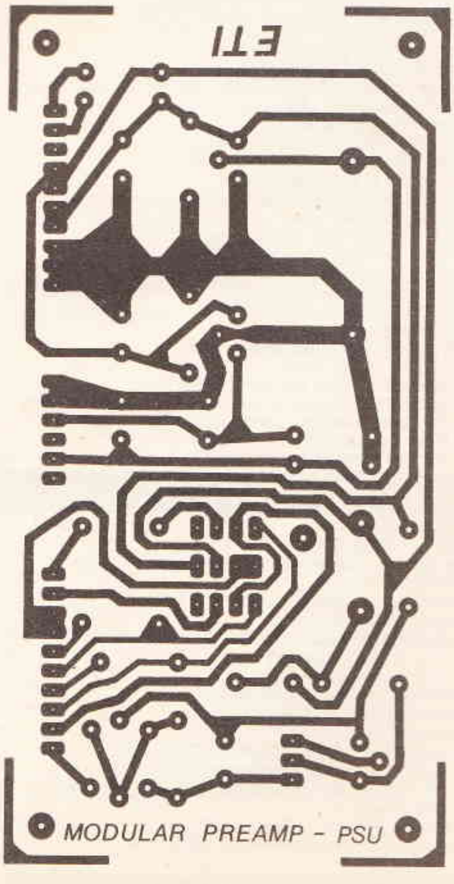


These three boards (left and opposite) are for the Modular Preamplifier, held over from last month.



The Chorus/Flanger Board





electronics today international
BOOK SERVICE

How to order: indicate the books required by ticking the boxes and send this page, together with your payment, to: ETI Book Service, Argus Specialist Publications Ltd, 145 Charing Cross Road, London WC2 0EE. Make cheques payable to ETI Book Service. Payment in sterling only please. All prices include P & P. Prices may be subject to change without notice.

BEGINNERS GUIDE

- **Beginner's Guide to Basic Programming** Stephenson £5.35
- **Beginner's Guide to Digital Electronics** £5.35
- **Beginner's Guide to Electronics** £5.35
- **Beginner's Guide to Integrated Circuits** £5.35
- **Beginner's Guide to Computers** £5.35
- **Beginner's Guide to Microprocessors** £5.35

COOKBOOKS

- **Master IC Cookbook** Hallmark £10.15
- **Microprocessor Cookbook** M. Hordeski £7.70
- **IC Op Amp Cookbook** Jung £14.25
- **PLL Synthesiser Cookbook** H. Kinley £7.70
- **Active Filter Cookbook** Lancaster £13.40
- **TV Typewriter Cookbook** Lancaster £11.15
- **CMOS Cookbook** Lancaster £11.85
- **TTL Cookbook** Lancaster £10.95
- **Micro Cookbook Vol. 1** Lancaster £15.30
- **BASIC Cookbook** K. Tracton £6.00
- **MC6809 Cookbook** C. Warren £7.25

ELECTRONICS

- **Principles of Transistor Circuits** Amos £8.50
- **Design of Active Filters with experiments** Berlin £11.30
- **49 Easy to Build Electronic Projects** Brown £6.00
- **Electronic Devices & Circuit Theory** Boylestad £13.20
- **How to build Electronic Kits** Capel £3.55
- **How to Design and build electronic instrumentation** Carr £9.35
- **Introduction to Microcomputers** Daglecs £7.20
- **Electronic Components and Systems** Dennis £15.00
- **Principles of Electronic Instrumentation** De Sa £11.40
- **Giant Handbook of Computer Software** £12.95
- **Giant Handbook of Electronic Circuits** £17.35
- **Giant Handbook of Electronic Projects** £11.75
- **Electronic Logic Circuits** Gibson £5.55
- **Analysis and Design of Analogue Integrated Circuits** Gray £30.25
- **Basic Electronics** Grob £11.30
- **Lasers — The Light Fantastic** Hallmark £7.70
- **Introduction to Digital Electronics & Logic** Joynson £5.25
- **Electronic Testing and Fault Diagnosis** Loveday £7.85
- **Electronic Fault Diagnosis** Loveday £6.25
- **Essential Electronics A-Z Guide** Loveday £7.50
- **Microelectronics Digital & Analogue circuits and systems** Millman £12.70
- **103 Projects for Electronics Experimenters** Minis £8.30
- **VLSI System Design** Muroga £34.10
- **Power FETs and their application** Oxner £9.40
- **Practical Solid State Circuit Design** Olesky £25.00
- **Master Handbook of IC Circuits** Powers £12.85
- **Electronic Drafting and Design** Raskhodoff £22.15
- **VOM — VTVM Handbook** Risse £8.50
- **Video and Digital Electronic Displays** Sherr £28.85
- **Understanding Electronic Components** Sinclair £7.50
- **Electronic Fault Diagnosis** Sinclair £4.50
- **Physics of Semiconductor Devices** Sze £17.35
- **Digital Circuits and Microprocessors** Taub £32.00
- **Active Filter Handbook** £7.60
- **Designing with TTL Integrated Circuits** Texas £15.20
- **Transistor Circuit Design** Texas £15.20
- **Digital Systems: Principles and Applications** Tocci £12.95
- **Master Handbook of Telephones** Traister £10.00
- **How to build Metal/Treasure Locators** Traister £6.00
- **99 Fun to Make Electronic Projects** Tymony £8.50
- **33 Electronic Music Projects you can build** Winston £6.95

COMPUTERS & MICROCOMPUTERS

- **BASIC Computer Games** Ahl £6.35
- **From BASIC to PASCAL** Anderson £9.95
- **Mastering Machine Code on your ZX81** T. Baker £7.25
- **UNIX — The Book** Banaham £8.75
- **Z80 Microcomputer Handbook** Barden £10.95
- **Microcomputer Maths** Barden £11.90
- **Digital Computer Fundamentals** Barter £9.90
- **Visicalc Book. APPLE Edition** Bell £15.55
- **Visicalc Book. ATARI Edition** Bell £15.55
- **Introduction to Microprocessors** Brunner £23.00
- **Programming your APPLE II Computer** Bryan £9.25
- **Microprocessor Interfacing** Carr £7.70
- **Microcomputer Interfacing Handbook A/D & D/A** Carr £9.50
- **Musical Applications of Microprocessors** Chamberlain £28.85
- **30 Computer Programs for the Home Owner in BASIC** D. Chance £9.25
- **Microcomputers** Dirkson £9.30
- **APPLE Personal Computer for Beginners** Dunn £9.50
- **Microcomputers/Microcomputers — An Intro** Gioone £11.80
- **Troubleshooting Microprocessors and Digital Logic** Goodman £9.25
- **Getting Acquainted with your VIC 20** Hartnell £8.50
- **Getting Acquainted with your ZX81** Hartnell £5.95
- **Let your BBC Micro Teach you to program** Hartnell £7.90
- **Programming your ZX Spectrum** Hartnell £8.50
- **The ZX Spectrum Explored** Hartnell £6.95
- **How to Design, Build and Program your own working Computer System** Haviland £9.30
- **BASIC Principles and Practice of Microprocessors** Heffer £7.15
- **Hints and Tips for the ZX81** Hewson £5.25
- **What to do when you get your hand on a Microcomputer** Holtzman £9.95
- **34 More Tested Ready to Run Game Programs in BASIC** Horn £7.70
- **Microcomputer Builders' Bible** Johnson £12.40
- **Digital Circuits and Microcomputers** Johnson £14.55
- **PASCAL for Students** Kemp £7.20
- **The C — Programming Language** Kernighan £18.20
- **COBOL** Jackson £9.25
- **The ZX81 Companion** Maunder £9.50
- **Guide to Good Programming Practice** Meek £6.40
- **Principles of Interactive Computer Graphics** Newman £13.95
- **Theory and Practice of Microprocessors** Nicholas £11.35
- **Exploring the World of the Personal Computer** Nilles £12.95
- **Microprocessor Circuits Vol. 1. Fundamentals and Microcontrollers** Noll £9.80
- **Beginner's Guide to Microprocessors** Parr £5.35
- **Microcomputer Based Design** Peatman £11.30
- **Digital Hardware Design** Peatman £9.80
- **BBC Micro Reavealed** Ruston £9.45
- **Handbook of Advanced Robotics** Safford £14.45
- **1001 Things to do with your own personal computer** Sawusch £8.50
- **Easy Programming for the ZX Spectrum** Stewart £7.15
- **Microprocessor Applications Handbook** Stout £34.40
- **Handbook of Microprocessor Design and Applications** Stout £37.60
- **Programming the PET/CBM** West £17.80
- **An Introduction to Microcomputer Technology** Williamson £8.20
- **Computer Peripherals that you can build** Wolfe £12.40
- **Microprocessors and Microcomputers for Engineering Students and Technicians** Wooland £7.10

REFERENCE BOOKS

- **Electronic Engineers' Handbook** Fink £56.45
- **Electronic Designers' Handbook** Giacoletto £59.55
- **Illustrated Dictionary of Microcomputer Technology** Hordeski £8.45
- **Handbook for Electronic Engineering Technicians** Kauffman £27.50
- **Handbook of Electronic Calculators** Kauffman £35.00
- **Modern Electronic Circuit Reference Manual** Marcus £44.00
- **International Transistor Selector** Towers £10.70
- **International Microprocessor Selector** Towers £16.00
- **International Digital IC Selector** Towers £10.95
- **International Op Amp Linear IC Selector** Towers £8.50
- **Illustrated Dictionary of Electronics** Turner £12.95

VIDEO

- **Servicing Home Video Cassette Recorders** Hobbs £12.95
- **Complete Handbook of Videocassette Recorders** Kybett £9.25
- **Theory and Servicing of Videocassette Recorders** McGinty £12.95
- **Beginner's Guide to Video** Matthewson £5.35
- **Video Recording: Theory and Practice** Robinson £14.40
- **Video Handbook** Van Wezel £21.90
- **Video Techniques** White £12.95

Please send me the books indicated. I enclose cheque/postal order for £.......... Prices include postage and packing
I wish to pay by Access/Barclaycard. Please debit my account.

5	2	2	4											

4	9	2	9											

Signed..

Name..

Address..

....

....

ELECTROMART

SEE YOUR BUSINESS GROW.
SIMPLY FILL IN THE COUPON BELOW AND SEND TO:
ASP LTD
145 CHARING CROSS ROAD, LONDON WC2

Please include my business details in the next available issue of ELECTRONICS TODAY INTERNATIONAL: 17.50 per insertion. Call us for Series discounts. 01-437 1002.

BUSINESS NAME: ....

ADDRESS: ....

....

....

TEL. NO.: ....

OPENING HOURS ....

CONTACT: (FOR OFFICE USE ONLY) ....

ELECTRONICS TODAY INTERNATIONAL **CLASSIFIED**

Lineage:
35p per word (minimum 15 words)
Semi Display: (minimum 2 cms)
£10.00 per single column centimetre
Ring for information on series bookings/discounts
All advertisements in this section must be prepaid.
Advertisements are accepted subject to the terms and conditions printed on the advertisement rate card (available on request)

01-437 1002
EXT 212
Send your requirements to:
Debbie Miller
ASP Ltd.,
145 Charing Cross Road,
London WC2H 0EF

ALARMS

ALARMS ADE

FREE BOOKLET on BURGLAR ALARMS with LOWEST U.K. DIY PUBLISHED PRICES
PHONE OR WRITE FOR YOUR COPY
051-523 8440
AD ELECTRONICS
217 WARBRECK MOOR
AINTREE, LIVERPOOL L9 0HU

TIMED ENTRY EXIT
ALARM — CONTROL PANEL
MAINS–BATT.
MODEL 9000E
–ONLY–
£ 29·50 INC.

2 ZONE – £33-69
- FULL 2 YEAR GUARANTEE
- Adjustable entry–exit with buzzer.
- Regulated power supply (1-2 amp).
- Latching 24 hour circuit.
- Visual & audible walk test.

PLEASE SEND FOR FREE CATALOG OF ALARM EQUIPMENT FROM
SIMPSONS ELECTRONIC ALARMS
70 PRIORY ROAD LIVERPOOL L4 2RZ
TRADE SUPPLIED
051-260-0300

BURGLAR Alarm Equipment. Please visit our 2,000 sq. ft. showrooms or write or phone for your free catalogue. C.W.A.S. Ltd., 100 Rooley Avenue, Bradford BD6 1DB. Telephone 0274 308920.

BOOKS

PARAPHYSICS JOURNAL (Russian translation); psychotronics, kirlianography, heliphonic music, telekinetics. Computer software. S.A.E. 4 x 9", Paralab, Downton, Wiltshire.

EQUIPMENT

P.C.B's

Printed Circuit Boards to your specification from artwork through to finished board.

QUICK DELIVERY – COMPETITIVE PRICES

CROFTON ELECTRONICS LIMITED
35 Grosvenor Road,
Twickenham, Middlesex
TEL: 01-891 1923/1513 Telex: 295093

Build your own high performance
AUDIO SIGNAL GENERATOR
£25.00 incl. case (p.p.£1)
Spec:
Very low distortion (only .02%)
Output 1v into 600 Ohms.
(Attenuated)
10Hz — 100Khz Sine-Square
(A Linsley-Hood design)
TELERADIO ELECTRONICS
325 Fore Street, Edmonton
London N9 0PE
Ready made **£30.00**

SURPLUS — ExEquipment 120 watt (60 + 60) power-amplifiers . . . case, controls + sockets, smoothing, glass/PCB + heatsinking. Boxes + data £10. KIA-8, LS29-9DZ.

AERIAL AMPLIFIERS improve weak television reception. Price £6.70. S.A.E. for leaflets. Electronic Mailorder, Ramsbottom, Lancashire, BL0 9AGH.

TRANSPARENT flexible keyboard covers allow operation of computers in dirty environments. Datails from: DBM Products. Box 6. Melton Mowbray. Leics. (0664 68415 after 4pm).

COMPUTERS

FUTURE TECHNOLOGIES
(ETI) 1 Hollybrook Rd., Shirley
Southampton SO1 6RB

CBM 64 Computer	**£198**
with cassette & 2 blank tapes	**£242**
VIC 20 starter pack	**£139**
Cassette alone **£44.90**,	tapes **£1 ea**
Spectrum 16K £99.95,	48K **£129.95**

Also Atari, Texas, accessories, software.
Cheque/PO with order
Send large SAE for lists (23p stamp)
Add £1 P&P for orders under £50
All prices include VAT

FOR SALE

Multiband portable radio. Air-WB-PB/TV-FM/CB, squelch, 20" directional aerial, batteries or adaptor powered, size: h8.5" Xw3.75" Xd2" **£12.50**.

Personal MW radio headset with built-in-speaker and belt clip, takes one PP3 battery, complete with lightweight headphones **£6.25**.

High quality crimp-tool, crips terminals, cuts mild steel bolts, cuts and strips wire, complete with 25 assorted terminals **£2.30**.

25W+25W 5-band car stereo booster amplifier-equaliser, 20-20KHz (X80) **£27.00**.

Same as above but with 7-band equaliser (L-707) **£34.50.**

Same as (L-707) but with LED power indicator (L-710) **£37.00**.

Suitable 25W car speakers 3-way swivelling tweeter (FX-17) **£38.50**.

All items guaranteed, prices include VAT and postage.

Orders to
L.E.G.S. LTD
334 Dickenson Road, Longsight
Manchester M13 0NG
(Mail Order Only)

ELECTRONIC ORGAN KEYBOARDS and other parts being cleared out as special offer. Elvins Electronic Musical Instruments, 40A Dalston Lane, London E8. 01-986 8455.

SURPLUS — ExEquipment 120 watt (60 + 60) power-amplifiers . . . case, controls + sockets, smoothing, glass/PCB + heatsinking. Boxes + data £10. KIA-8, LS29-9DZ. Merry Christmas.

To place an advert phone Debbie
01-437 1002
ext 289

BREATHTAKING novelty giantsize pictureframe screenview. 170cm diagonal converting easily any small TV. Extra sharp brilliant picture using our triplet lens (no fresnel) and optical screen lifetime guarantee. Brings intense home enjoyment. Construction manual £3.00 (refundable). Ing Banerjee, Sebast Kneippg. 4/3/10, 1020 Vienna, Austria.

POWER SUPPLIES. Excellent layout includes two panel meters in attractive aluminium case. 5 outputs ±15v ±5v 100ma +25v 1.5A variable. £55.50. J&S Mailorder, 6 Albion Grove, Stoke Newington, London N16.

PLANS 'N DESIGN

AMAZING ELECTRONIC plans, lasers, gas, ruby, light shows, high voltage teslas, van de graph surveillance devices, ultrasonics, pyrotechnics, new solar generator, 150 more projects, catalogue. S.A.E. Plancentre, Bromyard Road Industrial Estate, Ledbury HR8.

WANTED

TURN YOUR SURPLUS transistors, IC's etc into cash. Contact Coles Harding & Co., 103 South Brink, Wisbech, Cambs. Tel: 0945 584188. Immediate settlement.

SERVICES

MENDASCOPE LTD
Repair & recalibrate Oscilloscopes
All makes — all models
Otter House, Weston Underwood Olney, Bucks MK46 5JS Bedford (0234) 712445
For the complete service

REPAIRS, electrical, electronic measuring equipment. A complete service at a highly competitive price. Postage, estimates free. 14 day Turns Round. British Tele-Comm approved. Ledon Instruments Ltd, Gladstone Road, Folkstone, Kent. (0303) 57555.

MICRO-COMPUTER repairs. ZX Spectrum, VIC 20, C64 Pets, Commodore computers, printers and floppy disk. Phone Slough (0753) 48785. Monday to Saturday.

KITS

DIGITAL WATCH REPLACEMENT parts, batteries, displays, backlights etc. Also reports publications, charts. S.a.e. for full list Profords Conersdrive, Holmergreen Bucks. HP15 6SGD

KITS

TIME WRONG?

MSF CLOCK is ALWAYS CORRECT — never gains or loses. SELF SETTING at switch-on, 8 digits show Date, Hours Minutes and Seconds, auto GMT/BST and leap year, also parallel BCD for computer, receives Rugby 60KHz atomic time signals, built-in atenna, 1000Km range. £72-70.

AUDIO OSCILLATOR. 10Hz-200KHz 0-1V sine/square TTL £21-60.

Each fun-to-build kit includes all parts, printed circuit, case, instructions, by-return postage etc, money back assurance. SEND away NOW.

CAMBRIDGE KITS
45 (TA) Old School Lane, Milton, Cambs.

PRINTED CIRCUITS Make your own simply, cheaply and quickly! Golden Fotolac light-sensitive laquer - now greatly improved and very much faster. Aerosol cans with full instructions, £2.50. Developer 35p. Ferric Chloride 60p. Clear acetate sheet for master 15p. Copper-clad fibreglass board, approx. 1mm thick £2.00 sq. ft. Post/packing 75p. White House Electronics, Castle Drive, Praa Sands, Penzance, Cornwall.

DISCO EQUIPMENT built from easy to follow plans. S.A.E. for details. Projek Sound & Lighting, 44 Mathie Crescent, Gourock PA19 1YX.

JOB VACANCIES

ELECTRONICS ENGINEERS

Honeywell need dynamic, experienced Electronics Engineers to join their highly skilled team responsible for troubleshooting high-technology video-graphic systems.

Our benefits package is most attractive, including company car and 5 weeks' holiday. For further details contact: Richard Gould, Honeywell Control Systems Ltd., Honeywell House, Charles Square, Bracknell, Berks RG12 1EB.

Please quote ref: ET/79/H.

BUSY COMPONENT SHOP in North-West London requires hardworking person with pleasant attitude to customers in the shop and on the telephone. Knowledge of components essential. Salary negotiable. Phone the manager: 01-452 6662.

For all your requirements
Phone
ASP

Want the right person for the job?

Then why not advertise here?

Tel: 01-437 1002 ext 289

COMPONENTS

BUMPER BOX OF BITS
WOW! We've got so many components in stock, we can't possibly list them all — So buy a box. In it you'll find resistors, capacitors, displays, switches, panels with transistors, diodes, IC's etc., coils, pots... and so on. All modern parts — guaranteed at least 1000 items, minimum weight 10lbs. ONLY £8.50 inc. 48 page catalogue 50p.
ELECTRONICS WORLD
1e Dews Road, Salisbury, Wilts SP2 7SN

ELECTRONICS TODAY INTERNATIONAL

CLASSIFIED ADVERTISEMENT — ORDER FORM

If you have something to sell now's your chance! Don't turn the page — turn to us!

Rates of charge: 35p per word per issue (minimum of 15 words).

and post to **Electronics Today International, Classified Dept., 145 Charing Cross Road, London WC2**

Please place my advert in **Electronics Today International** for ...... issues commencing as soon as possible.

I am enclosing my Cheque/Postal Order/International Money Order for: (delete as necessary) £..... (Made payable to A.S.P. Ltd)

VISA OR Debit my Access/Barclaycard (Delete as necessary) We welcome Access

All classified advertisements must be paid for in advance.

Please use BLOCK CAPITALS and include post codes.

Classification ....

Name (Mr/Mrs/Miss/Ms) ....
(delete accordingly)

Address ....

....

Signature .... **Date** ....

Daytime Tel. No. ....

INDEX '83

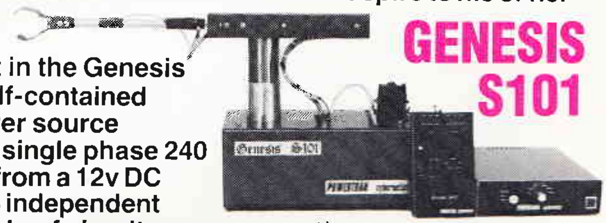
Low-price robots from POWERTRAN

– hydraulically powered

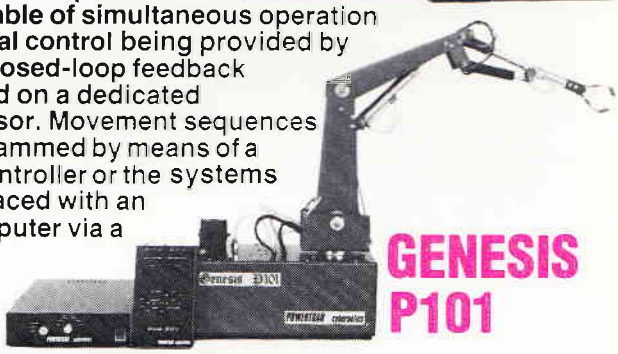
– microprocessor controlled

The UK-designed and manufactured range of Genesis general purpose robots provides a first-rate introduction to robotics for both education and industry. With prices from as low as £425, even the home enthusiast can aspire to his or her own robot.

Each robot in the Genesis range has a self-contained hydraulic power source operated from single phase 240 or 120v AC or from a 12v DC supply. Up to 6 independent axes are capable of simultaneous operation with positional control being provided by means of a closed-loop feedback system based on a dedicated microprocessor. Movement sequences can be programmed by means of a hand-held controller or the systems can be interfaced with an external computer via a standard RS232C link.



GENESIS S101



GENESIS P101

The top-of-the-range P102 has dual speed control, enhanced memory and double acting cylinders for increased torque on the wrist and arm joints. There is position interrogation via the RS232C interface, increasing the versatility of computer control and inputs are provided for machine tool interfacing.

All Genesis robots are available either ready-built or in kit form. The latter provides not only extra economy but also valuable additional training as an assembly project.

GENESIS P102

HEBOT II Turtle-type robot

For under £100, Hebot II takes programming off the VDU and into the real world. Each wheel is independently controlled by a computer, enabling the robot to perform an almost infinite number of moves. It has blinking eyes, a two-tone bleep and a solenoid-operated pen to chart its moves. Touch sensors coupled to its shell return data about its environment to the computer enabling evasive or exploratory action to be calculated.

The robot connects directly to an I/O port or, via the interface board, to the expansion bus of a ZX81 or other microcomputer.

HEBOT II

Weight 1.8kg

complete kit with assembly instructions	**£85**
Interface board kit	**£10**

MICROGRASP

A real, programmable robot for under £200! Micrograsp has an articulated arm jointed at shoulder, elbow and wrist positions. The entire arm rotates about its base and there is a motor driven gripper. All five axes are motor driven and servo controlled, giving positive positioning. The robot can be controlled by any microcomputer with an expansion bus – the Sinclair ZX81 being particularly suitable.

MICROGRASP

Weight 8.7kg, lifting capacity 100g

Robot kit with power supply	**£145.00**
Universal computer interface board kit	**£48.50**
23 way edge connector	**£2.50**
AX81 peripheral/RAM pack splitter board	**£3.00**

GENESIS S101

Weight 29kg, lifting capacity 1.5kg

4-axis model (kit form)	**£425**
5-axis model (kit form)	**£475**
5-axis complete system (kit form)	**£737**
5-axis complete system (ready built)	**£1,450**

GENESIS P101

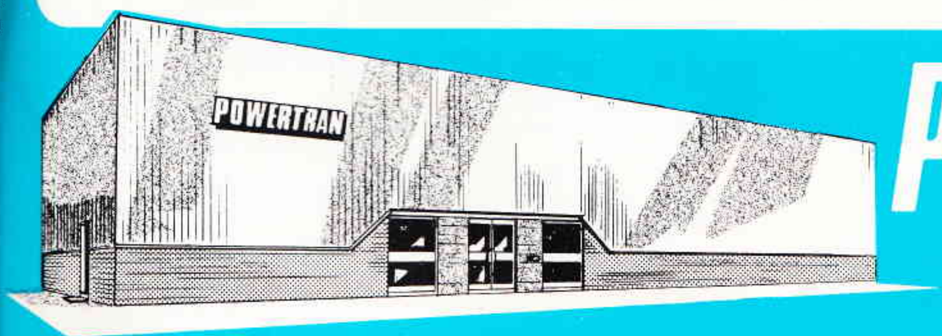
Weight 34kg, lifting capacity 1.8kg

6-axis model (kit form)	**£675**
6-axis complete system (kit form)	**£945**
6-axis complete system (ready built)	**£1,650**

GENESIS P102

Weight 36kg, lifting capacity 2kg

6-axis system (kit form)	**£1175.00**
6-axis system (ready built)	**£1950.00**
Powertran Cortex microcomputer self-assembly kit	**£295.00**
ready-built	**£395.00**



POWERTRAN cybernetics

PORTWAY INDUSTRIAL ESTATE, ANDOVER, HANTS SP10 3ET. TEL (0264) 64455 Telex 477407

Star sounds ★★ Star quality ★★ Star features ★★

Free SECURICOR DELIVERY on all orders over £100 (UK mainland only) Add just £2.50 on lower price orders

0 Stereo Mixer — this is a really atile new mixer that enables the structor DJ to produce a profes- al performance every time. There wo stereo inputs for magnetic cart- es, a stereo auxiliary input and mike . Other 'plus' features are auto- ing for fast or slow slider controls, -mixing, ducking, interrupt, input ulation, in short everything . . . the e works — AND — under £100 complete! Complete kit **£97.50** + VAT

TRANSCENDENT 2000 — Although only a 3 octave keyboard the '2000' features the same design ingenuity, careful engineering and quality components of its larger brethren. The kit is well within the scope of the first time builder — buy it, build it — play it! You will know you have made the right choice.
Complete kit **£165.00** + VAT

BIG NEWS ABOUT OUR LATEST ADVANCES IN ROBOTICS SEE INSIDE BACK COVER

SALES COUNTER
Collect your order from the factory. Open 9-12/1-4.30 Mon- Fri. Easy parking, no waiting

Digital Delay Line — With its ability to give delay times from 1.6 mSecs to up to 1.6 secs. Many powerful effects including phasing, flangine, A.D.T., chorus, echo &

vibrato are obtained. The basic kit is extended in 400 mS steps up to 1.6 secs. Simply by adding more parts to the PCB. Compare with units costing over £1,000!
Complete kit (400 mS delay)
£130 + VAT
Parts for extra 400 mS delay
£9.50 + VAT

versatile modular mixer, featured as a constructional article in Practical Electronics be built up to a maximum of 24 inputs, 4 outputs and an auxiliary channel. Each input nel has Mic and Line inputs, variable gain, bass and treble controls and a para- c middle frequency equalizer. There are send and return jacks, auxiliary, pan and controls and output and group switching. The output channels have PPM displays ecord and studio outputs. The auxiliary channel also has a PPM display and there is adphone monitor jack and a built-in talk-back microphone. The mixer modules plug base units each of which takes up to 6 channels. To eliminate hum, the power supply a separate cabinet.

KIT PRICES

channel	£19.90	Base unit and wooden front	£27.50
ut channel	£18.50	Pair of mahogany end cheeks	£12.50
iary channel	£22.50	Power Supply and cabinet	£19.50
k Panel	£3.00		

All prices are VAT exclusive

NSCENDENT POLYSYNTH — A four octave poly- ic synthesiser with outstanding design characteristics versatility and performance to match.
mplete kit **£230.00** plus VAT (single voice)
voice (up to three more) **£35.60** plus VAT

Free Soldering Practise Kit on request with your first kit — useful tips, well illustrated.

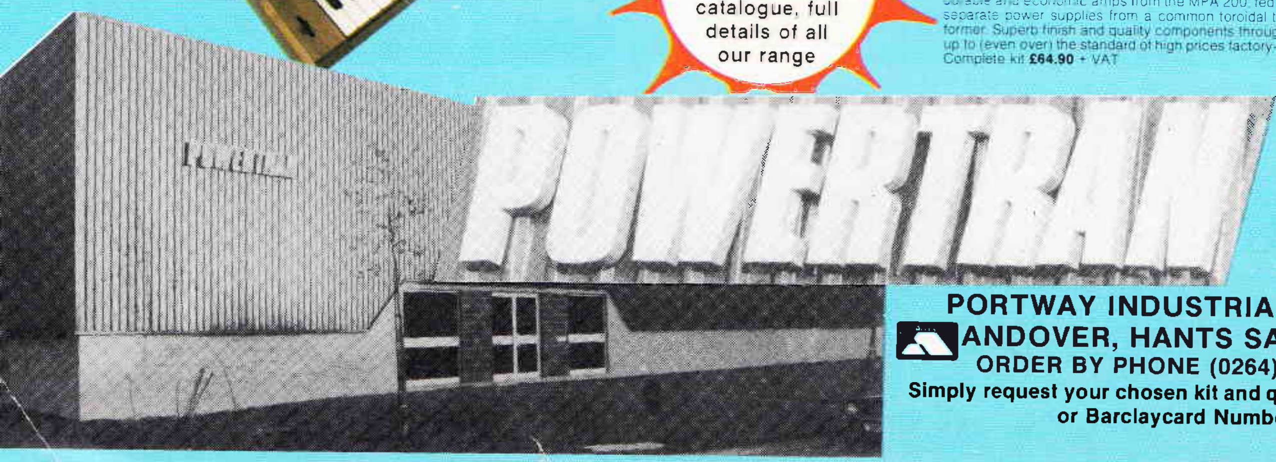
MPA 200 — is a low price high power 100W amplifier. Its smart styling, professional appearance and performance make it one of our most popular designs. With adaptable inputs the mixer accepts a variety of sources yet straightforward construction makes it ideal for the first time builder. Complete kit **£49.90** + VAT

Chromatheque 5000 — a 5 channel lighting system powerful enough for professional discos yet controllable for home-effects. Sound to light, strobe to music level, random or sequential effects — each channel can handle up to 500W yet minimal wiring is needed with our unique single board design. Complete kit **£49.50** + VAT

ETI VOCODER — 14 channels each with independent level control, for maximum versatility and intelligibility. Two input amplifiers — for speech/excitation — each with level control and tone control. The Vocoder is a powerful yet flexible machine that is interesting to build and thanks to our easy to follow construction manual, is within the capability of most enthusiasts. Complete kit **£175.00** + VAT

SP2 200 twice the power with two of the reliable, durable and economic amps from the MPA 200, fed by separate power supplies from a common toroidal transformer. Superb finish and quality components throughout — up to (even over) the standard of high prices factory-built units! Complete kit **£64.90** + VAT

Component packs for most kits are available See our great free catalogue, full details of all our range



WORLD LEADERS IN ELECTRONIC KIT DESIGN AND SUPPLY

PORTWAY INDUSTRIAL ESTATE ANDOVER, HANTS SA10 3NM.
ORDER BY PHONE (0264) 64455
Simply request your chosen kit and quote your Access or Barclaycard Number.