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MARCH 1984

85p

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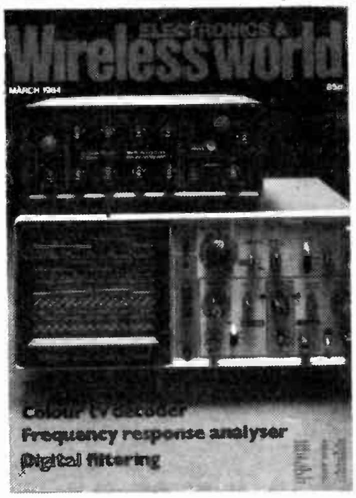

Front cover shows a Thurlby OM358 eight-trace multiplexer in use with a Hitachi V121 dual-trace oscilloscope to introduce our oscilloscope survey on page 57. Picture supplied by Thurlby.

NEXT MONTH

Bob Coates turns the Picotutor's 68705 microprocessor into a simple, low-cost interface for driving a teletypewriter from a microcomputer Centronics port.

As well as providing 5.5 and 6MHz sound, a synthesized tv modulator can be accurately switched to any u.h.f. channel.

Testing microprocessor systems is not so simple for the first-time builder without access to logic analysers or emulators. Carson gives some simple procedures that highlight hardware and software problems.

Surface wave, charge transfer and digital v.l.s.i. devices have enabled complex and powerful matched filters to be made. Geoffrey Robinson describes some examples that illustrate their different forms and uses.

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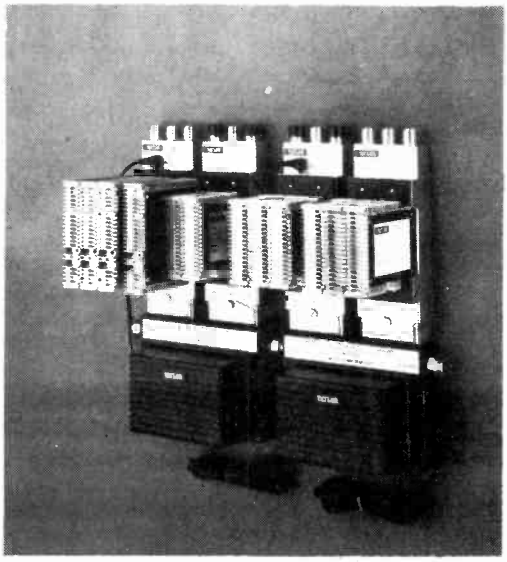
ELECTRONICS & Wireless world

MARCH 1984 VOL 90 NO 1578

CABLE T.V. HEAD END AND REPEATER AMPLIFIERS



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TS2845	Separate UHF/UHF inputs. Gain 28dB UHF, 22dB VHF. Maximum output 46dBmV.
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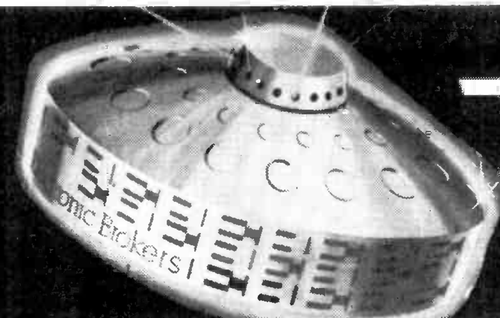

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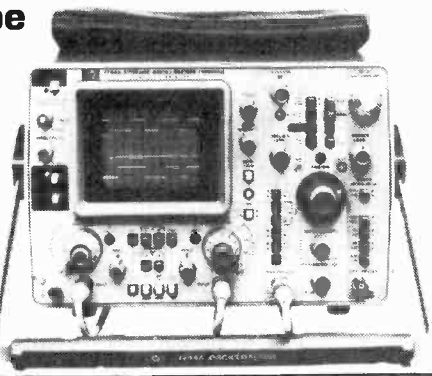

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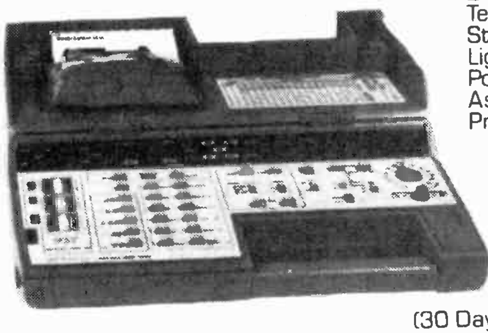

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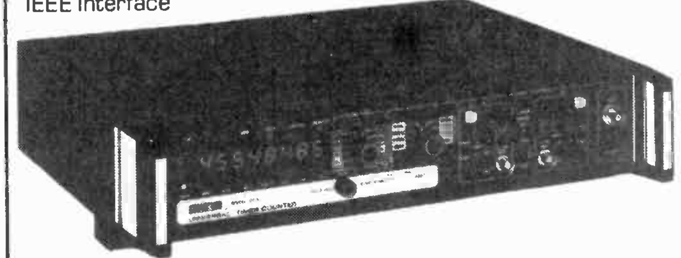

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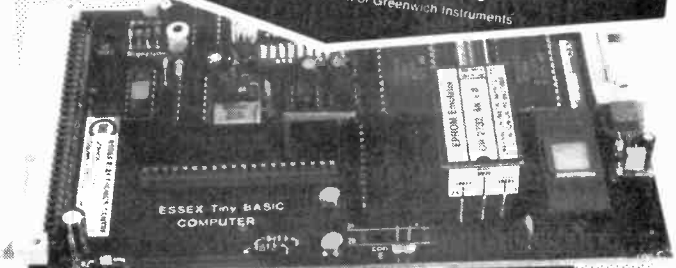

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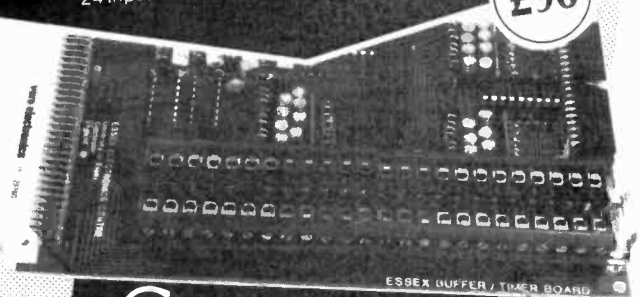

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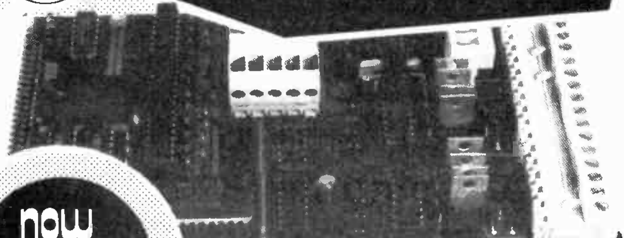

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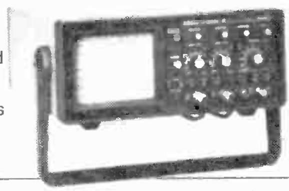

Hameg HM103 10MHz Oscilloscope £158
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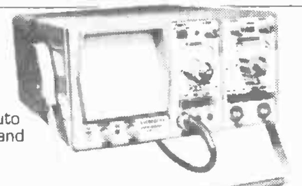

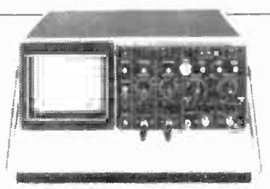

Philips PM3217 50MHz Oscilloscope £850
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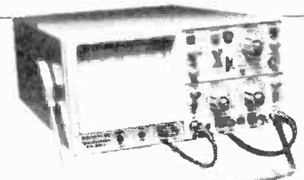

Hameg HM203-4 20MHz Oscilloscope £264
Designed for general purpose applications in industry and education. Versatile triggering performance to at least 40MHz.Dual trace X-Y operation, TV triggering, add and invert mode and component tester make the price/performance ratio of this scope most attractive.

Philips PM3219 Storage Oscilloscope £2675
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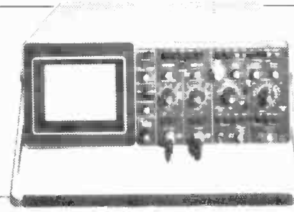

Hameg HM204 20MHz Oscilloscope £365
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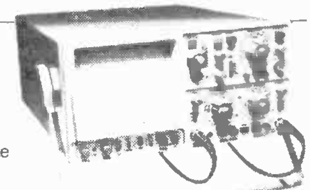
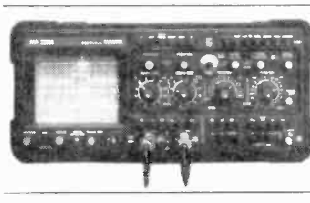
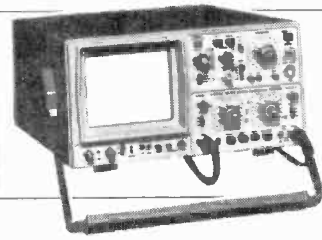


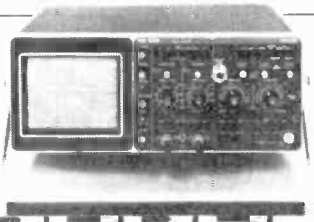


Philips PM3256 75MHz Oscilloscope £1245
Tough, light-weight ruggedised unit, with shoulder strap, that can be used in harsh service environments. Fast trigger circuits to over 100MHz. TTL triggering is standard. Trigger view third channel and full X-Y display. Dual trace with 2mV sensitivity and delayed time base.
Philips PM 3254 Single time base £1145



Hameg HM605 60MHz Oscilloscope £487
Outstanding performance with versatile triggering to 80MHz. Sensitivity 1mV to 30MHz and 2mV above. Bright display from 14kV CRT. Switchable 1kHz/1MHz probe calibrator. Dual trace, delayed sweep, X-Y operation, Z modulation, internal illuminated graticule and component tester.

Philips PM3267 100MHz Oscilloscope £1250
Versatile and economic instrument designed for advanced electronic environments. Separate main and delayed time base controls with comprehensive triggering facilities and trigger view third channel. Dual trace, 2mV sensitivity, full X-Y display, Z modulation and internal illuminated graticule.



Hameg HM705 70MHz Oscilloscope £588
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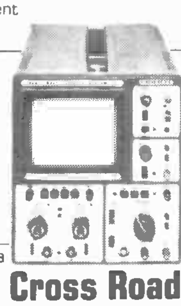

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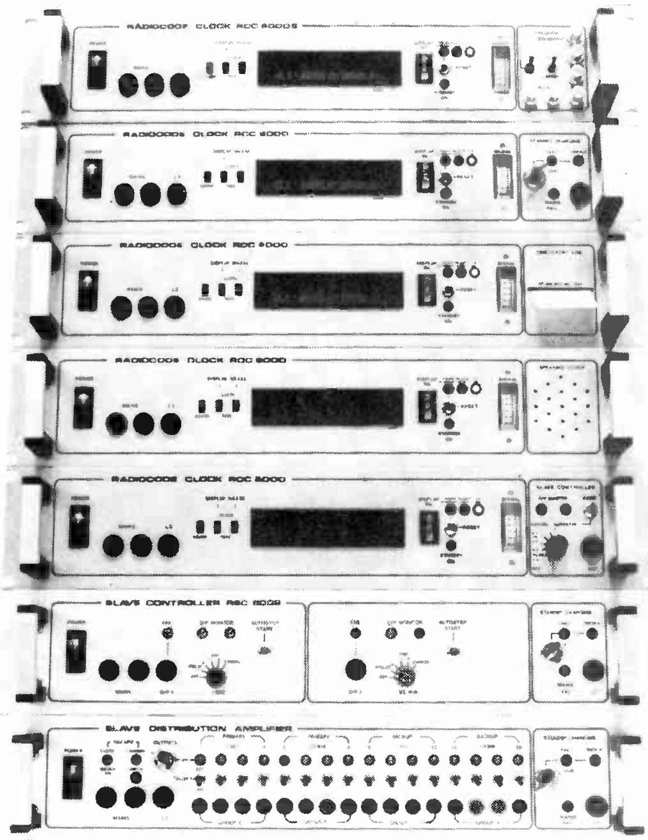

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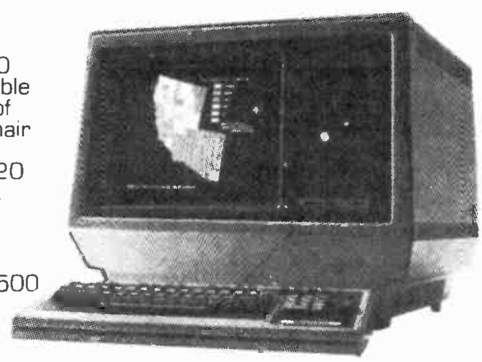

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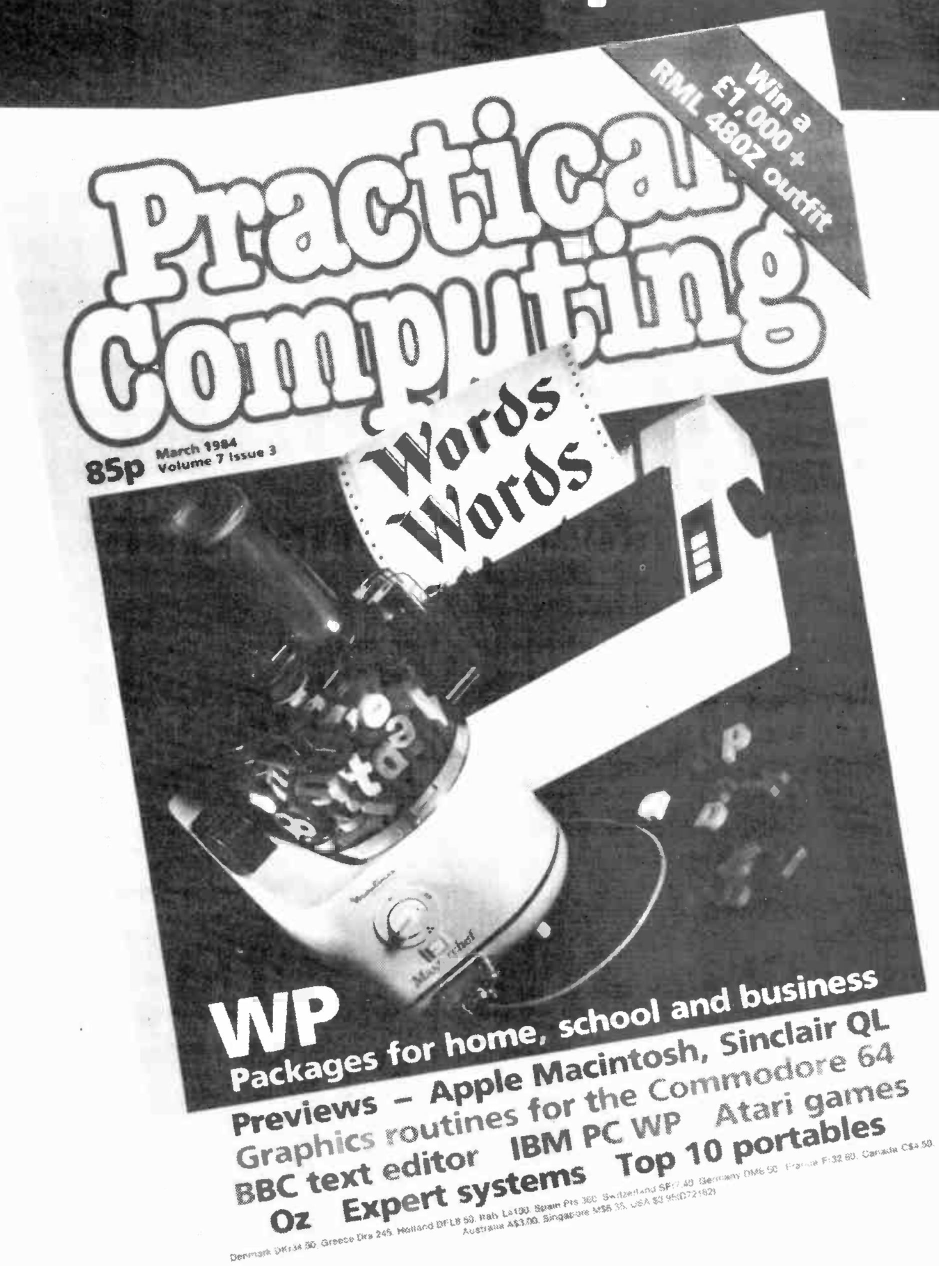

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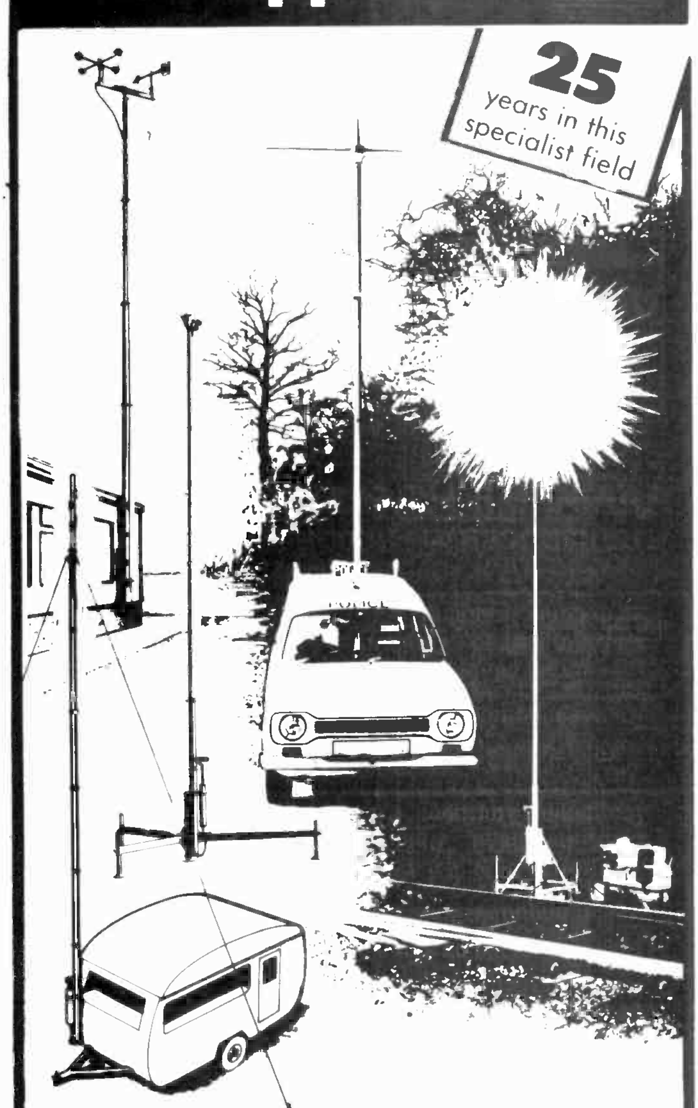

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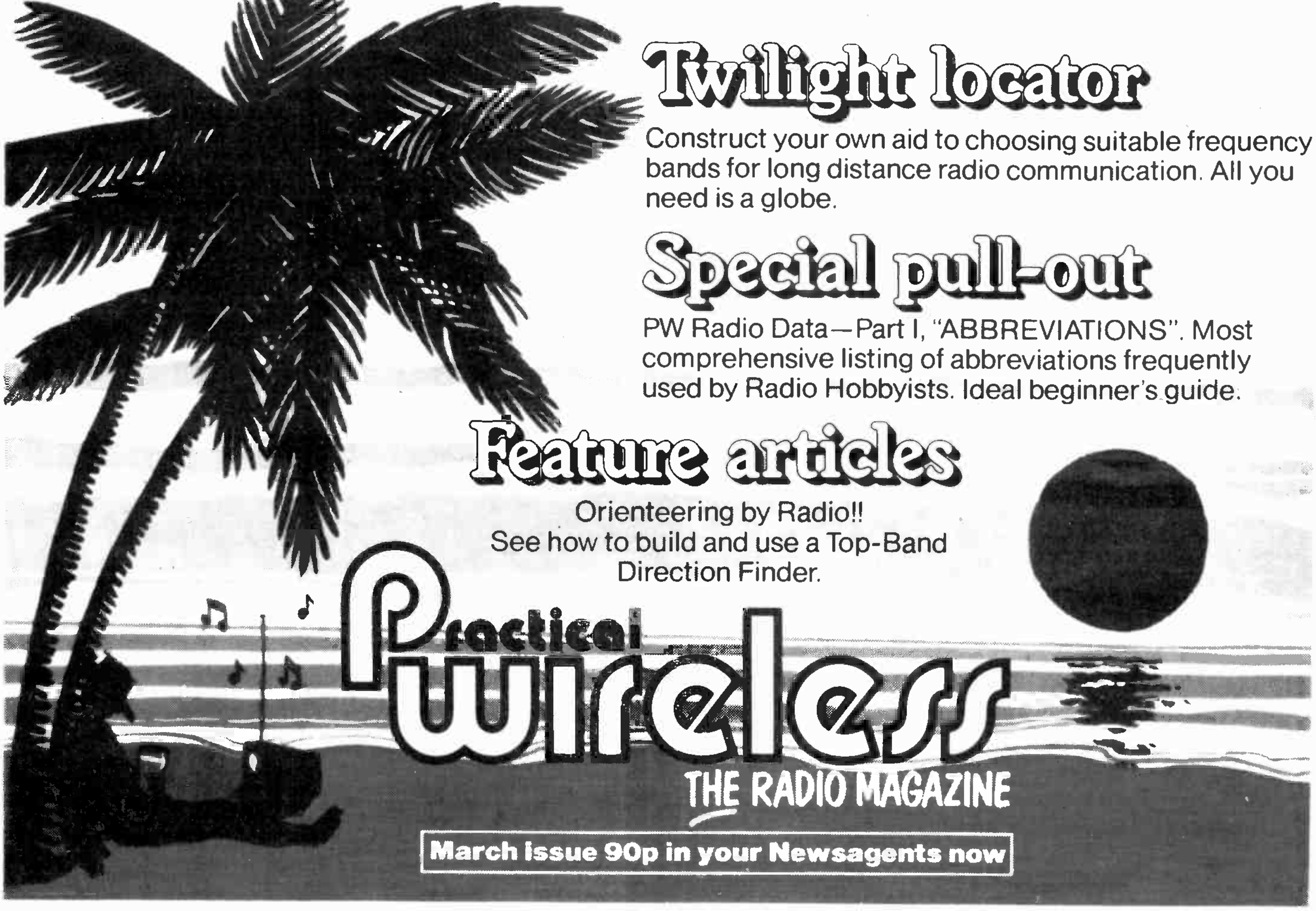

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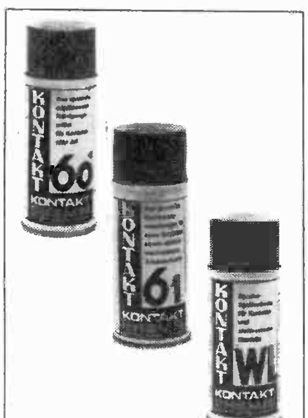

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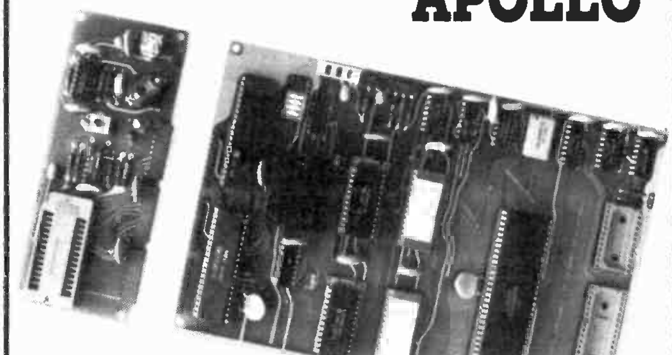

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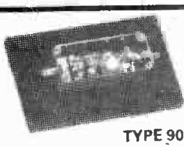

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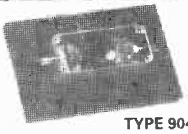

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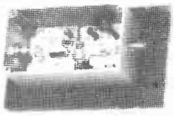

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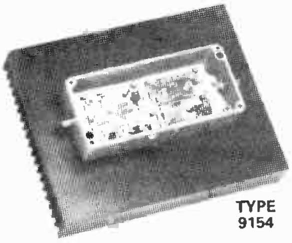
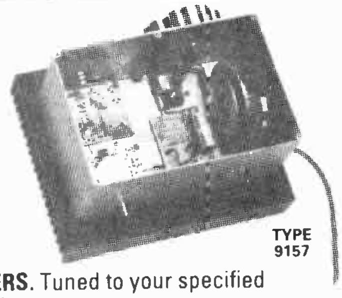
TYPE 9152 10 mW. input, 500 mW. output .... £160+5 p&p
TYPE 9159 500 mW. input, 5 watts output .... £180+£5 p&p



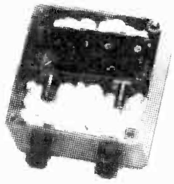
TYPE 9154



TYPE 9157

VMOS LINEAR POWER AMPLIFIERS. Tuned to your specified frequency in the range 10-250 MHz

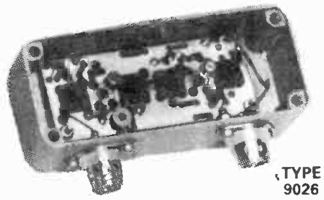
TYPE 9154 200 mW. – 2 watts input, 20 watts output .... £180+£10 p&p
TYPE 9160 As above with integral mains power supply unit .... £240+ £15 p&p
TYPE 9168 8 watts input, 80 watts output .... £240+£10 p&p
TYPE 9157 As above with integral mains power supply unit .... £295+£15 p&p
TYPE 9086 FM TRANSMITTER 88-108 MHz. 50 watts RF output. 24V+ supply. Complete modular system .... £380+£20 p&p
TYPE 9087 As above with integral mains power supply unit .... £440+£25 p&p



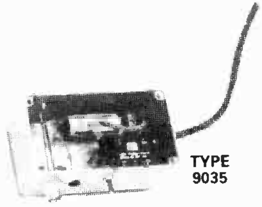
TYPE 9010

TWO STAGE GASFET STRIPLINE PREAMPLIFIERS
Tuned to your specified channels in bands IV or V

TYPE 9002 Two stage Gasfet preamplifier. N.F. 0.7 dB. Gain 25 dB. High Q filter. 15V.+ DC .... £85+£2 p&p
TYPE 9004 UHF two stage Gasfet preamplifier. N.F. 0.6 dB. Gain 25 dB. Aligned to your specified frequency in the range 250-500 MHz. High Q filter. 15V.+ DC .... £85+£2 p&p
TYPE 9012 Gasfet preamplifier mains power supply unit .... £24.50+£3 p&p
TYPE 9010 Masthead weatherproof unit .... £6.50+£2 p&p



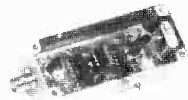
TYPE 9026



TYPE 9035

GASFET/MOSFET RF PREAMPLIFIERS. Aligned to your specified frequency in the range 30-250 MHz. Masthead/local use

TYPE 9026 N.F. 1.0 dB. Gain 10-40 dB. variable .... £39.50+£2 p&p
TYPE 9026FM As above. Band II 88-108 MHz .... £39.50+£2 p&p
TYPE 9006 Gasfet. N.F. 0.6 dB. Gain 10-40 dB. variable .... £65+£2 p&p
TYPE 9035 Mains power supply unit for above types .... £24.50+£3 p&p



TYPE 8034

TYPE 8034 PHASE LOCKED SIGNAL SOURCE using low frequency reference crystal. Specify output in the range 1-600 MHz. Output 10 mW. + 10 dBm. .... £79.50+£2 p&p
TYPE 9113 TELEVISION FREQUENCY CONVERTER. Changes channels in the range 40-1000 MHz .... £242+£5 p&p
TYPE 9056 1500 MHz. PRESCALER. Divides 100-1500 MHz. by 10 .... £69.50+£2 p&p

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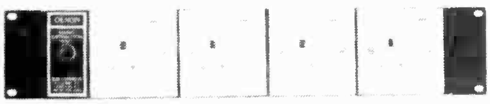

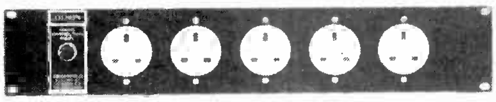

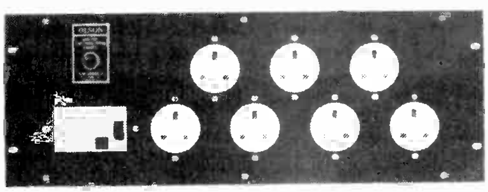

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SEMICONDUCTORS

AA119	0.10
AAY30	0.17
AAY30	0.17
AAZ13	0.15
AAZ15	0.15
AAZ17	0.15
AC107	0.55
AC125	0.25
AC126	0.25
AC127	0.25
AC128	0.30
AC141	0.28
AC141K	0.35
AC142	0.28
AC142K	0.35
AC176	0.30
AC187	0.28
AC188	0.28
ACY17	1.30
ACY18	1.15
ACY19	1.10
ACY20	1.10
ACY21	1.15
ACY39	2.50
AD149	0.75
AD161	0.35
AD162	0.35
AF106	0.35
AF114	0.75
AF115	0.75
AF116	0.75
AF117	0.75
AF139	0.33
AF186	1.00
AF239	0.39
AFZ11	4.00
AFZ12	4.00
ASY26	1.40
ASY27	0.90
ASZ15	1.20
ASZ16	1.10
ASZ17	1.00
ASZ20	2.30
ASZ21	2.50
AU113	2.50
AUY10	3.00
BA145	0.13
BA148	0.15
BA154	0.10
BA155	0.11
BA156	0.10
BAW62	0.05
BAX13	0.06
BAX16	0.06
BC107	0.16
BC108	0.16
BC109	0.16
BC113	0.15
BC114	0.15
BC115	0.18
BC116	0.19
BC117	0.23
BC118	0.18
BC125	0.18
BC126	0.18
BC135	0.15
BC136	0.19
BC137	0.19
BC147	0.12
BC148	0.12
BC149	0.13
BC157	0.13
BC158	0.13
BC159	0.13
BC167	0.11
BC170	0.11
BC171	0.11
BC172	0.11
BC173	0.11
BC177	0.28
BC178	0.28
BC179	0.28
BC182	0.11
BC183	0.11
BC184	0.11
BC212	0.11
BC213	0.11
BC214	0.11
BC237	0.11
BC238	0.11
BC301	0.33
BC303	0.34
BC307	0.11
BC308	0.11
BC327	0.12
BC328	0.12
BC337	0.12
BC338	0.12
BCY30	1.25
BCY31	1.50
BCY32	1.50
BCY33	1.10
BCY34	1.00
BCY39	3.40
BCY40	2.80
BCY42	0.30
BCY43	0.30
BCY58	0.19
BCY70	0.17
BCY71	0.18
BCY72	0.17
BCZ11	1.75
BD115	0.42
BD121	1.70
BD123	2.80
BD124	2.00
BD131	0.44
BD132	0.48
BD135	0.40
BD136	0.40
BD137	0.40
BD138	0.48
BD139	0.48
BD140	0.50
BD144	2.00
BD181	1.20
BD183	0.80
BD2137	0.54
BD238	0.54
BDX10	0.91
BDX32	2.00
BDY20	1.50
BDY60	2.75
BF115	0.35
BF152	0.16
BF153	0.16
BF154	0.17
BF159	0.17
BF160	0.17
BF167	0.24
BF173	0.30
BF177	0.35
BF178	0.35
BF179	0.35
BF180	0.28
BF181	0.28
BF182	0.30
BF183	0.28
BF184	0.28
BF185	0.30
BF194	0.14
BF195	0.12
BF196	0.13
BF197	0.14
BF200	0.40
BF224	0.25
BF244	0.28
BF257	0.27
BF258	0.27
BF259	0.28
BF336	0.34
BF337	0.33
BF338	0.36
BFS21	4.00
BFS28	2.25
BFS61	0.20
BFS98	0.20
BFW10	0.97
BFW11	0.96
BFX84	0.30
BFX85	0.30
BFX87	0.30
BFX88	0.30
BFY50	0.25
BFY51	0.25
BFY52	0.25
BFY64	0.30
BFY90	0.95
BSX19	0.27
BSX20	0.27
BSX21	0.29
BT106	1.20
BTY79/400R	2.00
BU205	1.30
BU206	1.50
BU208	2.00
BY100	0.40
BY126	0.13
BY127	0.14
BZX61 Series	0.17
BZY88 Series	0.10
CRS1/40	0.60
CRS3/40	0.75
CRS3/60	0.90
GEX66	3.00
GEX541	5.00
GJ3M	1.50
GM0378A	1.75
KS100A	0.45
MJE340	0.60
MJE370	0.73
MJE371	0.71
MJE520	0.47
MJE521	0.73
MJE2955	1.30
MJE3055	1.10
MPF102	0.35
MPF103	0.35
MPF104	0.35
MPF105	0.35
MPSA06	0.26
MPSA56	0.28
MPSU01	0.53
MPSU06	0.65
MPSU56	0.69
NE555	0.45
NKT401	3.50
NKT403	2.50
NKT404	2.20
OA5	1.20
OA7	0.60
OA10	0.55
OA47	0.12
OA70	0.25
OA79	0.12
OA81	0.17
OA85	0.17
OA90	0.08
OA91	0.08
OA95	0.08
OA200	0.15
OA202	0.15
OA211	1.50
OAZ200	1.50
OAZ201	1.50
OAZ206	1.50
OAZ207	1.50
OC16	2.50
OC20	2.50
OC22	2.50
OC23	4.00
OC24	3.00
OC25	1.00
OC26	1.50
OC28	2.00
OC29	2.00
OC35	1.50
OC36	1.50
OC41	0.90
OC42	0.90
OC43	1.50
OC44	0.85
OC45	0.65
OC71	0.55
OC72	1.00
OC73	1.00
OC74	0.70
OC75	0.65
OC76	1.00
OC77	1.00
OC81	0.65
OC81Z	1.20
OC82	0.90
OC83	1.00
OC84	0.80
OC122	2.75
OC123	2.00
OC139	3.00
OC140	4.00
OC141	4.25
OC170	1.25
OC171	1.25
OC200	1.50
OC201	2.50
OC202	2.75
OC203	3.00
OC204	3.00
OC205	2.75
OC206	2.75
OC207	2.50
OCP71	2.00
ORP12	1.00
R2008B	2.00
R2009	2.25
R2010B	2.00
T1C44	0.27
T1C226D	1.20
T1L209	0.16
T1P29A	0.43
T1P30A	0.45
T1P31A	0.33
T1P32A	0.36
T1P33A	0.54
T1P34A	0.67
T1P41A	0.44
T1P42A	0.42
T1P2955	0.70
T1P3055	0.56
T1S43	0.43
ZS140	0.25
ZS170	0.21
ZS178	0.54
ZS271	0.23
ZS278	0.57
ZTX107	0.12
ZTX108	0.12
ZTX109	0.12
ZTX300	0.13
ZTX301	0.14
ZTX302	0.18
ZTX303	0.18
ZTX304	0.20
ZTX311	0.13
ZTX314	0.25
ZTX500	0.14
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ZTX502	0.18
ZTX503	0.19
ZTX504	0.21
ZTX531	0.24
ZTX550	0.25
1N914	0.05
1N916	0.09
1N4001	0.06
1N4002	0.06
1N4003	0.06
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1N4005	0.09
1N4006	0.11
1N4007	0.12
1N4009	0.07
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1N5400	0.13
1N5401	0.13
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1S921	0.09
2G301	1.00
2G302	1.00
2G306	1.00
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2N698	0.32
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2N706	0.25
2N708	0.25
2N930	0.25
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2N1893	0.32
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2N2148	3.75
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2N2219	0.32
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2N4126	0.16
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2N4288	0.18
2N4289	0.18
2N4400	0.11
2N4401	0.11
2N4402	0.11
2N5457	0.32
2N5458	0.32
2N5459	0.32
2S017	10.00
2S019	12.00
2S026	25.00
2S103	1.50
2S302	2.00
2S303	1.50
2S322	3.50
2S324	3.50
2S701	2.00
2S745A	0.95
2S746A	0.95

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A2087	13.50
A2134	17.50
A2293	16.00
A2426	27.50
A2521	22.50
A2900	15.00
A3343	45.00
AZ31	2.75
AZ41	2.60
BK448	114.90
BK484	155.35
BS90	58.00
BS810	60.00
BT5	58.95
BT17	151.00
BT19	44.05
BT29	349.15
BT69	354.80
BT95	129.90
CBL31	4.00
CL33	4.00
CY31	3.00
C1K	20.00
C3A	22.00
C3JA	22.00
DA41	25.00
DA42	18.70
DAF91	1.75
DAF96	1.75
DET22	35.00
DET24	49.00
DF91	1.75
DF96	1.75
DK91	1.75
DK92	2.00
DK96	1.75
DL92	2.00
DL94	1.75
DL96	1.75
DLS10	14.00
DLS15	12.50
DLS16	12.50
DLS19	12.50
DM70	2.00
DM71	2.00
DM160	4.75
DY87	1.50
DY802	1.50
E55L	22.00
E80CC	8.81
E80CF	11.27
E80F	14.19
E80L	13.73
E81CC	8.00
E811	13.27
E82CC	8.10
E83CC	8.40
E86C	8.25
E88C	8.25
E88CC	8.42
E90CC	9.47
E90F	9.90
E91H	6.25
E92CC	8.75
E99F	9.10
E130L	18.50
E180CC	10.50
E180F	10.20
E182CC	13.25
E186F	11.50
E188CC	8.91
E280F	22.51
E283CC	12.00
E288CC	17.50
EA52	32.25
EA76	2.50
EABC80	1.25
EAC91	3.50
EAF42	2.50
EAF801	2.00
EB41	4.00
EB91	1.50
EBC33	2.50
EBC41	2.50
EBC81	1.50
EBC90	1.25
EBF80	1.50
EBF83	1.75
EBF89	1.50
EBL31	4.00
EC90	1.25
EC91	8.00
EC92	1.75
EC157	380.00
ECC33	4.50
ECC35	4.50
ECC40	4.50
ECC81	1.75
ECC82	1.75
ECC83	1.75
ECC84	1.75
ECC85	1.75
ECC86	2.50
ECC88	2.10
ECC89	2.00
ECC91	8.93
ECC189	2.10
ECC807	1.75
ECC808	3.00
ECF80	1.55
ECF82	1.50
ECF86	2.50
ECH35	3.00
ECH42	3.50
ECH81	3.00
ECH83	2.50
ECH84	2.50
ECL80	-1.50
ECL81	1.75
ECL82	1.50
ECL83	3.00
ECL84	1.50
ECL85	1.50
ECL86	1.75
EF37A	5.00
EF39	2.75
EF40	5.00
EF41	3.50
EF42	4.50
EF50	2.50
EF54	5.00
EF55	3.50
EF80	1.75
EF83	4.00
EF85	1.75
EF86	1.75
EF89	2.50
EF91	2.95
EF92	6.37
EF93	1.50
EF94	2.50
EF95	5.99
EF98	2.00
EF183	2.00
EF184	2.00
EF804S	12.00
EF805S	15.00
EH90	1.75
EK90	1.50
EL32	2.50
EL33	4.00
EL34MUI	3.00
EL36	2.50
EL41	2.80
EL42	2.50
EL81	5.25
EL83	6.00
EL84	2.25
EL86	2.75
EL90	2.25
EL91	9.69
EL95	2.00
EL156	30.00
EL360	8.50
EL500/504	3.00
EL509	7.00
EL821	13.00
EL822	13.97
EM34	5.00
EM80	2.50
EM81	2.50
EM84	2.00
EM85	2.75
EM87	2.50
EN32	17.46
EN91	£7.05
EN92	6.96
EY51	2.75
EY81	2.50
EY83	2.50
EY84	9.24
EY86	1.75
EY88	1.75
EY500A	3.00
EY802	1.75
EZ35	1.75
EZ40	2.50
EZ41	2.50
EZ80	1.50
EZ81	1.50
EZ90	2.00
FW4-500	3.50
FW4-800	3.50
G1.371K	35.00
G551K	12.00
G180.2M	17.50
G240.2D	12.00
G400.1K	17.50
GN4	9.00
GN4A	9.00
GS16	16.00
GT1C	15.00
GU50	20.00
GU51	20.00
GXU1	15.35
GXU2	30.00
GXU3	25.40
GXU4	44.50
GXU50	20.00
GY501	3.00
GZ32	4.00
GZ33	4.75
GZ34	3.00
GZ37	4.75
KT61	5.00
KT66	12.00
KT77 Gold Lion	9.00
KT88	15.00
KTW61	2.50
KTW62	2.50
KTW63	2.50
M8079	12.34
M8080	8.25
M8081	9.82
M8082	9.69
M8083	8.58
M8091	10.43
M8096	6.80
M8097	8.10
M8098	6.15
M8099	8.00
M8100	9.52
M8136	10.23
M8137	10.23
M8140	6.00
M8141	6.50
M8142	8.75
M8144	7.50
M8149	6.50
M8161	9.35
M8162	10.40
M8163	8.25
M8190	5.00
M8195	10.85
M8196	7.50
M8204	7.05
M8212	11.37
M8223	6.00
M8224	6.30
M8225	4.50
M8248	14.03
MD2901	115.00
MU14	2.50
MX119	55.00
MX123	72.00
MX145	56.70
MX151	17.25
MX152	131.25
MX161	152.25
MX163	20.25
MX164	25.52
MX166	147.00
MX168	50.00
N78	15.00
OA2	3.25
OA3	2.50
OA4	6.00
OB2	4.35
OB3	2.50
OC2	4.35
OC3	2.50
OD3	2.50
OZ4	3.50
PC86	2.50
PC88	2.50
PC95	1.75
PC97	1.75
PC900	1.75
PCC84	1.50
PCC85	1.50
PCC88	2.00
PCC89	1.75
PCC189	2.50
PCC805	1.60
PCC806	1.60
PCE82	2.00
PCF80	2.00
PCF82	1.50
PCF86	2.50
PCF87	2.00
PCF200	3.25
PCF201	3.25
PCF801	2.50
PCF802	2.50
PCF805	1.70
PCF806	1.70
PCF808	1.70
PCL82	2.00
PCL83	3.00
PCL84	2.00
PCL85	2.50
PCL86	2.50
PCL805/85	2.50
PD500	6.00
PE06-40N	45.00
PFL200	2.50
PL36	2.50
PL81	1.75
PL81A	2.00
PL82	1.50
PL83	2.50
PL84	2.00
PL504/5	2.50
PL508	2.50
PL509	6.00
PL519	6.00
PL801	1.50
PL802	6.00
PY33	2.50
PY81	1.50
PY82	1.50
PY83	2.50
PY88	2.00
PY500A	4.00
PY800	1.50
PY801	1.50
QQV02-6	30.50
QQV03-10	20.50
QQV03-20A	48.38
QQV06-40A	65.34
QQV07-50	68.60
QQZ06-40A	62.20
QU37	12.50
QV03-12	6.80
QV04-7	3.50
QV08-100	155.70
QY3-65	59.86
QY3-125	66.50
QY4-250	68.00
QY4-400	74.20
QY5-500	175.00
QY5-3000A	420.00
QZ06-20	32.70
R10	6.00
R17	3.00
R18	3.00
R19	9.24
R20	2.50
RG3-250	32.68
RG3-250A	32.68
RG3-1250	59.50
RG4-1250	61.60
RG4-3000	99.45
RR3-250	40.00
RR3-1250	45.75
S11E12	65.00
S130	6.00
S130P	6.00
STV280-40	14.00
STV280-80	21.00
SU41	5.00
SU42	10.00
TD03-10	35.00
TD03-10F	35.00
TT15	35.00
TT21	23.00
TT22	23.00
TT100	60.00
TY2-125	65.00
TY4-400	75.00
TY4-500	98.35
TY5-500	201.50
TY6-800	196.50
TY6-5000A	490.00
TY6-5000B	395.00
TY6-5000W	407.00
TY7-6000A	485.00
TY7-6000W	303.60
TZ40	25.00
U18-20	3.50
U19	13.75
U25	2.50
U26	2.50
U37	12.00
UABC80	1.25
UAF42	2.50
UB41	3.00
UBC41	2.25
UBF89	1.50
UCC84	1.75
UCC85	1.85
UCF80	2.00
UCH42	2.50
UCH81	2.50
UCL82	1.75
UCL83	2.75
UF41	2.00
UF42	2.10
UF80	1.75
UF85	1.75
UF89	2.00
UL41	3.50
UL84	1.75
UM80	2.00
UY41	2.25
UY85	2.25
VLS631	15.00
XG1-2500	55.00
XG2-6400	141.90
XG5-500	26.60
XG2-6400	162.00
XR1-1600A	53.75
XR1-3200	81.97
XR1-3200A	
XR1-6400	102.00
YD1120	395.00
YD1240	450.00
Z759	25.00
ZM1000	8.00
ZM1001	8.00
ZM1020	9.00
ZM1021	9.00
ZM1022	9.00
ZM1023	9.00
ZM1040	19.36
ZM1041	16.66
ZM1042	17.77
1B3GT	3.00
1B24	25.00
1B35A	48.00
1B63	64.00
1R5	1.75
1S5	1.75
1T4	1.75
2AS15	11.50
2C39A	60.00
2C43	70.00
2D21	3.25
2E26	8.25
2J42	98.00
2J55	175.00
2J70A	383.00
2J70B	336.00
2K25	125.00
3-400Z	85.00
3-500Z	85.00
3A5	3.00
3B24	11.00
3B28	15.35
3B29	20.05
3B240M	17.50
3B241M	17.50
3C23	25.00
3C45	24.50
3CX100A5	47.00
3E29	45.00
3S4	2.00
3V4	1.75
465A	60.00
4-125A	60.00
4-250A	80.00
4-400A	87.00
4B32	20.00
4C35	78.00
4CX250B	40.00
4CX350A	73.00
4X150A	60.00
4X150D	56.00
5B254M	35.00
5B255M	35.00
5C22	160.00
5J180E	1650.00
5R4GY	3.50
5U4G	3.00
5U4GB	2.50
5V4G	2.50
5Y3GT	2.50
5Z3	4.00
5Z4G	2.50
5Z4GT	2.50
6-30L2	1.75
6AB4	1.75
6AB7	3.00
6AC7	3.00
6AF4A	4.25
6AG7	3.00
6AH6	5.00
6AK5	5.99
6AK6	2.50
6AL5	1.50
6AM4	4.00
6AM5	9.69
6AM6	6.02
6AN5	4.75
6AN8A	3.50
6AQ5	2.25
6AS6	8.66
6AS7G	8.75
6AT6	1.25
6AU5GT	5.00
6AU6	2.50
6AV5GA	4.50
6AV6	1.50
6AX5GT	3.00
6B7	3.25
6B8	3.25
6BA6	1.50
6BA7	5.00
6BA8A	4.00
6BC4	4.00
6BE6	1.50
6BH6	2.50
6BJ6	2.25
6BK4	4.50
6BL6	85.00
6BL7GT	4.50
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6BN6	2.00
6BQ7A	3.50
6BR7	6.00
6BR8A	3.50
6BS7	6.00
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6BW7	1.50
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6BZ6	2.75
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6CB6A	2.50
6CD6GA	5.00
6CG7	2.50
6CH6	13.00
6CL6	3.75
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6D2	1.50
6DK6	3.00
6DQ6B	4.75
6EA8	3.00
6EB8	2.50
6EW6	2.25
6F6	3.00
6F23	1.60
6F28	1.60
6F33	33.50
6H1	14.00
6H2N	2.75
6H3N	2.75
6H6	3.00
6J4	5.50
6J6	8.93
6J7	4.75
6K4N	2.50
6K6GT	2.75
6K7	3.00
6K8	3.00
6KD6	7.00
6L6G	3.00
6L6GA	3.00
6L6GC	3.00
6L6GT	3.00
6L7	2.50
6N2P	2.50
6N3P	2.50
6N7	3.00
6P25	4.00
6Q7	3.75
6R7	3.25
6SA7	3.00
6SC7	2.75
6SF7	2.50
6SH7	3.00
6SJ7	3.25
6SK7	3.50
6SL7GT	3.00
6SN7GT	3.00
6SQ7	3.40
6SR7	4.00
6SS7	2.75
6U5G	3.50
6U8A	2.25
6V6GT	2.25
6X4	2.00
6X5GT	1.75
7B7	2.50
7C5	4.00
7C6	2.50
7H7	4.00
7R7	4.25
7S7	3.50
7Y4	2.25
7Z4	2.00
11E3	55.00
12AH8	5.00
12AT6	1.50
12AT7	1.75
12AU6	2.50
12AU7	1.75
12AV6	2.50
12AV7	3.50
12AX7	1.75
12AY7A	4.00
12B4A	3.50
12BA6	2.50
12BE6	2.50
12BH7	2.75
12BY7	3.00
12E1	20.00
12E11TT	28.00
12E14	65.00
13E1	170.00
19H4	27.50
19H5	47.50
24B9	67.25
30C15	2.00
30C17	2.00
30C18	2.00
30F5	1.60
30FL1/2	1.38
30FL12	1.80
30FL14	2.00
30L1	1.50
30L15	2.00
30L17	2.00
30P4	2.50
30P19	2.50
30PL1	3.00
30PL14	1.80
30PL15	1.80
35W4	1.00
50C5	1.50
75B1	6.05
75C1	4.50
85A1	7.50
85A2	4.45
90AG	12.96
90AV	12.96
90C1	6.00
90CG	14.54
90CV	15.45
92AG	12.96
92AV	12.96
95A1	8.45
150B2	6.50
150B3	8.35
150C2	3.25
150C4	6.00
211	35.00
723AB	125.00
803	25.00
805	45.00
807	3.75
811A	18.33
812A	18.33
813	125.86
833A	193.16
866A	20.03
872A	20.00
922	6.00
931A	18.50
1624	4.00
1625	3.50
2050	7.50
4212E	300.00
4212H	300.00
5544	81.97
5545	102.00
5551A	114.90
5552A	155.35
5642	9.00
5654	3.00
5651	4.45
5670	4.50
5675	28.00
5687	6.00
5696	4.50
5718	7.50
5725	5.50
5726	11.37
5727	7.05
5749	2.50
5751	4.00
5763	4.50
5814A	4.00
5840	4.00
5842	12.00
5876A	31.50
5879	5.00
5886	15.00
5963	2.50
5965	3.50
6005	2.25
6021	4.50
6057	10.23
6058	12.34
6059	6.00
6061	6.00
6063	3.75
6064	8.58
6067	10.23
6072	6.00
6080	14.00
6097A	235.00
6097B	200.00
6146A	8.25
6146B	8.25
6159B	19.00
6189	9.50
6201	11.40
6442	20.00
6883B	8.25
6973	4.00
7025	3.00
7551	6.25
7586	12.00
7587	18.50
7609	56.00
7868	6.00
7895	12.00
8005	110.49
8068	14.00
8122	90.00
8136	2.50
8417	6.00
18042	11.53
18045	10.49

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BASES

B7G unskirted	0.22
B7G skirted	0.30
B9A unskirted	0.22
B9A skirted	0.30
Int Octal	0.35
Loctal	0.55
Nuvistor base	0.75
8 pin DIL	0.10
14 pin DIL	0.10
16 pin DIL	0.10
Valve screening cans all sizes	0.30

CRTs

2AP1	8.50
2BP1	9.00
3BP1	12.00
3DP1	5.00
3EG1	10.00
3FP7	6.00
3GP1	6.00
3JP1	8.00
3JP2	8.00
3JP7	10.00
3KP1	15.00
3RP1	35.00
3WP1	20.00
5ADP1	35.00
5CP1	10.00
5CP1A	40.00
5FP15A	15.00
5UP7	25.00
DG7-5	63.32
DG7-31	58.07
DG7-32	58.07
DH3-91	56.83
DH7-11	113.12
VCR97	12.00
VCR138	12.00
VCR138A	12.50
VCR139A	8.00
VCR517A	10.00
VCR517B	10.00
VCR517C	10.00

Tube Bases Prices on application

INTEGRATED CIRCUITS

7400	0.16
7401	0.17
7402	0.17
7403	0.17
7404	0.18
7405	0.18
7406	0.43
7407	0.43
7408	0.20
7409	0.20
7410	0.17
7412	0.29
7413	0.32
7416	0.32
7417	0.32
7420	0.18
7422	0.20
7423	0.33
7425	0.30
7427	0.30
7428	0.43
7430	0.17
7432	0.30
7433	0.40
7437	0.32
7438	0.32
7440	0.32
7441	0.90
7442	0.72
7447AN	1.17
7450	0.18
7451	0.18
7453	0.18
7454	0.18
7460	0.18
7470	0.38
7472	0.33
7473	0.38
7474	0.38
7475	0.54
7476	0.42
7480	0.56
7482	0.75
7483	1.00
7484	1.05
7486	0.39
7490	0.60
7491	0.82
7492	0.60
7493	0.60
7494	0.82
7495	0.73
7496	0.82
7497	3.15
74100	1.54
74107	0.45
74109	0.73
74110	0.51
74111	0.71
74116	1.85
74118	1.00
74119	1.54
74120	0.83
74121	0.43
74122	0.62
74123	1.18
74125	0.58
74126	0.58
74128	0.63
74132	0.72
74136	0.51
74141	0.89
74142	2.30
74143	2.60
74144	2.60
74145	1.00
74147	2.00
74148	1.76
74150	1.80
74151	0.94
74154	1.80
74155	0.90
74156	0.90
74157	0.75
74159	2.20
74170	2.40
74172	4.40
74173	1.42
74174	1.60
74175	1.02
74176	1.16
74178	1.36
74179	1.36
74180	1.20
74190	1.90
74191	1.90
74192	1.90
74193	1.90
74194	1.25
74195	1.20
74196	1.35
74197	1.35
74198	2.70
74199	2.30
TAA570	2.30
TAA630S	3.50
TAA700	3.90
TBA480Q	1.84
TBA520Q	2.30
TBA530	1.98
TBA540Q	2.30
TBA550Q	3.22
TBA560CQ	3.22
TBA673	2.20
TBA700	1.52
TBA720Q	2.30
TBA750Q	2.07
TBA800	1.20
TBA920	2.90
TBA920Q	2.90
TBA990Q	2.90
TCA270Q	2.90
TCA760A	1.38

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- 3ms. access time
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- Includes case, leads and utilities disc
- Totally compatible with 5¼" drives

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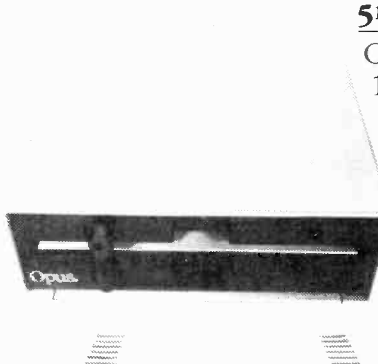
Dual Drive. **£459.95**



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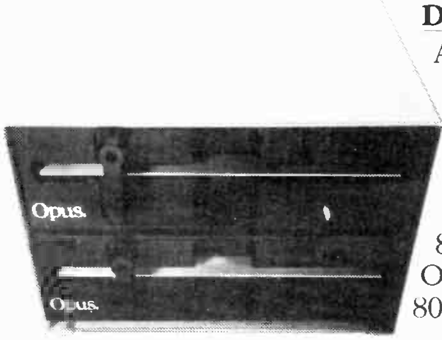

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Opus Dual 540ID. Single Sided 40 Track. 200K./400K. on line. **£379.50**

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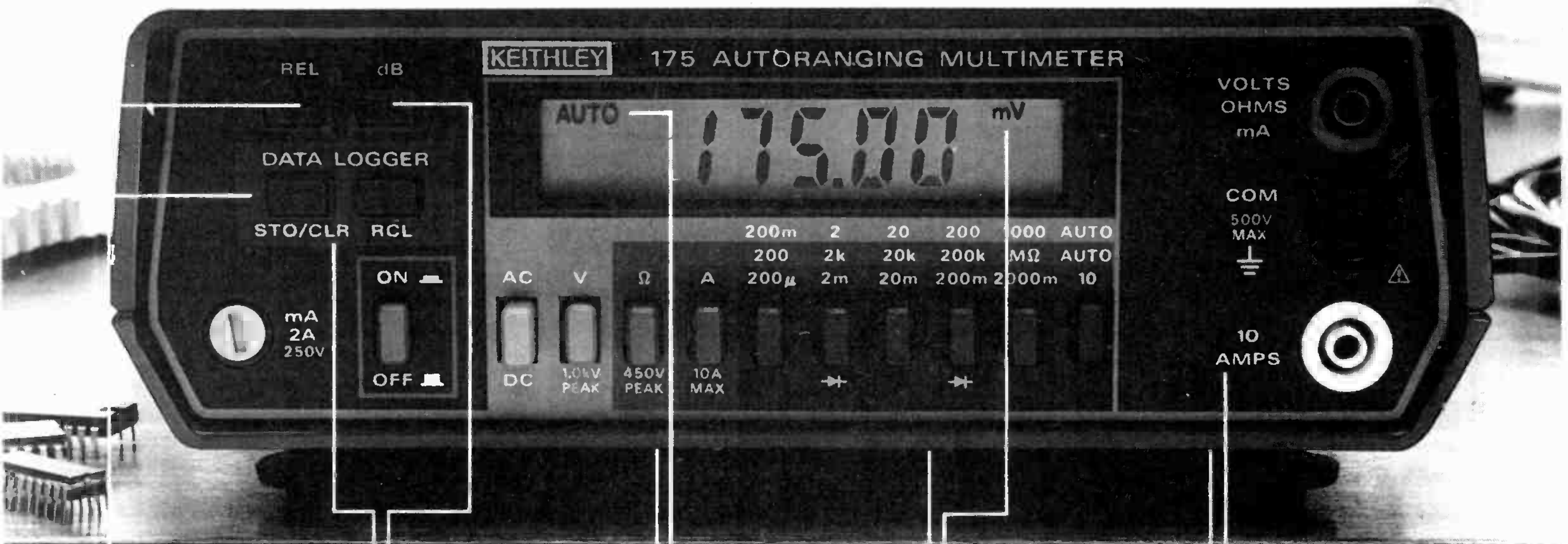

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ELECTRONICS &
Wireless World

Software copyright and piracy

The issue of software copyright is a vexed and intractable one. On the one hand, there is the undoubted need to provide a living for programmers and maximum distribution of valuable software. On the other hand, one must consider that software is not an art form and can be derived independently from situation logic; furthermore, if a processor contains many equivalent registers, any change in the use of registers means a new program, therefore people desirous of stealing the work of a programmer for commercial gain and having the time to do it and the backup to pay lawyers, presumably can. As Dean Swift pointed out, that the lawyer is interested in "whether the said cow be black or white" not in what title the claimant has to the cow.

There are two alternatives to ensure a proper return. Either every user must pay a fee to the inventor of the program, or the state must use the award-to-inventor system. Attempts have been made to shame users into the former course by writing on software packages the fact that the programmer must live and asking all users to buy their own expensive copy, for the fact is that popular material will always tend to be expensive, providing quite unjustified returns, like a best-selling book, while the minority-interest material will with the greatest difficulty recover costs. A book or program concerned with sewage cannot sell more copies than there are sewage works, yet may affect the lives of every citizen. Thus authorship of all kinds is grossly ill-rewarded by the commercial system.

This problem is entirely new, because in the past technical authors might be reasonably expected to have academic jobs and programs be published free. There is no way that the cottage industry of software production can protect its copyright. It must rely on honourable treatment. If it doesn't get it and if as a nation we want this industry to continue we will have to pay the workers from central funds.

This will distress the computer retail industry who naturally want to sell information in a physical object with a limited life and accident prone condition, like a paperback book.

Anyone who wants to pirate a very valuable program need only buy enough battery backed-up ram to hold it, for there is no way anyone can argue that software can't be copied into ram: similarly it would be very hard to argue that paper tape cannot be cut from this ram.

If one uses selective-bit inversion no one could ever prove a tape was their program; it is foolish to contemplate it. In the end people will pay for convenience if the software creators aren't greedy and shops take reasonable mark-ups. Blatant commercial pirates ought to be prosecuted, but talk of prosecuting friends for exchanging one's own copies is nonsense.

History in the making

Apart from those few radio and television pioneers who are regarded by the public as the great inventors – Marconi, Armstrong, Baird, Watson-Watt etc. – the bulk of engineers and scientists who have followed in their wake and contributed enormously to the technology have remained virtually unrecognised. Few engineers, let alone the public, associate the coaxial cable with Franklyn, the waveguide with Southworth, the optical fibre pipe with Kao . . . etc. Very few engineers write readable autobiographies, fewer still form the subject of in-depth studies by historians who can appreciate the precise value of the contributions they made to the state-of-art.

Occasionally one comes across exhortations to technologists such as "It isn't enough in any science to do things. It is necessary to communicate what has been done . . . not only your scientific or engineering results but also talk about how they arose, who was involved, all those things that are too often unrecorded. People's memories are not precise. But that does not matter because the essence of historical scholarship is to use memoirs and other primary sources with discretion. A person who has participated shouldn't worry about that bias he has due to his participation. The historians will take care of that in due time by comparing sources and checking dates."

Excellent advice – provided always that those later historians actually start digging, and manage to produce books that can be read with interest!

These thoughts have been generated by reading two recent exceptions to the general rule: Dr George Brown's lively and outspoken recollections of his life as a research engineer "and part of which I was" (Angus Cupar Publishers) that covers not only his pioneer work on aerials, r.f. heating and colour television but the familiar problems of an engineer caught up in commercial and political struggles to gain acceptance for his ideas. The second book was Andrew Hodges' excellent 600-page study of "Alan Turing – The Enigma" (Burnett Books, 1983) that provides a detailed study of the life and tragic early death of the brilliant mathematician who in 1936 first outlined the concept of the 'universal machine' from which was to spring the digital computer. He was a gifted member of that formidable team of cryptoanalysts who in the "creative anarchy" of Bletchley Park successfully tackled the difficult German naval enigma machine code; taught himself electronic and radio engineering in a couple of months at Hanslope Park; and struggled at NPL to get built the stored program computer ACE but found bureaucracy too strongly entrenched. In fairness to NPL, Turing was clearly not the easiest or most diplomatic person to work in harness with, though capable of attracting intense loyalty from those who assisted him during wartime.

A few years ago I received a letter from a technician who had worked alongside Turing at Hanslope when, with Donald Bayley, he was developing the never-to-be-used Delilah speech encryption system. Alan Turing was then advising the whole laboratory on circuit calculations, he had picked up practical radio engineering in less than three months, claiming "When I first looked at radio I could see it was 100% mathematics anyway so it was no problem."

Andrew Hodges has amassed an enormous amount of information on Turing, but the reason for his suicide in June 1954 remains a mystery. Hodges shows that the often-mentioned prosecution of Turing on homosexual charges was by then two years behind him. He speculates on the continued involvement of Turing with GCHQ in an era when the security investigations following the Burgess, MacLean, the third and fourth man scandals were still rumbling on, but provides no evidence of any link between these events and Turing's untimely death. Certainly there can be no evidence that Turing, patriot that he was, was ever a real security risk.

NTSC, PAL and SECAM

Dr Brown is particularly revealing about the bitter struggle in the period 1945-1955 between RCA and CBS over the sequential and compatible colour television systems, and the subsequent struggle in Europe over NTSC (which was basically the RCA system), PAL and SECAM. He shows clearly, though from an American viewpoint, that politics rather than engineering dominated the CCIR meetings at Vienna and Oslo, and the similarity of Russian, American, French and British skulduggery in the form of overnight changes of policy, suppression of technical reports, rigging of delegations and the like. As one retired British television engineer put it to me, in recommending George Brown's lively account of his struggles with RCA's management, "Just change the name of the firm, and you have the story of my life". For any young engineer who wishes to understand how things really happen, this is essential reading – though I noted that even the politically-conscious Dr Brown apparently failed to note one of the most astonishing events of the Oslo CCIR meeting in 1966 . In April of that year, a member of the British delegation returned (unsuccessfully) to the UK during the event for the express purpose of trying to have the Post Office man in charge of the British delegation removed, leading later to an off-the-record press briefing in which the leader of the British team bitterly attacked the broadcasting delegates.

Data security

Presumably we shall never know whether Turing was under pressure from the security people in 1954 though one has no doubt that, as a wartime member of the Government School of Codes and Ciphers, he would have figured in those secret files that will remain inviolate under both the 30-year rule and the Data Protection Bill. Yet there is plenty of evidence that such files frequently contain information confused by mistaken identification etc. This might not matter so much were it not for the evidence that the Security Service advise outside organizations, including commercial firms, when recruiting engineers for sensitive posts. With such information now fully computerized, the effects on people's careers can be far-reaching. Unlike many other countries not even the registrar, who will administer the British Act, will have power of inspection or supervision of either security or police files.

Clandestine war plans

Surprisingly one of the official files of 1953 now opened under the 30-year-rule details plans then proposed for clandestine activities in the event of war. The 1982 Falklands campaign showed that such activities still form an important part of British military planning. The 1953 proposals covered "stay-behind", evader and coup-de-main activities. Sir John Sinclair, then head of the Special Intelligence Service, requested the use of 15 fast patrol boats, three trawlers, 42 fishing boats, 8 long-range aircraft, use of a submarine, and no less than 400 specially trained signals operators. Britain, France and the USA were each expected to provide 500 agents and 50 aircraft for the first three weeks following the outbreak of war. It was recognized that such activities were a gamble, possibly paying a high dividend or "next to none". One wonders if the agents knew that they were to be part of a high risk gamble.

Costly clangers

Governments can and do make bad mistakes on their assessment of new electronics technology in addition to grossly underestimating the development costs. Now, the French Government and their nationalised Elf-Aquitaine oil company has been forced into revealing that they were "taken" to the tune of some £60million by the so-called Omega and Delta oil-sniffing systems that purported to reveal deeply buried geological strata to aircraft flying overhead, but was eventually shown to depend on prepared sketches fed into the machine. By surrounding the invention with an air of mystery, the Panamanian-registered company, Fisalma, was able to block all attempts to examine the costly prototypes. But it is not only the French

COMMENTARY

Government that has been known to back the wrong horse in electronics and telecommunications.

Recently Americans have become increasingly uneasy that the electronics equipment put into military aircraft, flight simulators etc can cost up to ten times its civilian counterpart. The electronics can cost many times more than basic aircraft. As one writer put it recently: "In the necessary secrecy that shrouds weapons development, a pipe dream can be pursued for years – and for billions of dollars – before someone catches on to its futility." The solution, it is suggested, would be to introduce independent technical monitoring of projects by a watchdog committee of top-notch engineers. But, one wonders, who would watch the watch-dogs? Engineers, as well as administrators, have been known to get it wrong.

The AM-stereo struggle

At the end of 1983 there was still no clear outcome to the "market-place" struggle in the USA between the four competing systems of a.m. stereo. In terms of transmitters, Harris had lost the lead to Kahn's independent sideband system used by some 80 stations including several major NBC music stations. Harris was stuck at about 65 stations, resulting from the FCC decision to restrain the company from marketing any more exciters until the type-acceptance dispute had been fully cleared up. Motorola was up to about 50 and their system has been endorsed by some large car radio firms. Trailing with single-figures was the Magnavox system, despite it being the original choice of FCC in 1979. Meanwhile Sony has marketed a $90 combined a.m./f.m. portable that can receive any of the four a.m.-stereo systems and including a switch to widen the m.f. bandwidth to 12kHz. A multimode set has also been marketed by Sansui.

AMATEUR RADIO

50MHz extension

The Department of Trade and Industry has agreed to a substantial extension of the special research permits for 50MHz operation by British amateurs holding Class A licences. The number will go from 40 to 100. DTI have asked the RSGB to recommend additional names by March 31. With all British 405-line television broadcasting in bands 1 and 3 now due to end in the first week of January 1985, British amateurs are hoping that the DTI will make an early announcement about any plans to implement the recommendation in the interim Merriman Report in 1982 that an allocation in this part of the spectrum should be made available to all British amateurs. There remains the problem that this part of the frequency spectrum (except channel 1) is likely to remain in use for television in virtually all other European countries.

RTTY

Ian Wade, G3NRW, the current editor of the British Amateur Radio Teleprinter Group newsletter, estimates that about one half of BARTG members are still using mechanical teleprinters but many are in process of adopting computer-based the electronic systems with over two-thirds of the membership owning home computers. Interest in the Amtor system with automatic correction of errors is also increasing rapidly and expected to really take off during 1984 with commercially manufactured units increasingly available. He also forecasts more amateur interest in digital data techniques including the"packet" systems. But there seems to be no end in sight to various problems of different technical standards, including the long standing problem of 45 versus 50 baud transmission, though some teleprinters, such as the Creed 444 will cope with both speeds. Bob Sayers, G8IYK is seeking contact with radio amateurs interested in adapting compact telephone-line facsimile equipments for h.f. transmission or for using such machines for other applications. He also points out that a special Met Office licence is needed to receive weather messages in r.t.t.y. format. Application forms for DTI licences can be obtained from Meterological Office (Licensing) London Road, Bracknell, Berks, RG12 2SZ. Full title of the licence is "Receiving licence for the reception of meterological information transmitted from special service stations".

During 1984 BARTG celebrates its Silver Jubilee having been founded in 1959. The group caters for those interested in most forms of data transmission, including r.t.t.y., Amtor, Fax, weather forecasting, satellites and telemetry. Current membership is about 1300. Membership details from John Beedie, G6MOK, 161 Tudor Road, Hayes, Middlesex UB3 2QG (telephone 01-561 0010). Apart from the quarterly newsletter BARTG publish "RTTY, the easy way".

Low power activity

Although extreme low-power operation is not an activity I would recommend to newcomers to the h.f. bands, it holds much interest for those with the necessary experience and patience. Indeed on some h.f. bands signals can come in at good strength from transmitters using power inputs of less than 5 watts over many thousands of miles. Low-power (QRP) operation in the UK has for a number of years been encouraged by the "G-QRP Club", formed in late-1974, and now having almost 2500 members. Rev George Dobbs, G3RJV, editor of its quarterly journal "Sprat" admits to being concerned that the fall-off of conditions on the h.f. bands due to the declining sunspot activity may make it more difficult to achieve good contacts on the higher of the h.f. bands but urges more activity on the "low-power calling frequencies" of 3560kHz and 7030kHz. He notes that low-power operation on these bands has not kept pace with the increasing number of members. He reports, however, an increasing interest in home construction of low power transmitters and compact direct-conversion receivers.

In brief . . .

George Stratton Loughton, founder in the 1920s of Eddystone Radio, died during December 1983. Eddystone was one of the first British firms to cater specifically for short-wave enthusiasts and radio amateurs with their "All World" series of receivers and components for home construction . . . RSGB membership has exceeded 35,000 for the first time . . . The RSGB National VHF convention is being held on March 24 at Sandown Park Racecourse, Esher, Surrey . . . A mobile rally is being held at the Carelton Community Centre by the Pontefract society on March 18 . . . An increasing number of amateurs in many parts of the world are now equipped for earth-moon-earth (moonbounce) contacts on the 1.3 and 2.3GHz band but Z25JJ, representing Africa, is closed for the time being while his equipment, including a massive 32ft dish reflector, is transported from Zimbabwe to South Africa . . . Much effort is being put into the rush building at the University of Surrey of its second spacecraft, UOSAT-B, which it hoped will be launched this Spring . . . Of the various Russian amateur satellites, RS6 and RS8 remain in operation. The problem on the L-band Oscar 10 transponder seems to have been successfully overcome . . . The IARU Region 1 Triennial Conference, bringing together the national IARU societies in Europe and Africa, is to be held in Sicily between April 7 and 14 . . . The installation of the RSGB's 50th President, R. G. Barrett, GW8HEZ, was at Cardiff Castle on January 14 . . . A number of changes affecting the British CB licence were introduced on February 1. No further licences are being issued to persons under 14 years of age but they can operate CB equipment under supervision. There is now an explicit ban on the playing of music and the re-transmission of radio and television broadcast material (both of which have always been illegal) and DTI draw attention to the CB Code of Practice in particular highlighting the recommendation that Channel 9 should be used for emergencies and assistance only.

PAT HAWKER, G3VA

Adaptable typewriter interface

Simple interface connects electronic typewriter to computer parallel output port. Self-documenting Pascal code facilitates translation into other languages that might be used in the target processor, and demonstrates how a printing routine is constructed rather than provides a rigid routine for only one situation.

by
C. M. Fortescue-Webb M.Sc.

Acquisition of a home-based computer requires a decision as to the type of printed output needed. The provision of a fully-formed letter printer allows a system to be used for word processing with a degree of professionalism that is absent from the usual low-definition dot-matrix machine. If an electronic typewriter is availble then the simple interface described here enables it to be driven from a Centronics or other parallel output port.

The interface is in principle applicable to any typewriter mechanism that uses electronic-style switches to complete a circuit when a key is depressed. Virtually all daisy wheel printers use this type of mechanism. Since the majority of small computer systems do not have printer spooling (i.e. the system is dedicated to driving the printer whilst the printer is active) the computer is used to provide as much as possible of the intelligence of the interface.

Although the interface itself is simple it is necessary to do some investigation to determine the correct connection points for the various wires – and then further work to find the correct data for each printed character. The interface was actually connected to an Olivetti Praxis 35 and the specific data as to connection points and character data refer to this machine. Enough information is included to enable adaption to any other machine.

General considerations

In operation the printer sequentially grounds one of the lines marked A through H and reads the data appearing on all the lines a through h, Fig. 1. If no keys are closed then the data will be read as all high but otherwise the occurence of a low will allow the closed key to be detected and decoded. Two points about this – first, a number of reads must give the same data for the printer to register the key closure and to avoid errors due to contact bounce. Second, not all possible crossing points on the matrix are used and so there are a number of possible data codes that may have no meaning to the printer as they should not be generated by the keyboard. Also there are two connections outside the matrix (I to i and J to j) used to tell the printer about keys that are pressed in conjunction with the main keyboard. Examples of this on the Praxis are Shift and Keyboard 1 or Keyboard 2.

To simulate a key closure the circuit of Fig. 2 could be used. When the select key line is true then the low-going pulse on the input line be coupled through to the output. By using open collector gates there will be no interaction between the various keys. The difficulty of such a scheme is that a key select line is needed for every key and this requires a lot of hardware. By using a multiplexer and demultiplexer coupled with open collector drivers the final arrangement shown in Fig. 3 is realised. Now three lines are used to select the input row and a further three to select the output column. The remaining two lines on the eight-line computer output are used for the shift and keyboard 1/2 switches. Incidentally, if your computer will only output a seven-bit character on the parallel port then the keyboard 1/2 or equivalent line will have to be operated manually.

It is also necessary to prevent the computer passing data to the printer at a rate in excess of that at which it can accept the data. The interface shown here uses a software delay loop in the driving routine to ensure that the character rate is within specifications. A longer delay is used for those functions on the typewriter that take longest – carriage return (up to two seconds on the Praxis), fast return (timing as carriage return) and tab. The alternative is to use hardware consisting of something like a 555 timer with a variable current source depending on the character being printed, with the output from the timer being the busy line and used for character separation. To achieve a maximum transmission rate it would be necessary to find an internal (to the printer processor system) status line that will show if the printer can accept a character and then use this line for the BUSY/ACKnowledge reply to the computer.

When the computer outputs data on a Centronics interface the strobe line is made low for a short time (a few microseconds) to tell the printer that data is available.

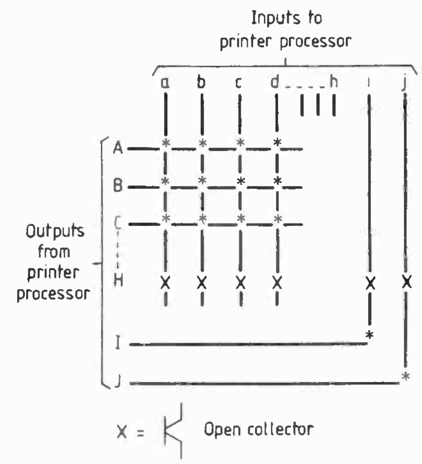


Fig. 1. Schematic of the matrix switching layout of typewriter keyboard. A keyswitch is present, normally open at intersections marked. Pull-up resistors to V_{CC} are connected to lines a to j inclusive.*

The printer responds by asserting BUSY and should pulse ACKnowledge low to signify that the character was accepted. When the printer is ready to accept another character it will drop BUSY. Many computer systems are content to ignore either BUSY or ACKnowledge but printers requiring line buffering (normally line printers) may use ACKnowledge to fill the line buffer and then assert BUSY whilst the characters are printing. Strictly the computer is not permitted to change the data on the Centronics port between the assertion of STROBE and the receipt

Charles Fortescue-Webb has been designing and producing microcomputer systems and electronic interfaces for eight years, with experience as chief engineer for a turnkey systems house in Ireland and as an independent consultant in microcomputer applications. His primary degree is in experimental physics and was followed by applied bio-medical research for a M.Sc. degree. Application of minicomputers to the analysis and costing of civil engineering structures led onto work with microprocessor systems. His hobbies include sailing, bridge, woodworking and tinkering with cars and electronics.

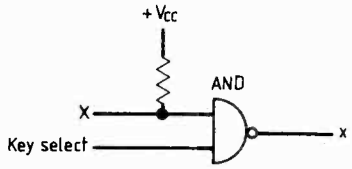


***Fig. 2.** Possible connection method to simulate a key switch connection when key–select is high. This circuit would be substituted at each * in Fig. 1, in which case a low on X will be coupled through to x via the open collector gate.*

of an ACKnowledge, nor to assert STROBE whilst the printer is BUSY.

Circuit details

The functioning of the actual circuit is straightforward and the full schematic is shown in Fig. 4. The layout corresponds to that used in Fig. 3. The monostable between the strobe and busy lines is used to separate a multiple sequence of the same character into separate 'key depressions' by enabling the LS138 for a set time after each strobe pulse. The period of the monstable must be adjusted to be sufficient for the printer to recognise the character yet less than the intercharacter delay and the shown values provide a good starting point. The maximum R value is about 5kΩ due to limitations of the LS t.t.l. inputs.

The original was constructed on Vero d.i.p. breadboard using ribbon cable to couple the inputs and outputs. If a small system is being used then it may be more convenient to add on a eight-bit latch to the computer address/data lines rather that construct or purchase a specific parallel port.

If the keyboard uses greater than five volts then a small 5V supply will be needed for the logic and the inputs to the LS151 should be isolated using diodes connected in series with the lines to the LS151 from the keyboard with the anode connected to the interface. If a key is pressed on the keyboard whilst the interface is connected then the keyboard supply voltage can be coupled through to the multiplexer unless isolation from higher voltages is implemented.

The typewriter/printer lines are shown with the connection schematic for the Praxis. It is possible that your warranty on the typewriter could be effected by connecting this modification and so it is perhaps wise to wait until it is out of the warranty period. When making connections to this main board be aware that mos chips may be used internally and so static should be avoided (no nylon carpets, plastics worktops etc.). A soldering iron with low leakage or securely grounded would be a wise precaution if using soldered connections. If using a mains-powered wire-wrap tool then do not work on the interface whilst it is connected to the keyboard.

Detective work

One of the first operations is to examine the keyboard connections of the selected machine to ensure that it is possible to

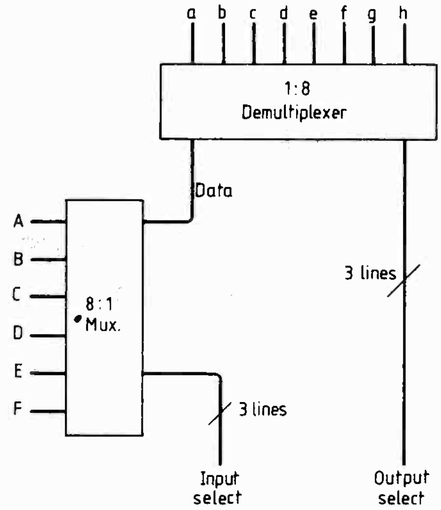


***Fig. 3.** Using a multiplexer and demultiplexer to replace a keyboard.*

make the connections without having to, for instance, replace the complete case. First be quite sure that the mains cable is removed from the machine – a surprise jolt when you are probing inside the machine can do much damage to man and machine. On the Praxis after unscrewing the two platen knobs, without losing the small disc in the left hand one, four screws in the underneath of the case can be removed. Turning the case right side up again should enable the top section to be lifted off over the back of the machine. Be careful of the paper-holding bar. The keyboard can now be removed by undoing the two screws, one at either end, that hold the metal backing plate to the base of the typewriter case.

Lifting it off gently brings to light a number of connectors and these can be parted without putting any tension on the wires. At this stage the printer processor and electronics will be exposed to view along with three brass nuts positioned on the processor board that hold grounding straps and the processor board to the keyboard sub assembly. After noting the way in which the grounding straps are positioned the nuts can be undone and the keyboard and processor unfolded to show the printed circuit traces of the keyboard and processor connections. A drawing of the two boards opened out is shown at Fig. 5 with the connection points numbered to correspond with the schematic diagram Fig. 4.

Suppose that the typewriter is a different model from that used above. Then some investigation is necessary to find the connecting lines. Without the manufacturers service manual the best method is to follow the printed circuit traces to the various keys. Keyboard switches may have either three connections (with the outer two commoned-check with a meter) or just two. The key connection traces should either end up on a chip with open collector drivers (in which case they are being driven from the printer processor) or else be connected to pull-up resistors if an input to the processor. If the keyboard processor combination can be 'powered up' whilst access is retained to the keyboard traces then processor output wire should have no or small voltages on them whilst processor input traces should be at 5V due to the pull-up resistors. In any event, provided that the keyboard is powered from five volts, an incorrect connection of the traces

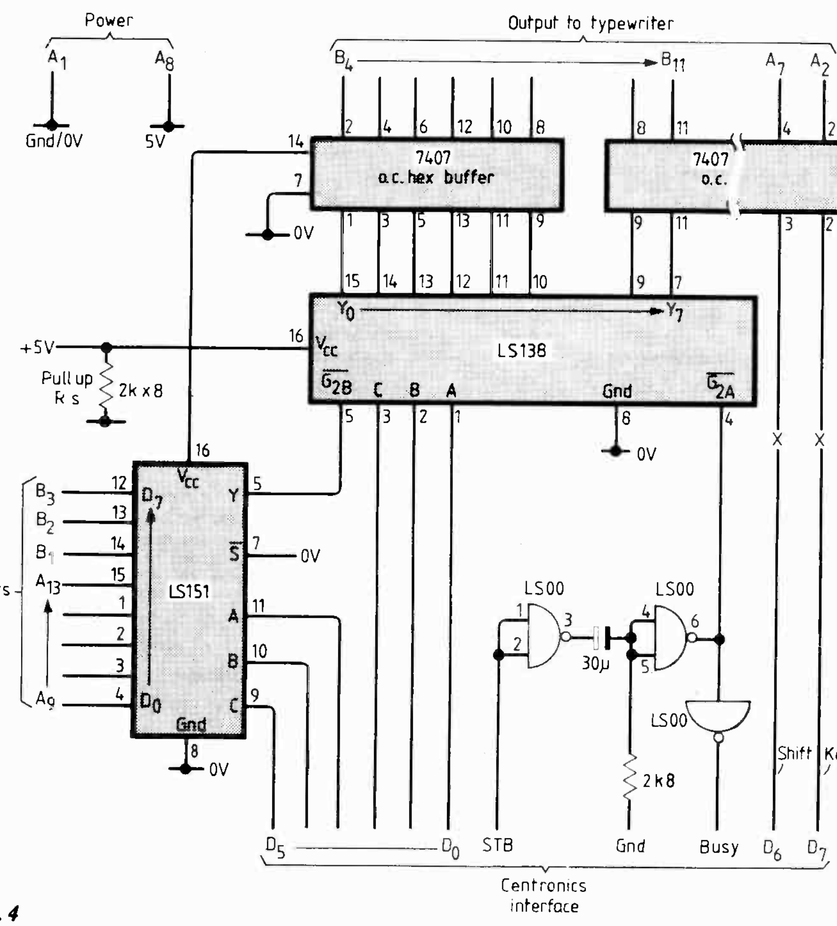


Fig. 4

to the interface will not cause damage but prevent the interface and/or the typewriter working properly. There is no need to assign specific assignments to each of the input/output connections on the interface since a software routine is used later to determine the actual data required to simulate a specific key closure.

The next stage is to determine the output data required for each simulated key closure. Connect up the computer-interface-typewriter combination and then run a program to output characters (with data values in the range of 0 to 255) and see what the response is from the typewriter. Be aware that some of the unused code can cause the typewriter to 'lock out' and not accept any more input. If this should happen the easiest way to recover is to turn the typewriter off then on again to reset the internal mechanism. Also some software driving parallel output ports will only output seven bits, the most significant bit being masked off as it is not used by many printers. If this is the case with your system then either the driving software can be altered or alternatively one of the dedicated lines (I . . . i, J . . . j in Fig. 1) can be deleted.

In the case of the Praxis this would mean that keyboard 2 was not available but for many applications this would be quite acceptable. The program in Fig. 6 which is written in Pascal will provide you with a file of the data and corresponding characters printed. If you find that the interface is behaving badly, for instance by not printing all characters then check both the interface and connections to the keyboard traces. It is easy to have 95% functionality even though the shift line say is not connected.

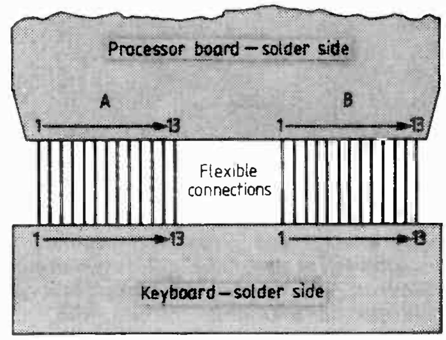


Fig. 5. Connection points on the opened out Praxis processor and keyboard.

List 1. Program to produce a file 'Trans. text' of ascii character and corresponding code to operate printer.

```
 Program Decode; (* Pascal under UCSD Version 4 *)

 var  Translation_file   : text; (* data and character file *)
      Printer            : text; (* Treated as a file *)
      j                  : integer; (* loop variable *)
      ch                 : char ;  (* character read from vdu *)
Begin;      (* program from hereon *)
Rewrite( Translation_file,'Trans.text'); (*Open Output file *)
Rewrite( Printer,'Printer:');            (*Open  Printer*)

For j := 0 to 255 do begin;   (* main loop *)
  Write(printer,chr(j));      (* data to printer *)
  Write(' Enter character printed ( ^ for non printing)');
  Read(ch);                   (* read character inputted from vdu *)
  writeln;                    (* new line on vdu*)
  writeln(Translation_file,j:5,ord(ch):5);  (* write to file *)
  end;                                 (* end of main j loop *)

Close(Translation_file,Lock);  (* keep the translation file *)
end.
```

List 2. Program to show how translation data can be used to run typewriter using codes from program in List 1.

```
 Program Encode;  (* Uses translation file to print on typewriter *)
 Const  cr = 13;  (* carriage return ascii value *)
 Var  Printer    : text;
      Decode     : Array(0..255) of 0..255;  (* holds printer codes *)
      k          : char; (* only used in demonstration program *)

 Procedure PRINT_INIT;  (* Initialises for the Printer *)

 Var  Translation_file  : text; (* data setup in program DECODE *)
      data, code, j     : integer;

   Begin;  (* procedure Print_init *)
   Reset ( Translation_file, 'trans.text'); (* Open file *)
   For j := 0 to 255 do Decode(j) := 0; (* initialise Decode array *)
   For j := 0 to 255 do begin;          (* file data to decode *)
      Read   (translation_file, data, code  ); (* read a line from file *)
      Decode(code) := Data;             (* and put to decode *)
   End;                               (* of the j loop *)
   Close(Translation_file);           (* no further need for this *)
   Rewrite(Printer,'printer:');       (* open printer for output *)
   end;                             (* of procedure Print_init *)

  procedure delay(ticks:integer); ( gives a 'ticks' milliseconds delay )
  var i,j,k:integer;
  begin;
    For i := 1 to ticks do
       For j := 1 to  8  do k := k+1;( 1 ms delay )
  end;

Procedure PRINT ( ch: Char );  (* accepts a character for printing *)

Var    i  : integer;

  Begin;        (* Procedure PRINT *)
  i := ord(ch);      (* find integer value of ascii character *)
  i := decode(i);   (* and use to get printer data *)
  write(Printer,chr(i)); (* and output to Printer *)
  if ch = chr(cr) then delay(1000) else delay(90); (*  11 c/sec *)
  end;
End; (* of Procedure Print *)

Procedure PRINT_EXIT; (* called after finished with printer *)

  Begin;                   (* start of Print_exit *)
  print(chr(cr));          (* Carriage return to Printer *)
  Write(Printer,chr(255)); (* Holds interface out of action to
                              enable all typewriter functions *)
  Close(Printer);          (* No further use for printer *)
  End;             (* of Procedure Print_Exit *)

BEGIN;

  (* This is where your main routine would be.  The following
    is a short sample Program that can be used to test the
    interface, and would not be present for normal use *)

    Print_init;    (* initalise the printer channel *)

    For k :='A' to 'z' do begin;
      write( k );   (* put out the character on vdu *)
      print (k);    (* and on the printer to check correct action *)
    end;

    Print_Exit;  (* and close up the channels *)
END.
```

Operation

The final step is to generate a small program that takes any character that you wish to output to the printer, translates this to the appropriate data code, and then outputs it on the parallel interface. The best method of implementing such a routine is in assembly language and then to incorporate it into the bios (basic input-output system) so that the operation is transparent to the host program. To give an idea of what is required and to provide a basis for further experimentation the small routine shown in Fig. 7 is written in Pascal and can be incorporated into an applications routine. The routine is broken up into three procedures: Print-init to open the printer channel, Print to actually translate and output the characters and Print-over to perform any closing tasks. Note that the main translation array TRANS must be declared in the main routine since Pascal cannot hold local variables from call to call of a sub routine. If you wish to use the printer for word processing then you will probably want to extend this program to enable such things as underlining and printing both £,p and $,c.

continued on page 39

Improving colour television decoding

4 – Simple one-line comb decoder on a small single board can be added to existing receivers

Much of the background material and illustrations in these articles derives from the author's BBC work and that of his colleagues in the Research and Designs Departments. The particular proposal for a domestic receiver decoder described here is the author's own rather than a BBC concept.

by D. C. A. Read
B.Sc. (Eng), M.I.E.E.

Considering now the actual electronics, Fig. 34 shows a circuit diagram of the video path built to incorporate the foregoing principles (part 2, January issue). Composite video (1V pk-pk) is applied to the circuit to produce outputs that are suitable for the various decoder chips now readily available. Output pins can directly feed the decoder chips TDA3516A or 3560 from Mullard.

Transistors Tr_1 and Tr_2 are complementary emitter followers providing low-impedance drives, appropriate resistors being fitted to match the delay-line characteristic impedance and the chroma bandpass filter impedance. Also, a low-impedance feed is available for the sync filter which is an optional extra. The three coils and capacitors (L_{1-3}, C_{5-7}) form a symmetrical gaussian bandpass filter (described later) set up by adjusting all three inductors so that maximum subcarrier level occurs at the output, also with minimum 7.8kHz at chroma transitions.

The filtered chroma signal is fed out via Tr_{18} to provide low-impedance drive to the chroma input pin of the demodulator chip or chips. PAL decoding i.cs normally use a chroma-length line (64μs−56ns) to provide delay-line PAL decoding for enhanced U/V separation in the chroma circuits. Colour prints 7, 8 and 9 are screen photographs with luminance off, showing, in print 7, the chroma demodulation performance using the field sweep skew test waveform for line-by-line decoding. Print 8 shows one chroma line in use i.e. combing the chroma over two lines; this is the standard method in most television sets. Using two-line delays, print 9 shows three-line combing in the ratio ¼:½:¼. The third line has no offset whereas the centre line has a 56ns offset. No further chroma work was felt necessary on this add-on card and this design will use one chroma line. This is a reasonable compromise which provides some comb filtering of the luminance, a 3-dB reduction of fine cross-colour, and, by adding and subtracting equal amplitude from the two lines, a 3dB reduction of random noise occurs. The slight loss of vertical resolution is only apparent when viewing computer graphics. Spatially, on horizontal transitions, the luminance and chroma are displaced by half a line in the field, but this is only seen on electronically generated signals.

In the circuit of Fig. 34, Tr_3 amplifies the signal from the chroma bandpass filter to provide a high level input for the DL60 delay line, which has a typical insertion loss of 11dB. The output transducer of this delay line is floating and can therefore provide a balanced push-pull drive to the MC1596 balanced modulator input with the d.c. supply bias provided by resistors

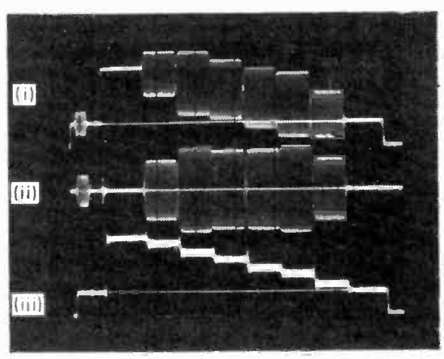


Fig. 35. Modifier comb-circuit waveforms. Top trace is the input composite PAL video signal, middle trace shows the chroma envelope after the Tr_1, Tr_2 buffer and gaussian bandpass filter. After a further buffer this signal is fed out to pin 3 of the decoder TDA 3561A (or 3560) (if the one-chip decoder is used). Minimum 7.8kHz twitter at chroma transition indicates good group delay symmetry in the gaussian filter. Bottom trace is the luminance signal as fed to pin 10 of the one chip decoder.

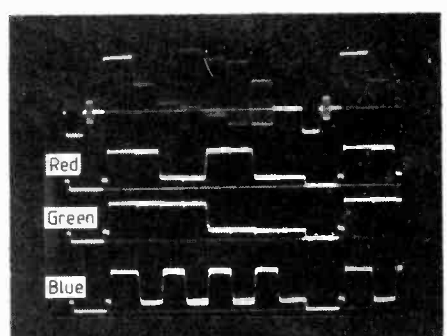


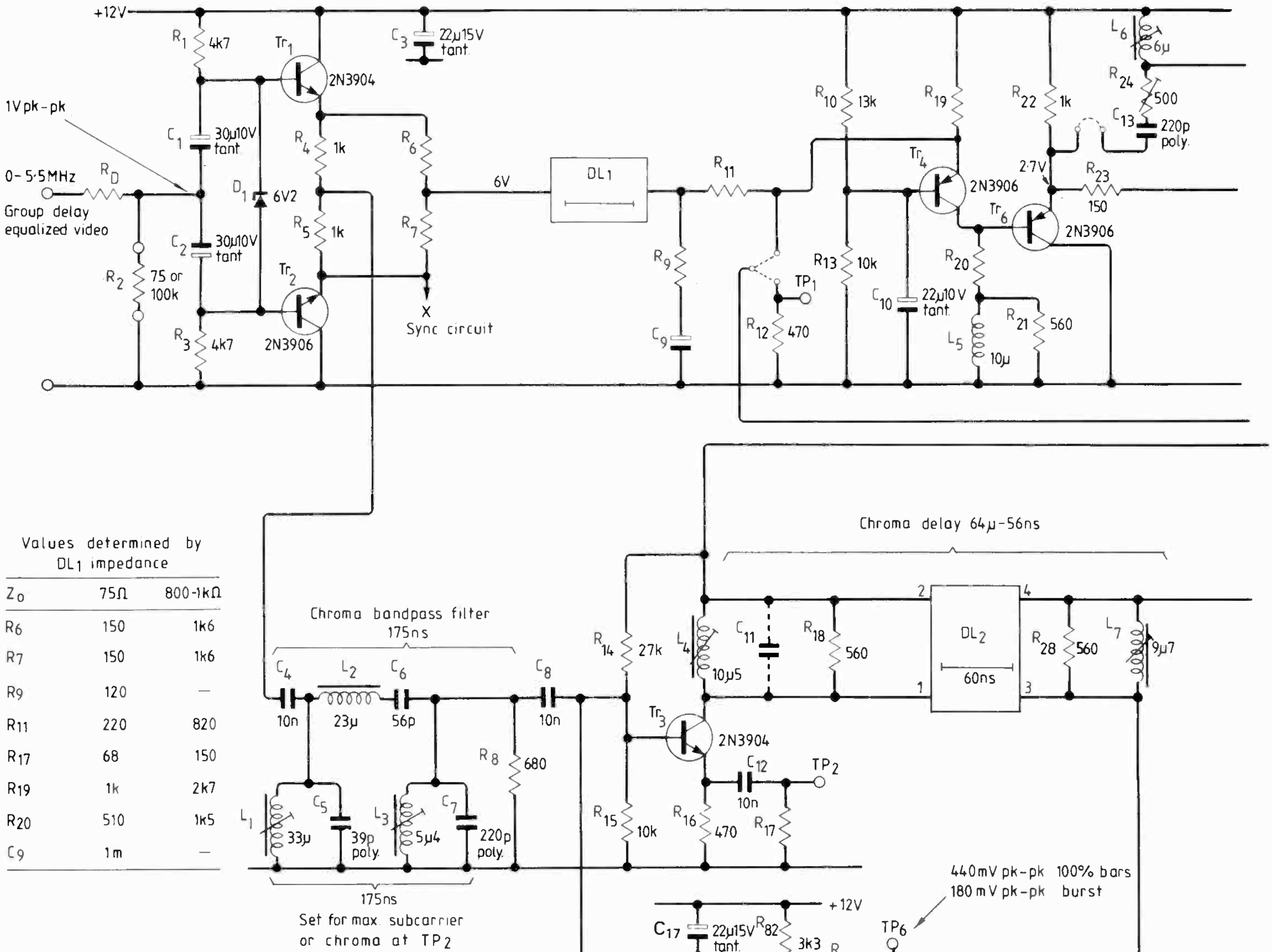
Fig. 37. Signal waveforms for the complete decoder. Top trace is 1V composite video input. The lower three traces are red, green and blue outputs from the modifier comb and TDA3516A (or TDA 3560) chroma chip.

The full extent of picture improvement can only be achieved if the suggested modifications are incorporated into a receiver in which attention has been paid to a number of other aspects of performance, a similar experience to improving high quality audio. These would include the use of a 26in tube (preferably high resolution), an efficient aerial (possibly with a down-lead amplifier), a tuner and i.f. amplifier response flat to 5.5MHz and with the demodulated video group-delay equalized to give minimum phase errors. It would also be beneficial to receive the incoming r.f. signal from a transmitter of good performance.

The performance of the modifier used to comb chroma from the composite signal (to provide clean luminance) is degraded in the presence of phase errors. These errors are largely introduced by the video signal modulation and demodulation processes and mainly comprise poor group delay response across the chroma bandwidth (f_{sc}±1.3MHz) and by differential phase (chroma phase shift with the change of luminance level).

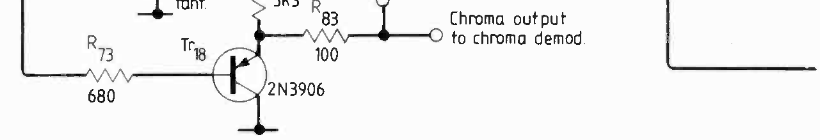
Further information on transmitter performance and alternative circuits to place between the i.f. output and the PAL decoder will be given in a later article. These alternative circuits would be preferable for smaller screen sizes (assuming the standard tv receiver tube).

Some other developments which will be of relevance if the time delay for their introduction and cost are not too great are ITT's digital tv i.cs and the Philips n-mos memory chips. Philips also make a high resolution 26in tube (which will probably double the standard tube price) that can be operated at twice the normal line and field scanning rate. Memory chips store the incoming signal over a field or picture period; video information is thus available for scanning twice in the period of one input picture. This double scanning removes flicker and enables other decoding methods to be used, as outlined in the December and January articles. (See also the German Radio Show report, November 1983 issue pages 74, 75.)



Values determined by DL1 impedance

Z_0	75Ω	800-1kΩ
R_6	150	1k6
R_7	150	1k6
R_9	120	—
R_{11}	220	820
R_{17}	68	150
R_{19}	1k	2k7
R_{20}	510	1k5
C_9	1m	—



R_{29} and R_{30}. The gain of this modulator, acting as a PAL modifier, is set by the resistance between the emitters of the transistors being driven from the chroma delay line. Pins 7 and 8 have suitably phased and d.c. balanced (R_{42}, 5kΩ pot.) drives of 8.8MHz (twice colour subcarrier) taken from the chroma demodulator chips via buffer stages Tr_8, Tr_9 which also provides phase shift. The two phase shifters plus the changeover shown adjacent to C_{28} and C_{29} mean that the change in phase setting available to the modulator is in excess of 360°. Thus a setting will always be found, regardless of the decoder chips being used, to obtain the correct phase in the overall system. Pin 9, the demodulator output is fed directly to a grounded base stage via 10nF blocking capacitor (C_{21}). Therefore no signal can be seen at pin 9. Also summed at the grounded base stage is the composite PAL video from the luminance delay line. The delay of this, compared with the delay time through the gaussian bandpass filter plus the DL60 delay line and the modifier, is such that the two signals summing at the grounded-base stage are exactly 64μs apart.

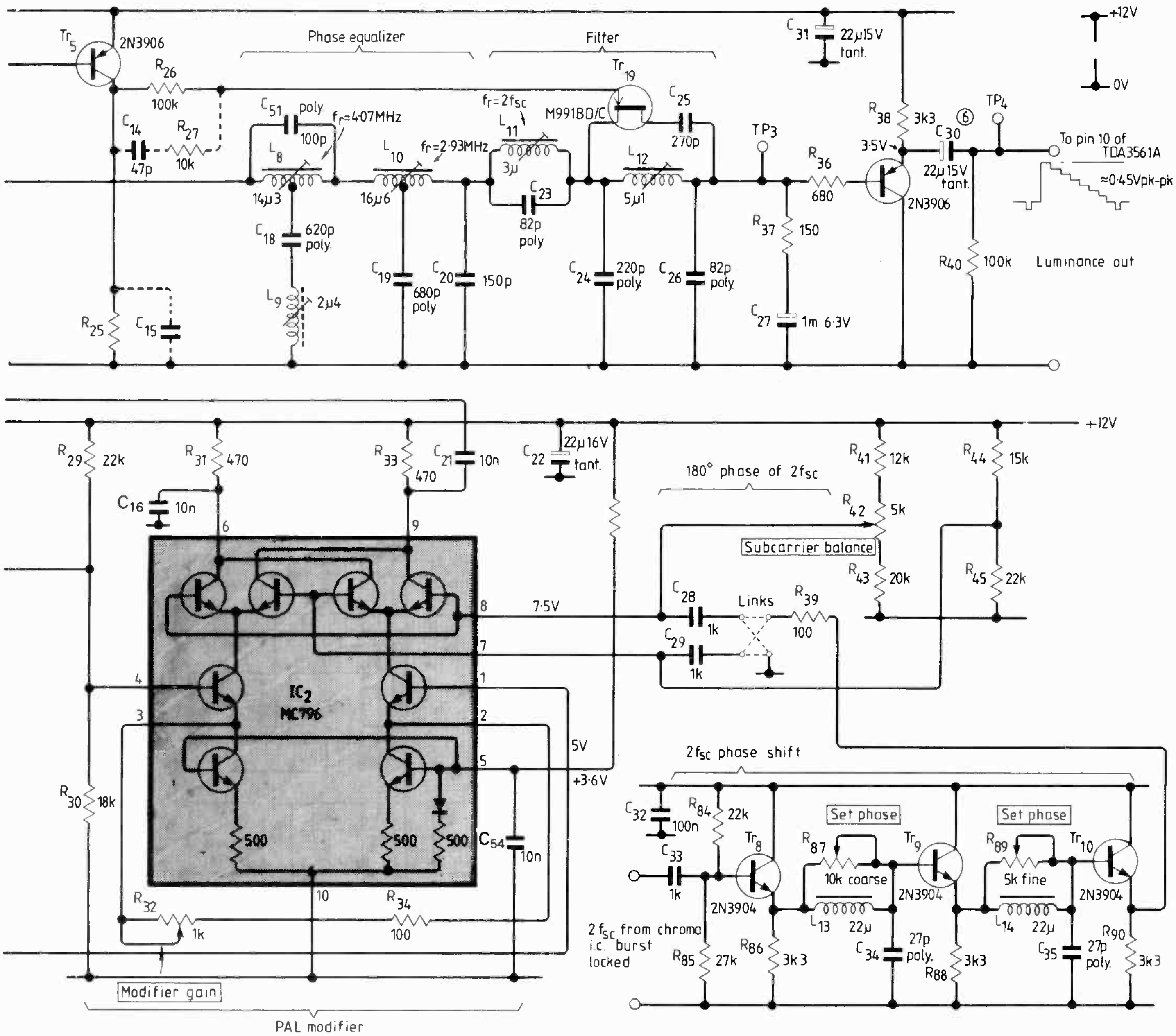
The collector load of Tr_4, R_{20}, gives sufficient gain to provide a suitable level to the output filter, this being buffered by emitter follower Tr_6 and R_{23} (150Ω) representing the characteristic impedance to the output filter.

The first sections L_8 and L_9, form a phase/group delay equalizer as is L_{10}. The filter itself is formed by L_{11} and L_{12}; the last element in the filter L_{12} has an additional capacitor switched in by the f.e.t. to bring it to resonance at subcarrier frequency when the notch is needed, such as at a horizontal colour transition. As the notch switches in and L_{12} becomes resonant, the input impedance to the filter rises. The small resulting increase in voltage available at Tr_6 emitter therefore drives Tr_5 harder and the notch 'snaps in' with a positive-feedback effect. Components L_6 and C_{13}, with variable resistor R_{24} are in series resonance at subcarrier frequency; R_{24} is adjusted to set the threshold of the notch. The notch will switch in very quickly with Tr_5 bottoming on the peaks of the 4.43MHz oscillations developed across L_6. With R_{25} of 10MΩ the decay is slow, switching the f.e.t. off about half a line later.

If the voltage supplied to the gate of this f.e.t. is displayed on a black and white receiver with an external sync feed and viewed adjacent to the colour receiver, the amount of time the notch is in is shown to represent a very small proportion of the total picture area. The loss of resolution can therefore be considered slight. It is also statistically unlikely that fine luminance detail will occur on horizontal colour transitions when the notch is switched in.

If luminance detail is continually present at 4.43MHz, the notch will be introduced and detail lost; it is as if the notch were always present. But the delay in operation of the adaptive notch switch will allow luminance edges through unscathed and this gives subjective improvement to the picture resolution.

It has been found in practice that with an input of test card F from a slide scanner, the threshold control resistor is best set so that the 4.5MHz gratings pass through with minimal degradation. Subcarrier from horizontal coloured edges will then cause the notch to switch in if the amplitude increases above the equivalent amplitude of this 4.5MHz grating. The 4.5MHz grating on the analogue test card (about to be replaced by a digital one) is well below the 0.7V black-to-white amplitude. However, switching to the electronically generated signal Channel 4 test card, the notch is permanently in during the 4.5MHz grating. But on pictures, the notch switches in when horizontal dot



Notes

① L_5 and R_{21} can provide 1 to 3dB h.f. lift, normally shorted by link.

② R_{25} 10MΩ for slow turn-off of adaptive notch, 100kΩ for fast turn-off

③ C_{14}, R_{27} slightly speed-up switch-on but need not be fitted. Set for best 2T lobes

④ C_{11} not fitted but can be used to trim phase

⑤ Poly ≡ 2% polystyrene   Cer ≡ ceramic disc or Redcap/Bluecap

⑥ C_{30} 100µ 12V Mullard for three-chip decoder. Lum. input has 2k7 in series & 22k to 12V. Remove R_{40}

⑦ Refer to next installment for filter adjustments

⑧ Inductors are wound with 5 or 6-strand 48s.w.g. Litz or 38s.w.g. (0·16 or 0·14mm dia.) enamelled copper wire

***Fig. 34.** Diagram of circuit that processes chroma and luminance signals.*

Inductor details

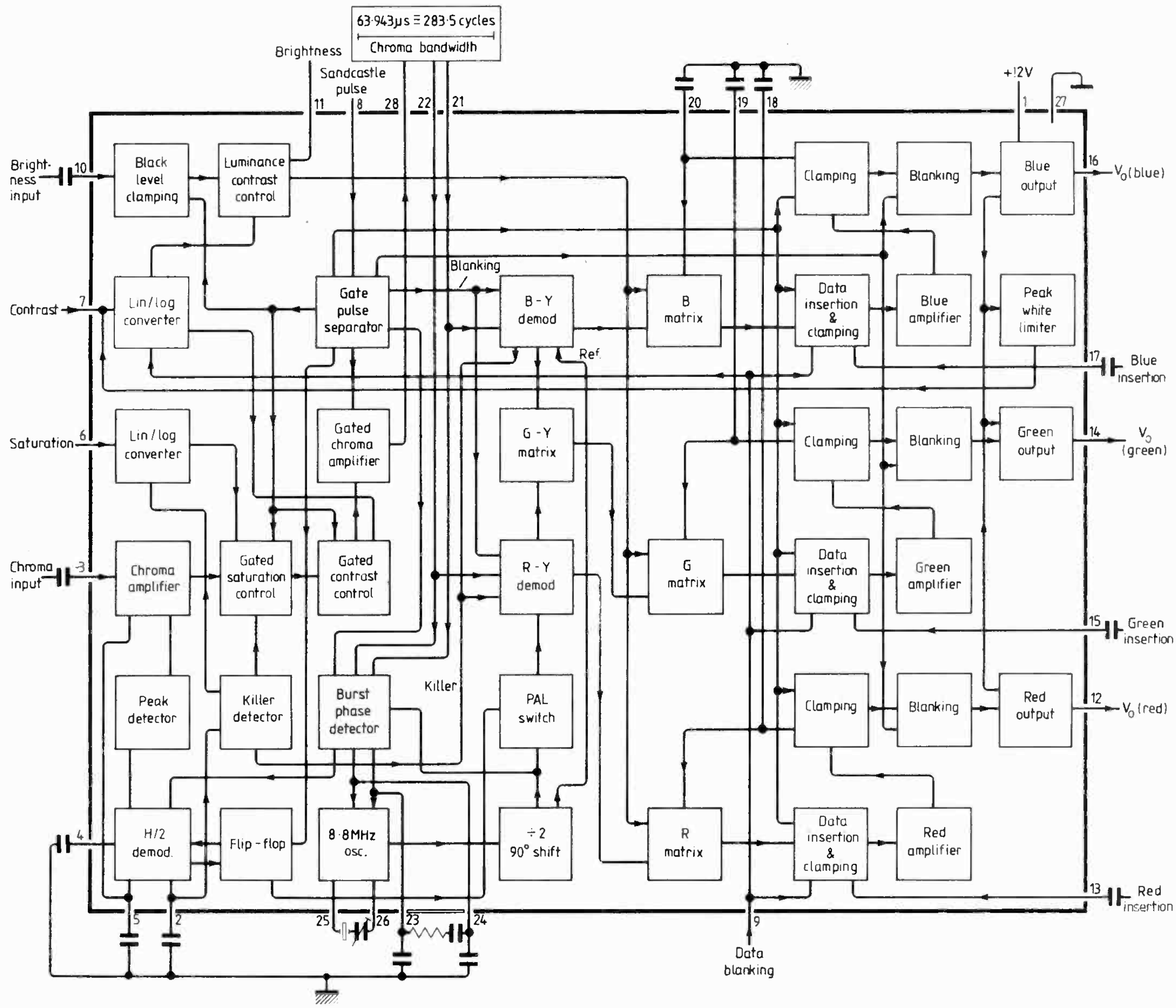
No.	Value (µH)	Turns Neosid E2	Turns Toko 10K
1	33	37	55
2	23	34	42
3	5·4	15	18
4	10·5	21	27
5	5 Painton or Sigma choke		
6	6	16	21
7	9·7 or 10 Painton or Sigma choke	20·5	26
8	14·3	13+13	16 16
9	2·4	10	13
10	16·6	14+14	17+17
11	3·8	13·5	16
12	5·1	15	18
15	150 Painton or Sigma choke		

crawl becomes just visible at normal viewing distance, assuming ⩽3.5×screen diameter. This seems a suitable criterion for determining the threshold of the notch. It may be considered that a slightly lower threshold which degrades 4.5MHz gratings on the test card will further reduce visibility of horizontal dot crawl. This is a setting which will be made subjectively to suit the individual.

At the output of the filter the signal is terminated (R_{37}, 150Ω) and buffered. Transistor Tr_7 provides a low-impedance drive output as many clamps in decoder chips require a low-impedance point. The coupling capacitor may have to be changed to suit the time constant of such clamps, depending on whether the extra circuit board is fitted to a three, two or one-chip decoder.

Setting-up procedure (luminance)

In the first place, it is required to obtain a timing difference between the two signals summed at Tr_4 emitter of exactly 64µs. 100% colour bars are used as the test signal, although 95%, 75% or EBU bars would be suitable.



The normal functions expected of a PAL decoder are adequately provided by the Mullard one-chip decoder TDA3561A. The chip requires separate chroma and luminance inputs – the circuit of Fig. 34 provides these in enhanced form. Pin 25 feeds PAL modifier via Tr_{15} in Fig. 34.

1. Disconnect either the input or output end of DL_1, and with the $2f_{sc}$ feed also disconnected (by removing the links adjacent to C_{28} and C_{29}) unbalance the modifier pins 7 and 8 (R_{42} turned to an end-stop).
2. With the output of the modifier linked to R_{12}, TP_1, the chrominance passing through the gaussian filter and DL60 delay line can be displayed on an oscilloscope and the signal path checked.
3. Reconnect the modifier Tr_4 emitter so that the chroma envelope can be seen at the output test point TP_4 (Fig. 34). The waveform appearance should be as shown in Fig. 35, middle trace. The green/magenta centre transition, will need to be expanded on the oscilloscope so that the signal is resolved down to 50ns (see Fig. 24, January).
4. The link at TP_1 is switched so that the modifier output is across R_{12} and is not fed into Tr_4 emitter. Reconnect $2f_{sc}$, put the oscilloscope probe on TP_1 and rebalance pins 7 and 8 on the modifier so that the carrier ($2f_{sc}$) is nulled to zero. This represents carrier balance of the modulator/modifier.
5. Again feed the direct composite PAL signal to Tr_4 emitter by reconnecting DL_1. This results in the colour bar signal being seen at the output test point TP_4 (Fig. 35 top trace); the delay line must now be adjusted so that the green/magenta transition occurs exactly at the same timing as it would in the gaussian/DL60/modifier route. The aim should be to get a timing coincidence of better than 50ns and as good as 20ns if possible (top trace, Fig. 24 January). Note the amplitude.
6. Disconnect either the input or output lead of DL_1 as before, re-connect the modifier (link at Tr_4 emitter), adjust the gain of the modifier with R_{32} (1kΩ pot.) to obtain the same chrominance amplitude as in preceding step.
7. Reconnect the luminance (link at DL_1), with the chrominance from the modifier also being summed at Tr_4 emitter, it only remains to adjust the phase of the modifier output. Using R_{86} (10k pot.) and R_{89} (5k pot.), the coarse and fine phase adjustments in the $2f_{sc}$ feed (and, possibly, the links adjacent to C_{28} and C_{29} for 180° change), a point will be reached where the phase of the chroma from the modifier will cancel the chroma of the composite PAL signal.
8. The amplitude of the $2f_{sc}$ feed from the phase shifting stages $Tr_{8,9,10}$ can be from 0.3 to 1.3V pk-pk and it may be necessary to adjust C_{34} and/or C_{35} to obtain reasonably constant amplitude as the appropriate 'set phase' controls are taken between end stops. Check at Tr_9 emitter first and adjust C_{34} on test for constant amplitude over the full range of R_{86}. Repeat for C_{35} and R_{89}.
9. Finally to achieve the best null and to optimise the chroma cancellation on all levels (steps) of the resulting luminance, a small adjustment on the gain will be required. It is as well to use the gain pot (R_{32} 1k) the phase pot (R_{89} 5k) with the modifier balance pot (R_{42} 10k) in a converging sequence to minimize residual subcarrier for all the steps in the luminance signal.

The trace in Fig. 35 shows the composite PAL signal as measured across R_2 (input

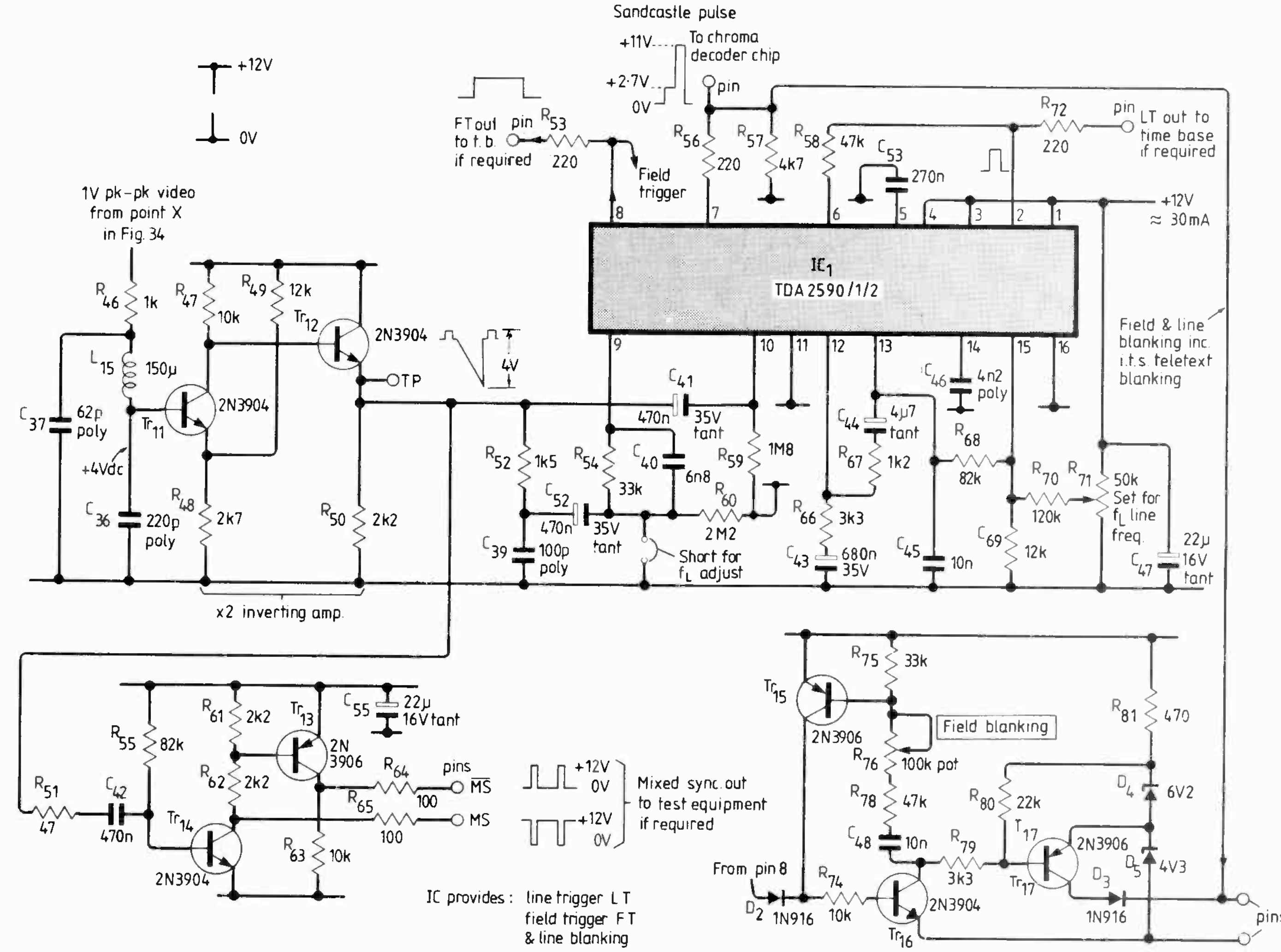


Fig. 36. Diagram of circuit of sync processor chip providing field blanking and other pulses.

terminating resistor), the middle trace is the chrominance at TP_2 which is being fed out to the chroma circuits of the demodulator (external to this additional circuitry), and the lower trace at TP_4 shows that the chroma from the modifier output is cancelling the composite PAL chroma to leave a clean luminance signal.

Fig. 36 shows some optional additional circuitry that may be used depending on the receiver to be modified. Point X is taken from the emitter of the input buffering pair in Fig. 34, Tr_2. This feeds a filter with a characteristic impedance of 1kΩ provided by R_{46}. The high-impedance terminated filter has a low-pass linear amplitude response which removes all the subcarrier and highband luminance energy but retains the sync risetimes with optimum shape. The filter design will be detailed later with group delay/phase and amplitude responses. Transistor Tr_{11} amplifies the signal and Tr_{12} emitter follower drives the sync separator chip IC_1, (TDA2590). There are other versions i.e. 2591, 2592, 2593 but in this application the available alternatives are not important. All the chips are capable of driving line output stages and field scan i.cs directly.

The chip has a sync-slicing system which is self-adjusting, according to the video amplitude, to maintain a 50% slice on sync edges. The line frequency can be set to approximately 15.625kHz using R_{71} (50kΩ pot) with the input signal shorted at the points shown adjacent to C_{52}, R_{60}.

When the short is removed, the phase locked loop is centralized. This chip also provides field triggers and line triggers. By feeding the line trigger output pulse back into the chip (on pin 6 via R_{58}) a 'sandcastle' pulse is generated which, if necessary, is then available for the chroma decoder chip. In most of the receivers, however a sandcastle pulse is already available and this circuitry would not be required.

The line and field trigger pulse trains could both be used to drive line and frame time bases if the whole receiver is being engineered. There is another optional circuit available. This widens field trigger pulses via the monostable (Tr_{15}/Tr_{16}) and thus provides blanking of the ITS (insertion test signal), and teletext (Ceefax and Oracle) and other data signals in the field block. See Fig. 38.

On the author's attic workroom receiver, the picture is underscanned so that all four corners can be seen and the 'business' at the top of the picture becomes unacceptable without widened blanking The extra blanking circuit ensures that only active picture lines are displayed. The other optional extra, formed by Tr_{13} and Tr_{14}, is solely used to drive test gear which needs to be locked to mixed syncs.

The luminance output of the board from Tr_7 can be coupled into the Mullard one-

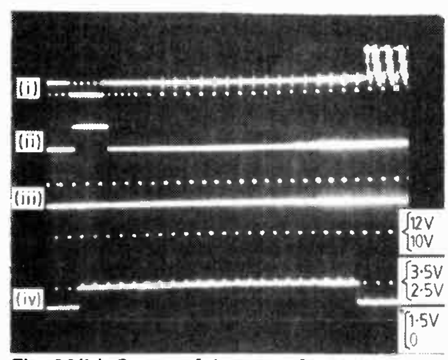


***Fig. 36(b).** Some of the waveforms occurring in Fig. 36 circuit. Trace (i) is video signal fed to pre-sync separator filter C_{37}, L_{15} and C_{36}. (ii) is field trigger from pin 8 of TDA2592 and (iii) line trigger from pin 2, (iv) shows RGB clamping (top), output picture blanked (middle) and active picture – line and field blanking off (bottom).*

chip TDA3561A (or 3560) which is mainly used as a colour decoder (see Fig. 20, January issue pages 54, 55). The coupling component feeding the luminance input, on pin 10 can be a 0.47μF non-polarized ceramic/polyester capacitor. The chrominance input on pin 3 fed from Tr_{18} also requires d.c. blocking; 10nF is suitable. The d.c. on both pins 3 and 10 of the decoder chip are typically 2.2V and the output on Tr_7 is typically 3.5V. If a small tantalum capacitor is used, check for polarization particularly where other chips are employed.

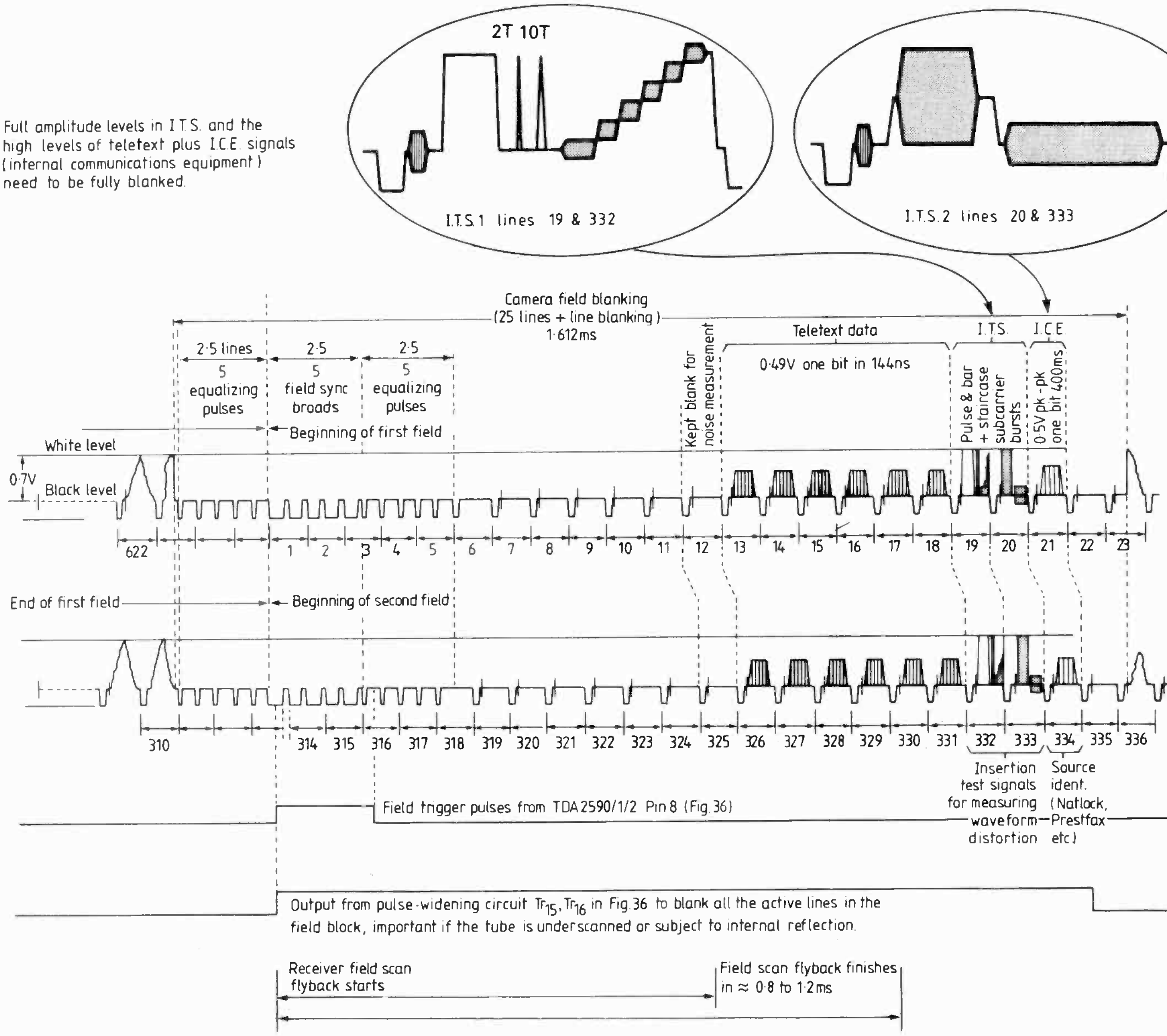


Fig. 38. Vertical synchronizing and blanking waveforms. As shown, field blanking interval lines are also used for teletext, ICE (internal communications equipment), ITS (insertion test signals), and clear lines for noise measurement. TDA2562A also uses lines 21, 22, 23 for RGB tube black-level stabilizing.

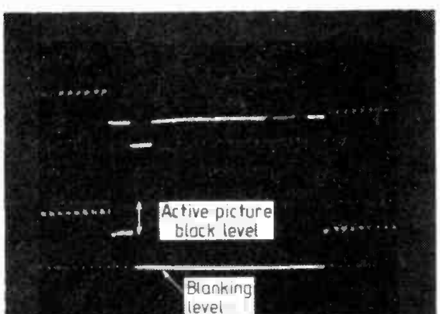
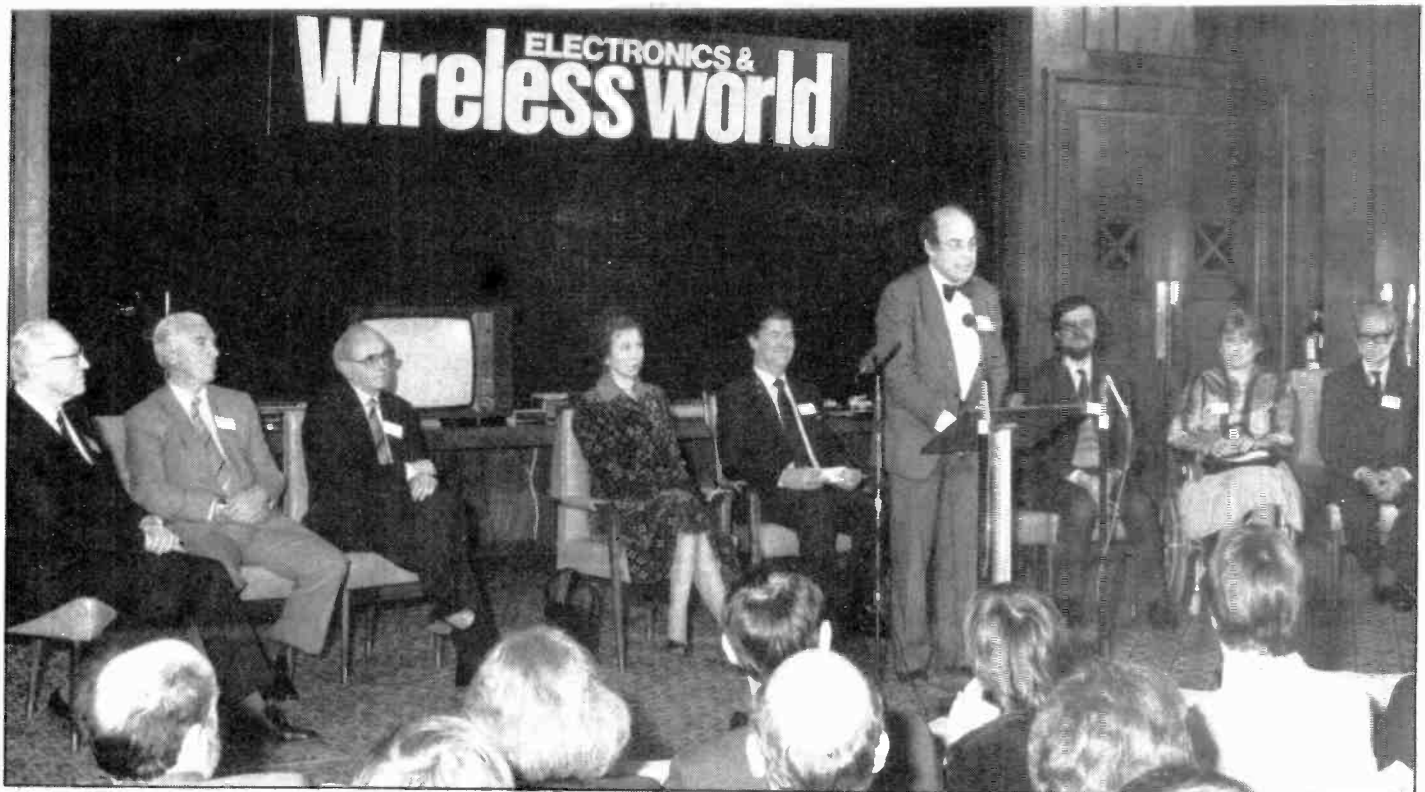


Fig. 38(b). Off-air video signal and extra blanking to prevent any adverse visibility at the picture top. Top trace shows some lines in use in the field blanking period. Bottom trace is final green drive to display tube, indicating line blanking and extra field blanking provided by the circuit of Fig. 36.

Provision was at one time made to adjust the chroma level output with a pair of resistors attenuating the feed to Tr_{18} base. When adjusting the level feeding the decoder chip TDA3561A or the equivalent two and three-chip versions, it was found to be difficult to determine which chroma level suited the decoder to obtain maximum chroma linearity (the linearity being somewhat poor). Also the matrix which produces the red, green and blue signals from the luminance and colour-difference signals can have up to 10% and amplitude errors. By optimizing the chroma level and averaging out the matrix errors across the RGB outputs a fairly good compromise can be achieved as is shown in the photograph, Fig. 37.

The blanking as generated by the extra circuitry Tr_{16}, Tr_{17} and IC_1 (TDA 2590/1/2/3) is applied to the blanking input of the TDA3561A chroma demodulator chip. A line-rate trace of the blanking component is shown in Fig. 37 in which the fainter line represents the field blanking. Using this trace and with the oscilloscope timebase switched to field lock, the pot R_{76} is adjusted so that the field blanking ends at the beginning of the first line in the active picture. The blanking should end half way through line 23 in the first (even) field, and at the beginning of line 336 on the second (odd) field; see Fig. 38. The insertion test signal (two lines per field), teletext information (four lines per field or six lines on some channels), and the ICE signal (internal communications equipment coding line), will then all be blanked by the widened field pulse.

With the extra board (modifier etc.), set up, the picture will attain a horizontal resolution which is close to the vertical resolution. The equivalent vertical and horizontal resolutions can be calculated as follows. There are 625 lines transmitted in each picture period (40ms) but as 25 lines are blanked in each field (20ms) there are only 575 active lines in each picture or 287.5 active lines per field. These 287.5 lines determine the vertical resolution, i.e. the maximum number of cycles that can occur within the picture height. The transmitted pictures has a horizontal to vertical aspect ratio of 4:3, so 287.5 vertical cycles are equivalent to 383.3 horizontal cycles. Given that the active line period is 52μs (64μs less 12μs blanking), the period for each cycle of this maximum equivalent horizontal resolution then is 135.62ns (52/383.3). The frequency is to equivalent to 7.37MHz. This is the justification for improving the horizontal resolution. WW



Left to right: Bill Bond (judge), David Gemmell (judge), Philip Darrington, H.R.H. Princess Anne, Sir Keith Skinner (chairman of Business Press International), Heinz Wolff (judge), Richard Lambley, Elizabeth Fanshawe (judge), Meredith Thring (judge).

Electronic devices for the disabled

Dr Tony Heyes receives his prize from Princess Anne.

First prize in Wireless World's recent competition was won by Tony Heyes of Nottingham University for his Sonic Pathfinder, a navigation aid for the blind. Dr Heyes received his award of £2,500 from Princess Anne at a presentation on January 30. Second prize, £1,500, went to Phil Pickersgill and Nic Stewart of Wokingham for a speech training device which they named Pausaid.

The four £1,000 prizes for runners-up went to

- David Battison and David Palmer of Cambridge, for their Miaphone, a speakback facility for blind, disabled typists.
- Michael Bolton and Alastair Taylor of Aberbeen, for their computer interface for the disabled.
- William McCarthy of Edinburgh, for his depth gauge for the visually handicapped.
- Ian Mitchell of Hull, for his Talking Box, a communication aid designed initially for speech-impaired children.

Philip Darrington (right), Wireless World editor, with Dr Heyes and a Sonic Pathfinder. Left is Richard Lambley, projects editor.

Dr Michael Bolton (right) shows Princess Anne his computer interface.

Judging and presentation of the awards took place on January 30th at the Institution of Electrical Engineers in London. Twelve entries selected for the final stage of the competition were demonstrated to the judges by their authors, who were Elizabeth Fanshawe of the Disabled Living Foundation, David Gemmell of Possum Controls Ltd, Bill Bond of the Polytechnic of the South Bank, Professor Heinz Wolff of the Brunel Institute for Bioengineering and Professor Meridith Thring, Queen Mary College, London University.

Princess Anne spent more than half an hour examining the devices and discussing them with their designers. In an address afterwards, she spoke of the ingenuity and inventiveness of those who had entered the competition. She said "Your enthusiasm and your efforts may not make you household names, but will certainly earn you the sincere gratitude of a highly individual and progressively independent group of people". Princess Anne spoke also of those who had not reached the finals, whose entries might still warrant development and possible future production. "If they do that", she said, "they will have their own reward".

Speaking on behalf of the judges, Professor Wolff praised the designers for their cost-consciousness. They recognised that technical aids had to be paid for by someone. "A competition of this kind as a stimulus for technically knowledgeable people to exercise their compassion and think about people less fortunate than themselves is itself very valuable".

An article by Dr Heyes describing his prize-winning entry will appear in *Wireless World* shortly, and we plan to include details of other interesting entries during the next few months.

Differential temperature integrator

Battery-powered remote-reading integrating thermometer has application in energy-conservation schemes

R. Everett

As much as 25% of the UK's primary energy consumption is in domestic buildings, yet relatively little is known about the details of its use. Individual tastes vary wildly and variations of annual energy consumption of 3:1 or more between identical houses are quite common. Because of this, testing out some new insulation measure or heating system requires monitoring a large number of houses. This can be a very expensive business.

The traditional instrument for temperature recording has been the thermograph, a kind of clockwork chart recorder, still to be seen ticking away in the corners of art galleries and museums. More recently memory-based electronic recorders have appeared that can be read out into a computer.

For most housing work all that is required are weekly or monthly averages of temperature plus the opportunity to sample spot values, such as the evening living-room temperature. Most importantly, this must be done without disturbing the house occupants and without spending vast sums on cabling back to a central datalogger. The differential temperature integrator was specifically developed for the Pennyland field trial in Milton Keynes, one of many sponsored by the UK Departments of Environment and Energy in recent years, and involved monitoring 80 houses of varying insulation level and south-facing window area[1].

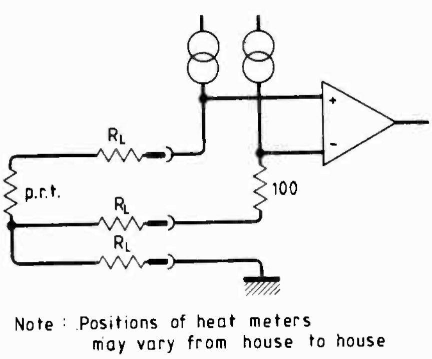


Fig. 1. Three-wire bridge circuit puts equal lead resistance in each arm, with one lead in common.

Why a 'differential' integrator?

The heating energy consumption of a house is roughly proportional to the average inside-outside temperature difference (ΔT), the constant of proportionality being an indication of the insulation level of the house. To evaluate the effectiveness of insulation, weekly heating energy consumption needs to be correlated with weekly ΔT. We can extend the process to include solar radiation to make an estimate of the 'passive' solar gains into a house. ('Passive' as opposed to the 'active' solar energy that you get from solar panels.)

As various zones of a house are at different temperatures, a weighted average of the different temperatures of different rooms is required. Thus the job of the d.t.i. is simply to generate cumulative integrals of the difference in temperature between each of three sensors inside the house, two downstairs and one upstairs, and a fourth on the outside, preferably on the north side out of the sun's rays. The temperatures are sampled every 8 minutes and the cumulative integrals are clocked up on three liquid-crystal displays, in units of degree-days (i.e. 1degC for one day, commonly used in building work). For the Pennyland field trial the integrator was mounted alongside the gas and electricity meters in an external meter cupboard where it could be read by the researchers without entering the house. The d.t.i. also has a hold mode allowing any of the four temperatures to be sampled on a test point with a d.v.m.

This device is a logical solution to a monitoring problem; I was not surprised therefore to find a paper proposing such a device after completing the prototype[2].

Circuit design

The temperature sensors used are thin-film platinum resistance types (such as RS 158-238), effectively precalibrated to ± 0.3degC. This type of sensor has a resis-

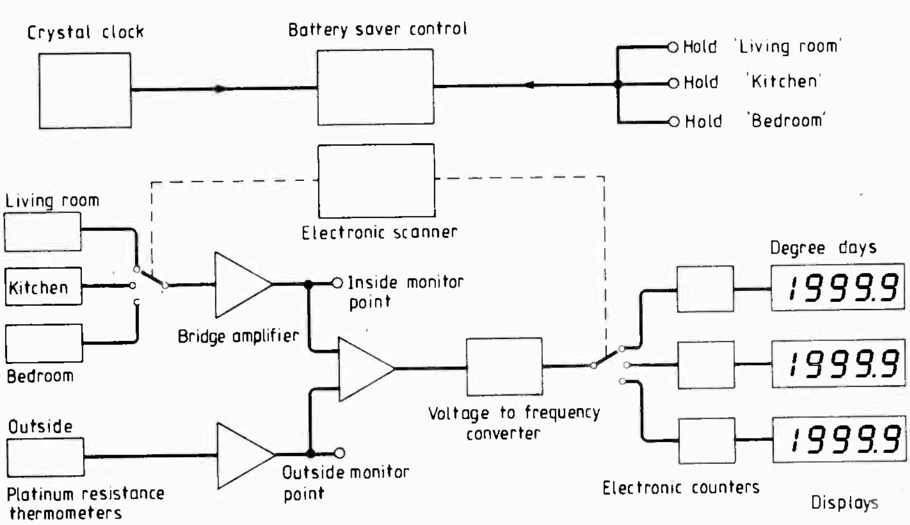
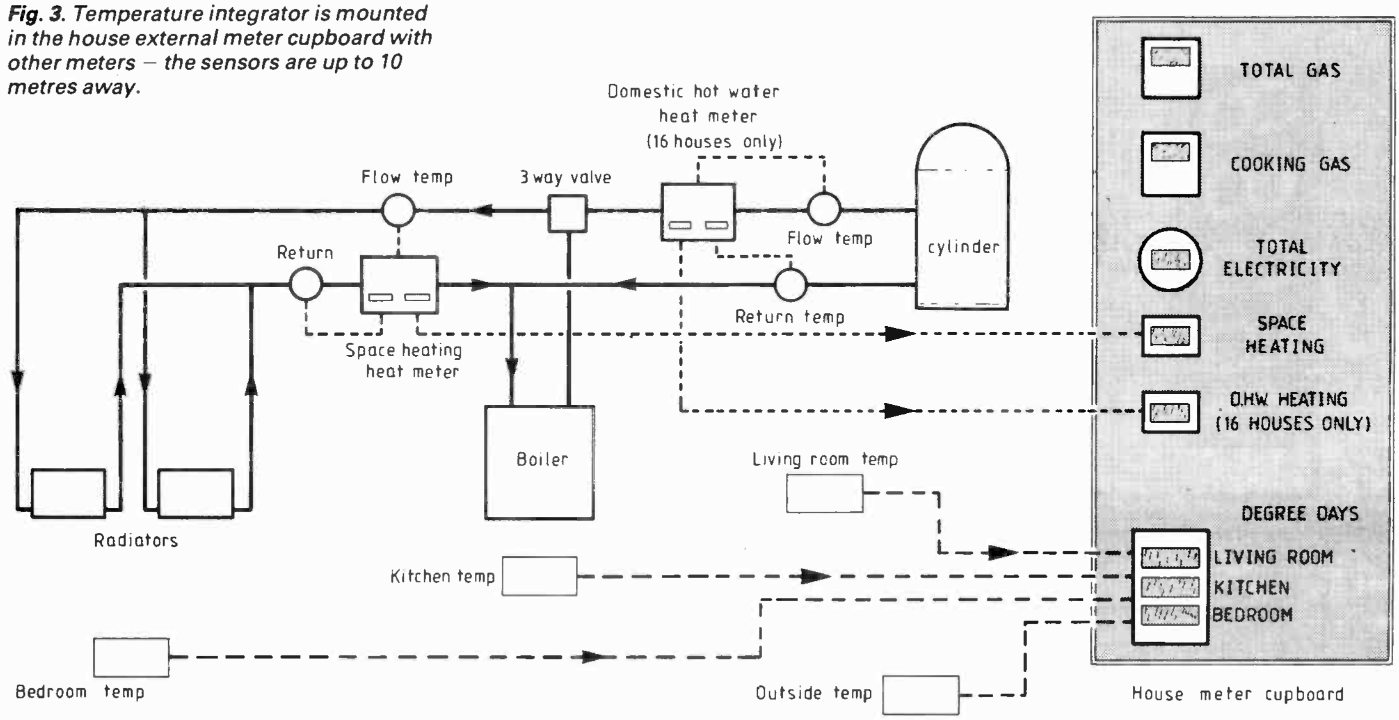


Fig. 2. Battery-saving circuitry samples temperatures every few minutes – the amplifier and v. to f. converter are multiplexed between sensors.

Designed for temperature monitoring in energy conservation field trials at Milton Keynes this thermometer provides weekly average temperature differences between each of three zones of a house and the outside air temperature. Put crudely, heating energy consumption to a house is proportional to the temperature difference and the constant of proportionality is a measure of the quality of house insulation. The device requires three platinum resistance thermometers installed in the house, nominally one each in living room, kitchen and a bedroom, and an outside air temperature sensor. These four sensors are wired to the integrator box located in some convenient place, such as a meter or bin cupboard on the outside of the house, where it can be read weekly along with gas and electricity meters without disturbing the house occupants.

Fig. 3. Temperature integrator is mounted in the house external meter cupboard with other meters – the sensors are up to 10 metres away.



tance of 100 ohms at 0°C rising to 138.5 ohms at 100°C.

Because lead resistances are likely to be significant it is usual to use them in a bridge arrangement, as in Fig. 1. Here the p.r.t. is compared with a precision 100 ohm resistor (e.g. RS158-086) and the bridge ensures that equal lead resistances appear in each arm, with one resistance in common.

I wouldn't recommend the use of i.c. constant-current sources in this type of bridge. Many have large temperature coefficients (read the fine print for long-term drift characteristics!) and more than one is sold as a dual-purpose constant-current source/temperature sensor! More recently, precalibrated thermistors have become available cheaply and these are now a better choice for temperature measurement than p.r.ts because of their higher output.

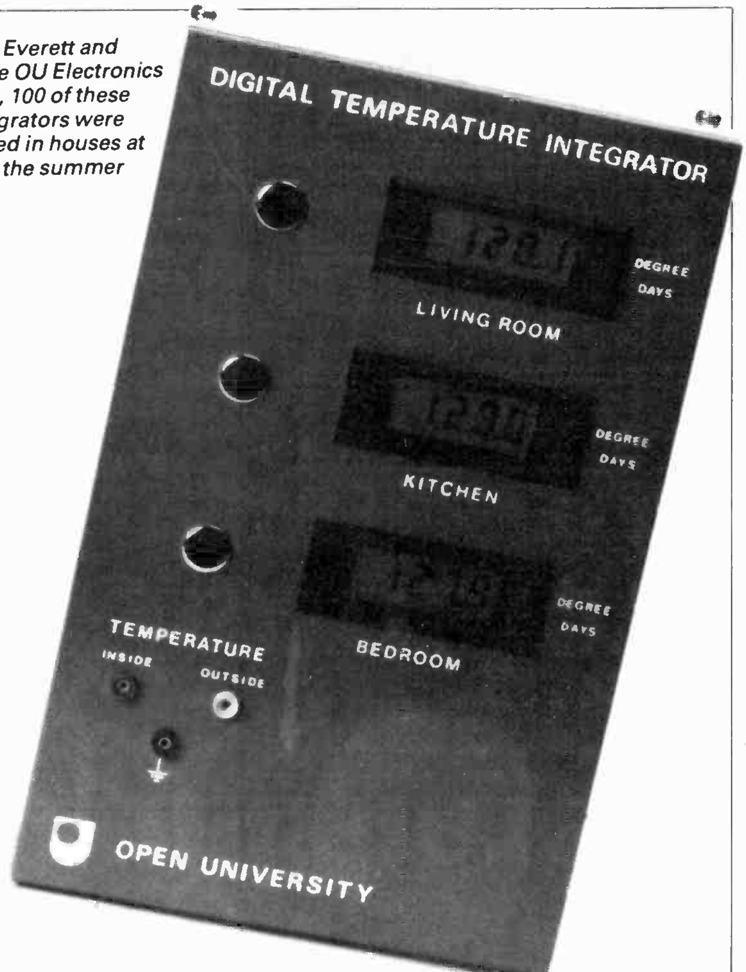
The temperature integration process is achieved by feeding the difference between the inside and outside temperatures to a voltage-to-frequency converter and then counting and displaying the resulting pulses. To minimize drift, the bridge amplifiers are ICL7600 commutating auto-zero types. To keep the component-count down the internal temperatures are multiplexed into a single bridge amplifier and v-to-f converter (see block diagram).

Much of the circuitry is devoted to battery saving. This allows four D-size and six AA-size alkaline cells to last up to six months.

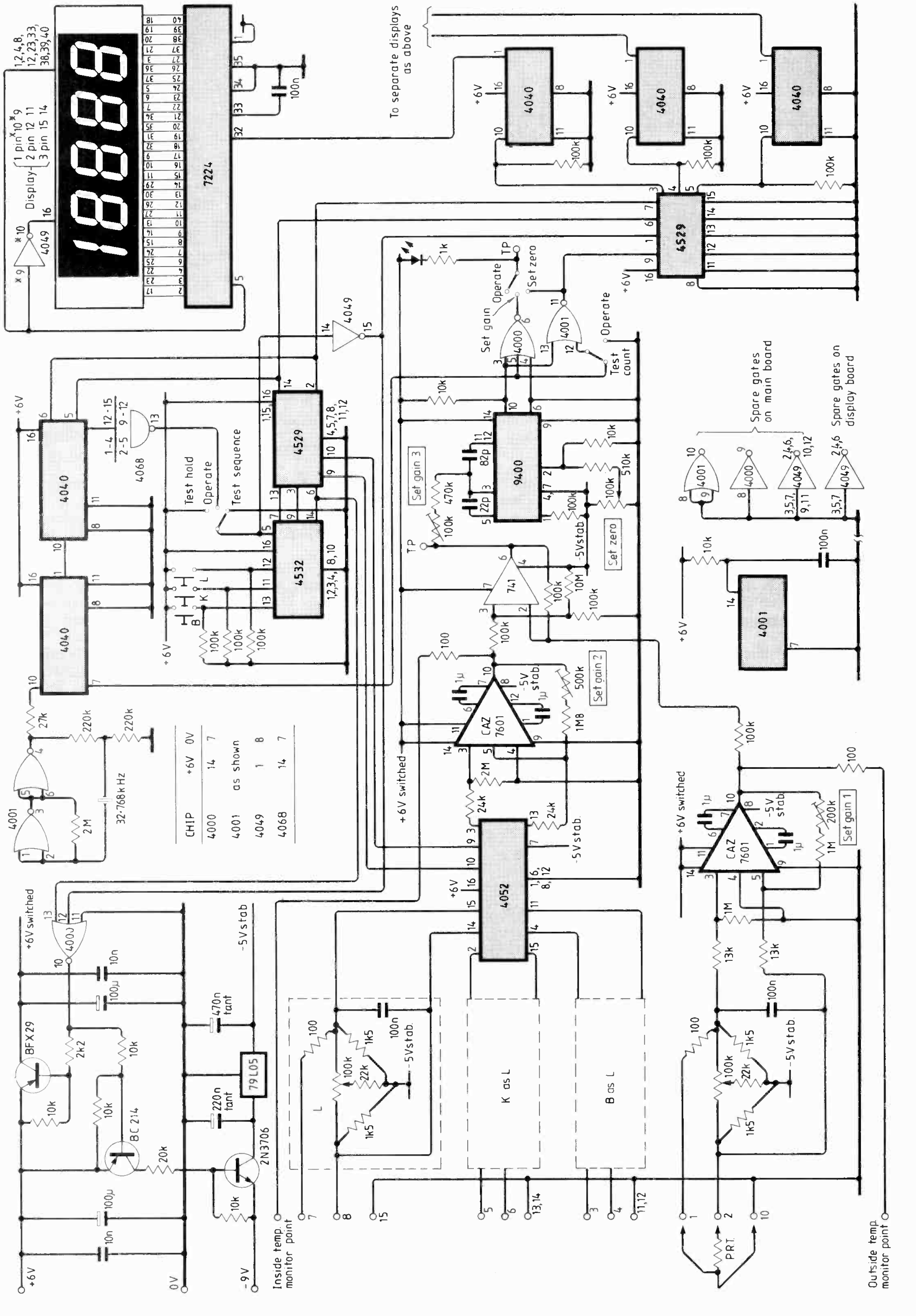
The 32.768kHz crystal oscillator is counted down by 4040 counters and decoded with the 4068 and gate to wake up the sleeping system for two seconds in 512 (about eight minutes). In the off state, battery consumption is essentially that of the three liquid crystal displays (about 300μA). The circuit cycles through four phases of 500ms each, starting with a settling period with the amplifier inputs grounded. Then each of the sensors in turn is routed through the input multiplexer and the bridge amplifier to the v-to-f converter. The resulting pulse train is routed to the appropriate 4040 counter and 7224 counter/display driver.

The v-to-f converter (Teledyne 7400 or RS307-070) requires a stabilized negative voltage rail as a reference, the stability of

Designed by Bob Everett and engineered by the OU Electronics Common Facility, 100 of these temperature integrators were made and installed in houses at Milton Keynes in the summer of 1981.



Bob Everett is currently a Research Fellow in the energy research group of the Open University. He studied mechanical and electrical engineering at Cambridge University, graduating in 1970, and subsequently worked on computer phototypesetting development for the (then) International Publishing Corporation. Since 1976 he has worked on the monitoring and computer analysis of a number of solar energy projects in Milton Keynes. He is embarrassingly fond of his ZX81.



7224
4040
4529
4532
4052
4068
4001
4000
4049
9400
741
CAZ 7601
79L05
BFX29
BC 214
2N3706
Test hold
Operate
Test sequence
Set gain
Set zero
Test count
Set gain 1
Set gain 2
Set gain 3
+6V switched
-5V stab
32·768kHz
To separate displays as above
Spare gates on main board
Spare gates on display board
K as L
B as L
PRT
Inside temp. monitor point
Outside temp. monitor point
CHIP +6V 0V
4000 14 7
4001 as shown
4049 1 8
4068 14 7

◀ *Fig. 4. Light-emitting diode and associated switches were included for production testing and could be omitted. The l.e.d. was an idea to set the v. to f. converter gain without an oscilloscope by beating the output against the crystal clock, but the 'scope is a lot easier in practice.*

the positive rail being not nearly so critical. Hence the use of a 9V battery regulated to 5V to drive v-to-f converter, bridge amplifiers and the bridge.

Pressing any one of the individual hold buttons powers the system. The 4532 priority encoder selects the appropriate two-bit address and also allows the normal integration mode priority should the counter time out. The bridge amplifiers are powered and the appropriate temperature can be sampled on the two test points with a d.v.m. (1 volt≡10degC).

Setting up

The design contains a rather confusing array of switch settings for testing and setting up, most of which turned out to be unnecessary. The bridge amplifier gains and offsets can easily be set up in the hold mode using standard resistors (100Ω≡0°C and 110Ω≡26.0°C). The v-to-f offset is set to give a 5Hz tickover at zero ΔT (visible on the l.e.d. in the set-zero switch position). The v-to-f gain is set by adjusting the output to 8.192kHz at a ΔT of 16.9°C. The beat between the v-to-f output and the reference signal from the clock chain should be visible on the l.e.d. with the test switches set to set-gain. Alas, in practice it is far more visible on a 'scope.

One vital ingredient missing from the design is a way of detecting leaky c-mos chips. With complex battery powered equipment, one leaky chip or a floating gate can mean the difference between microamps and milliamps of battery consumption. But which chip is it? Desoldering them at random from a double-sided printed circuit board is a recipe for disaster, and yet a few 100ohm resistors in the power rails to localize the fault could have saved many boards from the bin.

This design dates from 1980. A production run of 100 were made in 1981 and have performed reliably since then. With the close of the Pennyland field trial they are likely to be passed on to further trials. Although the design is a little dated, it is still difficult to get the same performance at the price from a micro design (the components excluding board and box come to about £120), but it it is only a matter of time.

Members of the Open University Electronics Common Facility transformed the scruffy prototype into a production device. Funding for the Pennyland project came from the Department of Energy, through their Passive Solar Energy Programme, and the Department of Environment as an extension of their 'Better Insulated House' programme. WW

References

1. Energy Projects in Milton Keynes, S. Fuller, J. Doggart & R. Everett, 1982. Available from Milton Keynes Development Corporation.

2. Simple data-logging instrumentation for monitoring the thermal performance of buildings, Charles Newcomb, Proc. 5th Passive Solar Conference, University of Massachusetts, 1980.

Adaptable typewriter interface

continued from page 28

Table 1. Small sample of the output of program of List 1.

Data to printer	*Ascii decimal equivalent*
12	82
13	77
14	64
15	75
16	94
17	94
18	80
19	83
20	87

Table 2 shows the ascii code in binary for a character (written in left hand side of column) and decimal data representation of the binary code to be sent to the printer (right hand side). For example ascii code 1100100 is found from intersection of column 100 and row 1100 giving character 'd' translated to decimal code 123 for the printer. Non-printing characters are shown by blank entries.

Bits 7654 \ 321	000		001		010		011		100		101		110		111	
0000	nul														bel	
0001	bs	114	ht	70	uf		vt		ff		cr	48	so	71	si	98
0010			dc1	68	dc2	67	dc3	65	dc4	66						
0011							esc	96					rs	69		
0100	sp	113	!	154	"	22	#	158	£	54	%	29	&	52	'	40
0101	(	8	)	56	*	30	+	26	,	125	–	80	.	85	/	62
0110	0	120	1	94	2	86	3	126	4	78	5	118	6	110	7	116
0111	8	104	9	72	:	23	;	87	(	8	=	90	)	56	?	144
1000	@	14	A	27	B	53	C	57	D	59	E	60	F	11	G	41
1001	H	55	I	10	J	47	K	15	L	63	M	13	N	45	O	58
1010	P	18	Q	28	R	12	S	19	T	44	U	42	V	9	W	20
1011	X	17	Y	43	Z	25	(	8			)	56				46
1100	Y	40	a	91	b	117	c	121	d	123	2	124	f	75	g	105
1101	h	119	i	74	j	111	k	79	l	127	m	77	n	109	o	122
1110	p	82	q	92	r	76	s	83	t	108	u	106	v	73	w	84
1111	x	81	y	107	z	89		8	|	157		56				

Notes and limitations

Some residual problems exist such as the fact that the ascii code does not allow for characters such as half-space or ÷ which are available from the typewriter keyboard. One possible solution to this is to define characters in the code range 128 to 255 and then to use software to substitute these special codes when the alternate character set is required. A decision to include or discard such codes will have a bearing on the complexity of your final program as will, for instance, forcing your non-proportional spacing typewriter to right-margin justify text.

Note that the Praxis does not seem to read the keyboard 1/keyboard 2 status unless the character buffer is empty and so it is necessary to delay before changing the keyboard status if the printing rate is above about ten characters per second.

A more serious limitation is the amount of time that the printer can run continuously until it needs a cooling off period. Typewriters are seldom driven by people who type virtually continuously and so they tend to overheat with this kind of use. For example the Praxis is not really up to printing more than 40 minutes continuously without say a 20 minute rest for the mechanism to cool down a bit. If the printer does get overheated it tends to skip characters and generally mess up the text, thus necessitating a reprint. A lot of printing can be done in 40 minutes but for really long and hard use it is probably more effective to purchase a heavy-duty daisy wheel printer in the first instance.

The problem of feeding single sheets of paper into the printer can be overcome either by forcing a software delay (the simplest method) at the start of each new page or else detecting the form feed character, then setting a latch to hold BUSY high until manually reset.

There are of course plenty of hardware options to add on if desired. A uart can be added to accept serial input but be careful about drawing too much current from the printer power supply. A preprogrammed eprom inserted into the data lines will enable the printer to accept straight ascii character data rather than the modified set used here. By this stage you are probably considering one of those single-chip eprom-based processors to produce an interface with all the 'bells and whistles'. WW

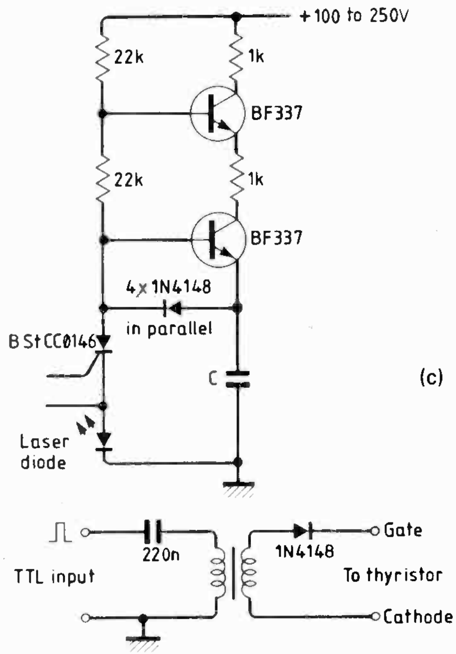
CIRCUIT IDEAS

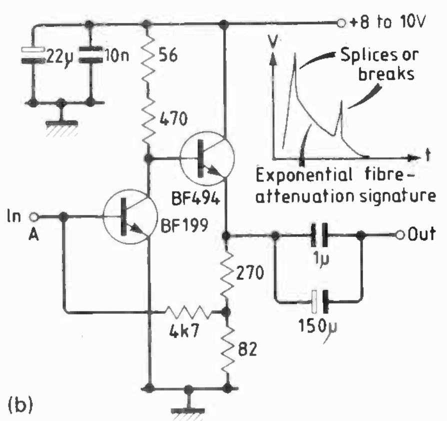
Optical-fibre measurements

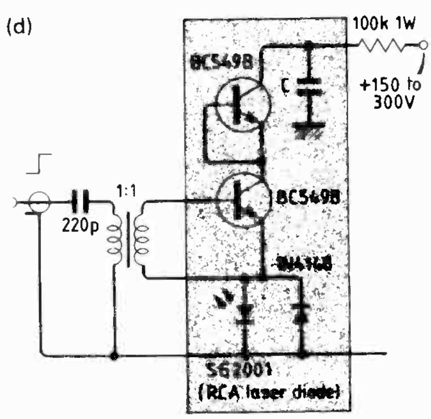
Used with an optical-fibre directional coupler, these circuits allow backscatter measurements on fibres with >10dB one-way insertion loss. Light pulses of 50ns are used in the avalanche photodiode pre-amplifier which, when carefully constructed, has a 10-40MHz bandwidth. Small-signal Schottky diode D stops $Tr_{1,2}$ saturating when strong optical reflections occur. Resistor R should be as high as possible, depending on the required bandwidth. When displaying fibre backscatter curves on an oscilloscope, the second amplifier circuit may be useful (b). Oscilloscope bandwidth should be equal to or greater than 40MHz.

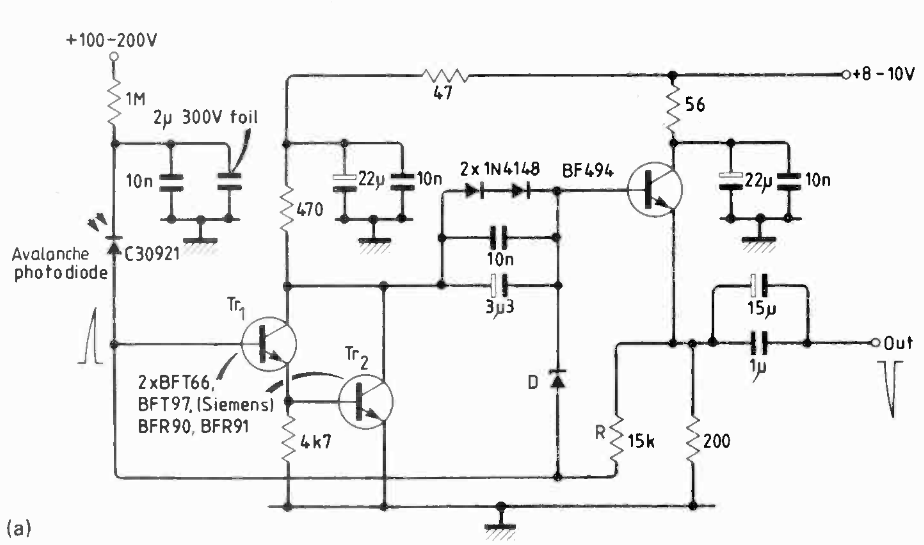
In the GaAs laser-diode pulse circuit, (c) capacitor C charges through the transistors and is discharged through the Siemens fast-recovery thyristor and the RCA SG2004/5/6 laser diode. These 904nm laser devices suit the C30921 avalanche photodiode. Capacitor C, chosen to give 50% light-on time, depends on the laser diode and supply voltage and is typically around 8nF. Pulse repetition rates higher than 10kHz are possible. Using a ferrite pulse transformer to drive the thyristor provides isolation (shown separately).

As an aid to optical-fibre bandwidth measurement, final circuit (d) can produce light pulses as short as 200ps with capacitor C at 45pF and using selected transistors in avalanche mode. Input pulse-repetition frequencies between 100Hz and 100kHz are possible. Siemens BC549s showed avalanche effect at $V_{CEO}>70V$ and $V_{(BR)CES}>140V$ d.c. Each of the transistors must be above these limits and only small-signal devices may be used. Wiring within the boxed section should be as short as possible.



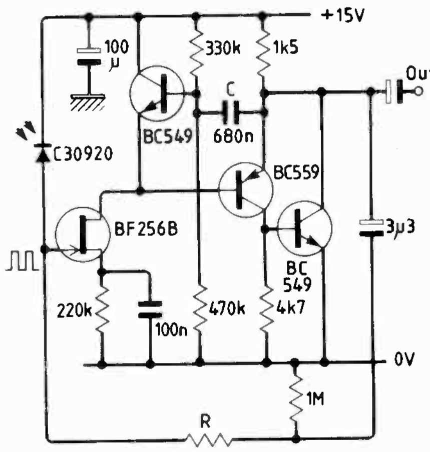






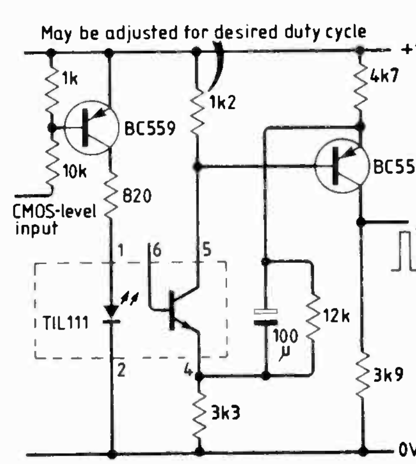
Chopped-light amplifier

Filtering the output of this amplifier to within 100Hz of the chopping frequency of say 1kHz allows light levels down to 10pW to be detected when R=10MΩ. A bipolar transistor fixes the fet drain voltage so



selection is not required; drain current may be altered by adjusting the source resistor. Voltage gain of the fet is high through inclusion of capacitor C which provides a high dynamic-load impedance. Amplifier noise is 0.04pA r.m.s./$\sqrt{Hz}$ and noise of the RCA C30920 p-i-n diode is 0.06pA r.m.s./$\sqrt{Hz}$.

Schmitt-trigger opto-coupler



J. Vandewege
Ghent University
Belgium

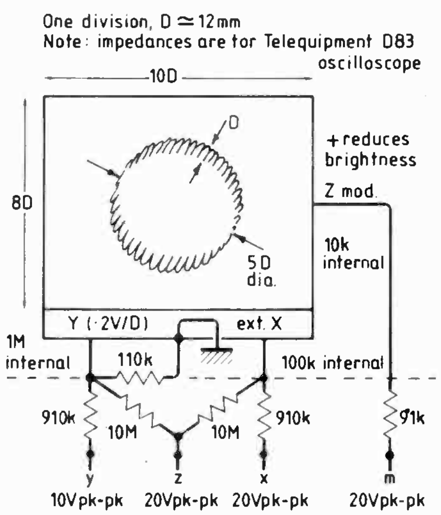
Aligning four frequencies

Four a.c. signals may be compared on a four-channel oscilloscope, but a more graphic representation can be obtained using an oscilloscope in XY mode and adding pseudo-Z and Z modulation signals. This is particularly useful when testing phase-locked loops or tuning several signals simultaneously.

This arrangement, originally devised for a Telequipment D83 oscilloscope, was used to set up two 50Hz sinewaves in quadrature (at x and y) by means of a Lissajous circle. A 2.5kHz signal introduced at z causes the circle to take on a crown shape; this signal appears stationary when its frequency is an exact multiple of the fundamental signal. The highest frequency, 5kHz in this instance, is applied at m to modulate brightness and results in a stationary stripe when synchronized.

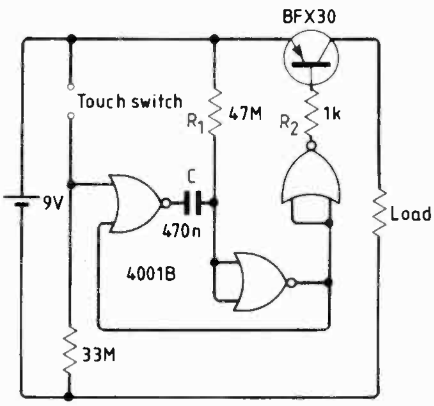
With practice, z and m can be adjusted simultaneously. For lower multiples applied to z characteristic shapes are obtained, i.e., three lobes at 2f and four lobes at 3f. If frequencies at x and y are not the same, as usual, Lissajous figures are stationary when the frequencies are exact multiples of each other. For digital signals, sensitivity may be increased by reducing series-resistor values.

C. J. D. Catto
Cambridge



Simplified battery timeout

This contribution is a cheap and simple means of conserving battery power using only six components. After the touch switch is activated, power is applied to the



load for a period equal to $0.69CR_1$. Resistor R_2 determines current limiting and may be changed. Quiescent leakage current is less than 100nA and with values shown, the power-on period is 13s and current limiting is at about 450mA. At 200mA, voltage drop is only 200mV.

S. Whitt
Ipswich
Suffolk

Programmable pulses with delay

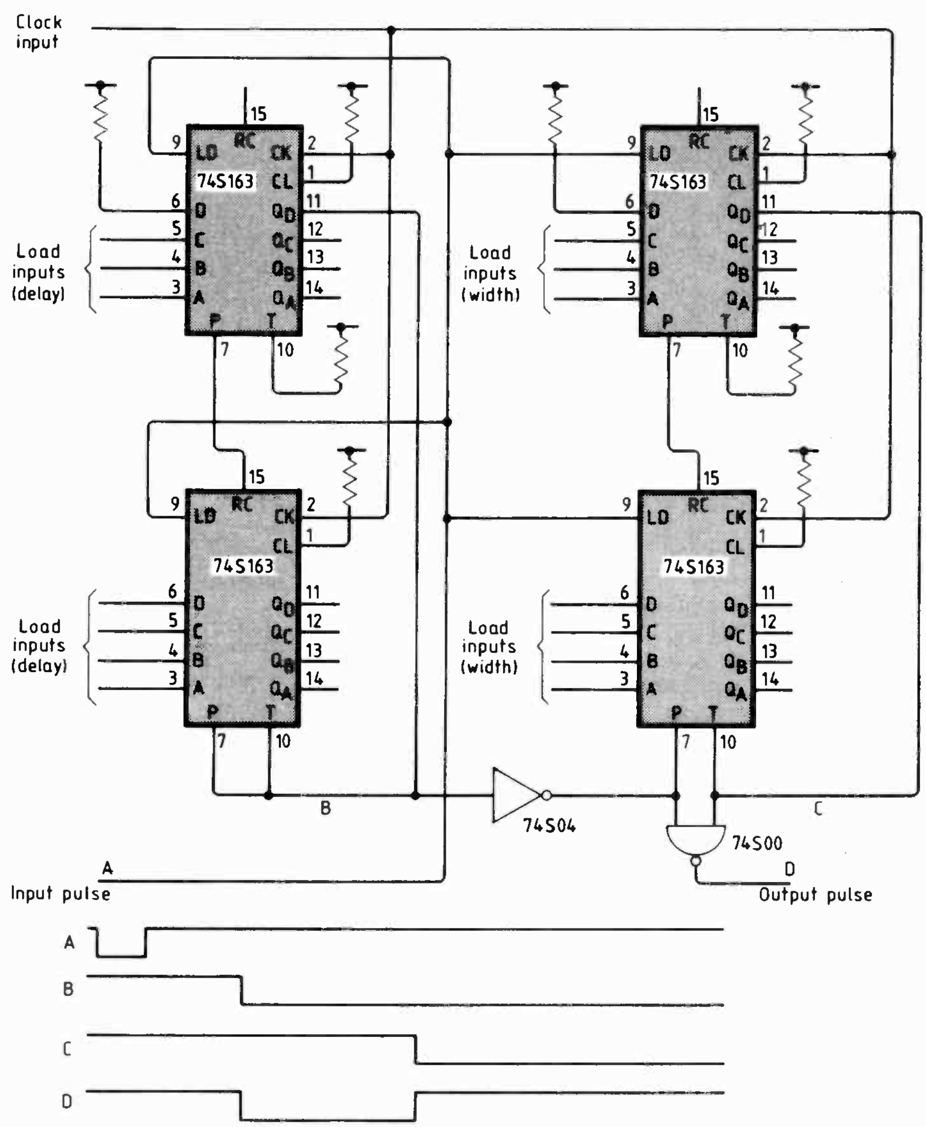
On triggering, this programmable circuit produces a pulse after a delay. Accuracy of the pulse and delay periods is determined by the accuracy of the clock so the design doesn't suffer from drift associated with monostable circuits and works reliably at high frequencies.

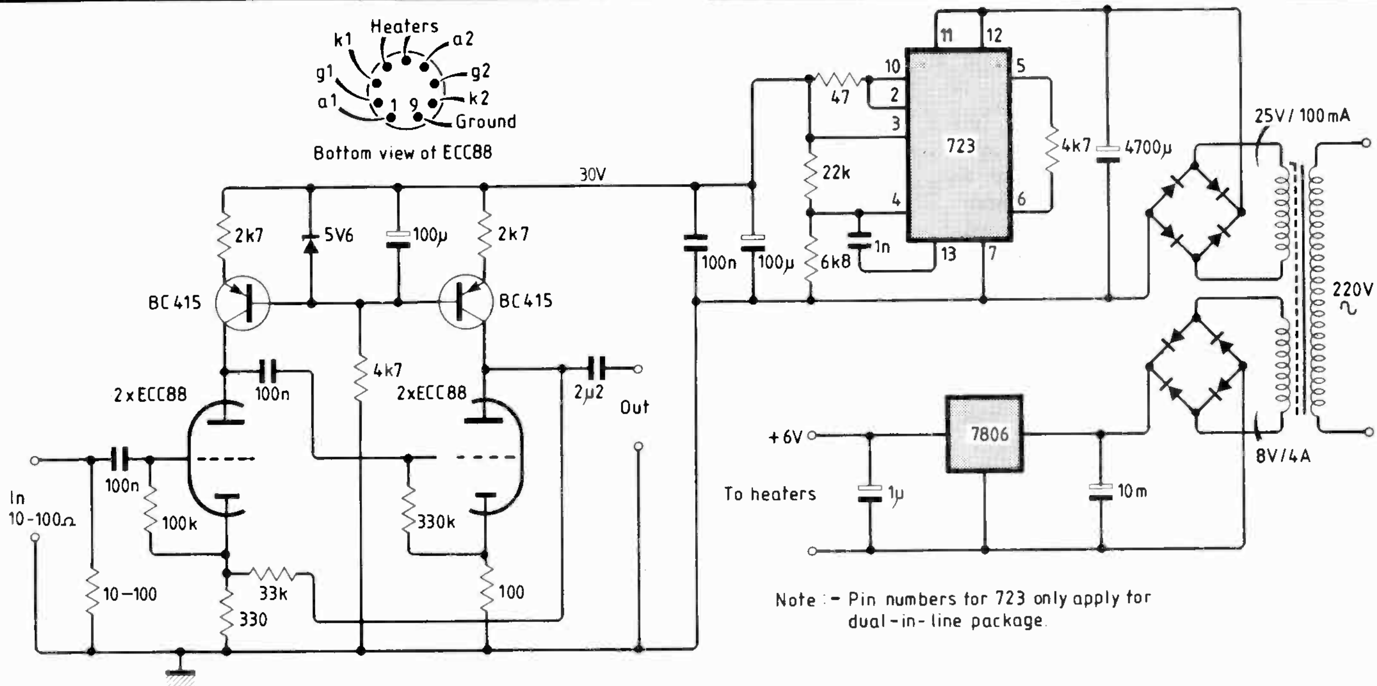
The first counter determines delay and the second one pulse width. Counter Q_D outputs are used as these change synchronously with the clock and don't produce glitches at the output but it means that the maximum count is half of that possible using the ripple-carry output. Eight-bit counters are shown but any number of bits may be used by cascading more or fewer 74S163 i.cs. Delay D for a load value L is given by

$$D=(2^n-1)-L$$

where n is the number of counter bits. In this case, n is seven.

A. D. Hacket
Salisbury
Wiltshire



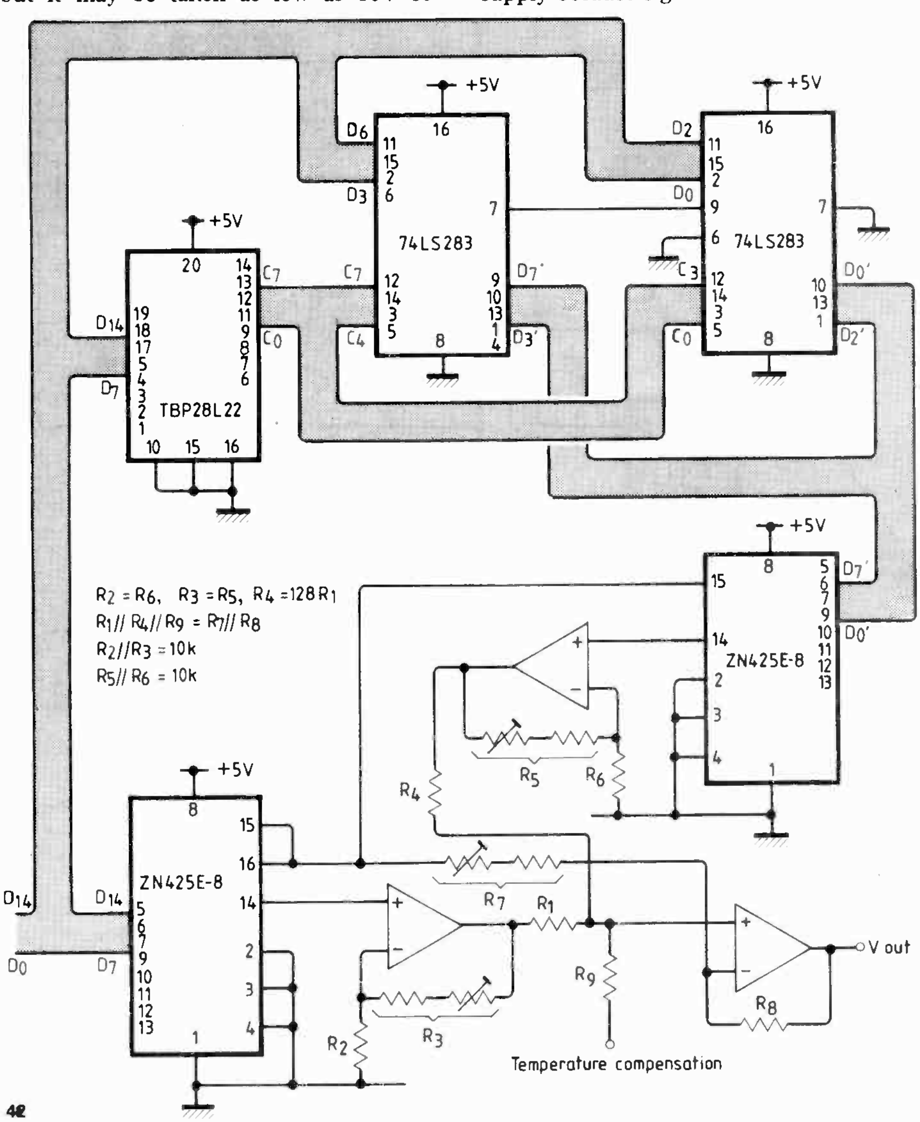


Moving-coil amplifier

I find that this moving-coil cartridge amplifier using valves gives a more natural sound than many circuits using transistors and it is easy to construct. Anode voltage rating of the ECC88 dual triode is only 90V but it may be taken as low as 10V so power-supply design is simplified. The two sections of each ECC88 are connected in series and low-noise transistors connected as constant-current sources form anode loads for the two stages. Gain of each stage is about 30.

A 723 regulator is used for the main supply because signal-to-noise ratio of the amplifier depends on noise, output impedance and ripple rejection of the supply. Popular 78-series regulators are not good enough. Valve heater supply must be regulated for the same reasons but in this case a 7806 suffices. Overall closed-loop gain of 100 is determined by the 33kΩ resistor, which may be lowered to reduce gain. Open-loop gain is 600. Loading required for different makes of cartridge varies but is usually between 10 and 100Ω. Capacitors are critical and high-quality polycarbonate or polypropylene types should be used throughout, except for power-supply smoothing.

Per Hojlev
Copenhagen
Denmark



15-bit d-to-a using ZN425 converters

Two cheap eight-bit d-to-a converters are combined to form a 15-bit converter in this circuit. Output of the left-hand converter is calibrated for all input values (0 to 255) and a correction value is programmed into the 28L22 prom with 00 corresponding to −511/512 l.s.b. and FF_{16} corresponding to +511/512 l.s.b. This correction is added to the seven least-significant bits of the input data to provide an eight-bit input to the second converter. Reference voltage for both converters is derived from one i.c. to reduce errors due to ageing and temperature fluctuations.

Resistors $R_{3,5}$ are adjusted to give correct scaling factors for the two d-to-a converter outputs and R_7 corrects for output offset. Component values are not shown since these will depend on the application and output voltage range required. Temperature compensation can be applied through R_9 and by using an external reference voltage.

S. W. Beet
Merseyside

The parallel-fed voltage multiplier

Although any desired voltage may be obtained by stringing together a sufficient number of cells, a voltage converter has many advantages. Battery testing and replacement are simpler, and there is the option of using a single rechargeable device to power the whole of the circuitry.

R. D. Purves and C. Prescott

Our particular need arose during the design of a portable muscle stimulator for biomedical use. The initial specification called for a unit to give output pulses at 10Hz, of 200μs duration and amplitude 15mA maximum into a load of approximately 8kΩ, representing the resistance of electrodes placed on skin over the muscle. The stimulator was to be carried about in a pocket or on a belt, and would be used for 6 to 12 hours per day. The power source was to be a single PP3 9V battery, and we hoped to keep the current drain below 1mA to ensure long battery life*.

The specification evidently requires a voltage supply of at least 120V. As the output energy per pulse is 0.36mJ, the average power drawn from the supply is 3.6mW. If voltage conversion could be achieved with 100% efficiency, the current drain from the battery would be only 0.4mA. Thus the target value of 1mA seemed approachable. However at power levels below 10mW a conversion efficiency of even 50% is hard to achieve, as we found by examining a commercial stimulator with broadly similar specifications. It employed the conventional oscillator and step-up transformer, rectifier approach to voltage conversion, and its current drain was several milliamps. This poor efficiency, less than 20%, encouraged us to consider an alternative method.

Fig. 1 shows the well-known Cockroft-Walton cascade voltage multiplier in the form commonly used when an alternating voltage is available to drive it. A minor modification at (b) enables it to be driven by antiphase square waves which do not have to swing below 0V. These circuits are series-fed: the a.c. or square-wave driving voltage is applied to the end of a chain of capacitors in series. Design and analysis are notoriously difficult, because the current and voltage waveforms for each stage are different. It is known that with optimal allocation of resources the capacitor values should not all be equal, but should increase from C at the output end to NC at the driven end. Another disadvantage is that the additional output voltage per stage is not constant, but diminishes by one diode drop V_f for each stage in the circuit.

* Battery-powered instruments, by Ian Hickman, *Wireless World*, vol. 87, 1981, pp.57-61.

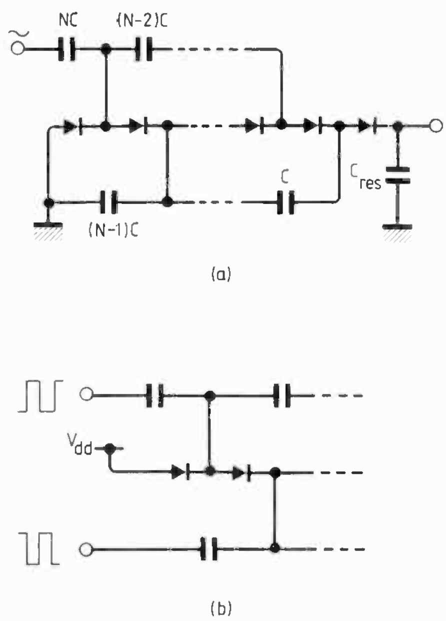


Fig. 1. In the Cockroft-Walton series-fed voltage multiplier the output reservoir capacitor C_{res} is chosen to have a reactance, that is much less than the load impedance at the working frequency. (a) is the single-ended version, while (b) is a modification for push-pull input where antiphase square waves do not have to swing below 0V.

Thus in Fig. 1 (b) with a driving swing from 0 to V_{dd} of 9V and V_f taken as 0.6V, one stage provides 9+8.4=17.4V, two stages provide 9+8.4+7.8=25.2V, and so on up to 14 stages which provide 72V. Beyond this limit extra stages contribute nothing.

While pondering these deficiencies we discovered that some remarkable improvements result if the configuration is changed to the parallel-driven form of Fig. 2. The N capacitors now all take the same value, which simplifies construction. The open-circuit output voltage per stage has the constant value $V_{dd}-V_f$ and so the total output voltage $(N+1)(V_{dd}-V_f)$ can be increased without limit. Finally, the analysis is facilitated by the fact that apart from a step-wise increase in d.c. level, the current and voltage waveforms for each stage are identical (this is strictly true only if N is even, so that points X and Y see the same total capacitance).

Dr Purves is with the department of pharmacology, University of Otago, New Zealand, and Mr Prescott is at the department of anatomy & embryology, University College, London.

The most important design parameter of a power supply, after its open-circuit output voltage, is the equivalent output resistance. The parallel-fed multiplier's output resistance can be derived directly as the ratio of open-circuit output voltage to short-circuit output current. For calculation only, it is convenient to return point Z of Fig. 2 to earth instead of to V_{dd} and to treat the diodes as having zero forward voltage drop. With these assumptions the output voltage becomes NV_{dd}. A further assumption, which will later be relaxed, is that square wave sources X and Y have negligible internal resistance and thus provide a full swing from 0 to V_{dd} regardless of the load. Now if the output terminal is earthed the diodes and capacitors act in 'bucket brigade' fashion to transfer a charge CV_{dd} from one stage to the next in each cycle. The average short-circuit current is therefore CV_{dd}/T where T is the square-wave period; it follows that the multiplier output resistance is NT/C.

A more general expression for output resistance, derived in the appendix, is

$$(NT/C)\coth(T/2NRC)$$

in which the hyperbolic term corrects for the finite resistance R of the square-wave

continued on page 45

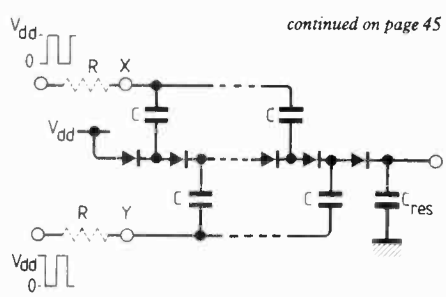


Fig. 2. Parallel-fed voltage multiplier. Resistors R represent the equivalent resistance of the square wave sources.

Frequency response analyser

Using an oscilloscope to display response, this educational aid to understanding frequency response of amplifiers and tuned circuits covers the band 40Hz to 400kHz.

by K. Srivatsa, R. Partha and S. L. Sridharmurthy

The heart of the analyser is a voltage-controlled oscillator, Fig. 1, whose ramp voltage varies the frequency. The v.c.o. used, the Intersil 8038, has a linear relationship between control voltage and frequency with the required range of 1:10,000 covered in four sweeps, each sweep causing a decade change in frequency. A given frequency range depends on external resistances and a capacitor. In our scheme, four different timing capacitors are used, one for each sweep range, switched in a repetitive sequence. The switching circuit shown in Fig. 1 is also used for providing retrace pulses for the bootstrap ramp generator and external trigger input for stabilized oscilloscope display. For a large frequency sweep, the v.c.o. requires a control voltage decreasing from V_{max} to V_{min} of V_{cc} to $2V_{cc}/3 + 2$. The level shifter with inversion after the ramp generator shown in Fig. 1 solves this problem.

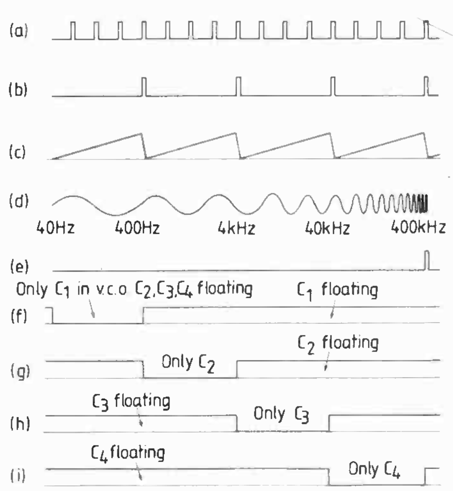
The v.c.o. output is attenuated and fed to the input of the device under test (d.u.t.), say an RC-coupled amplifier. The frequency-dependent output of the device under test is passed to the oscilloscope Y-input.

K. Srivatsa, with a B.E. and M.Tech. in electronics, lectured at the University Visvesraraya College of Engineering, Bangalore, before becoming senior engineer (software) at Processor Systems Pty Ltd, Bangalore. His co-authors graduated from UVCE in 1982 with B. E. (Electronics) and have taken up jobs in power electronics (Sridhara Murthy) and digital microwave communication (R. Partha).

Figure (2a) shows the clock input to the switching circuit, with a duty cycle of about 10%. Waveform (b) is derived from (a) with a period equal to four times the clock period. These pulses are passed to the bootstrap ramp generator circuit causing retrace.

The ramp at (c) has a frequency of 400Hz. This waveform is inverted and level shifted before the v.c.o., whose output is shown in (d). Waveform at (e) has a period of four times the ramp period used for external sweep triggering to give a flicker-free display. Waveforms (f) to (i) switch the required capacitor into the v.c.o.

Fig. 2. Waveforms (a) to (f) are found at the nodes 1 to 6 in Fig. 1.



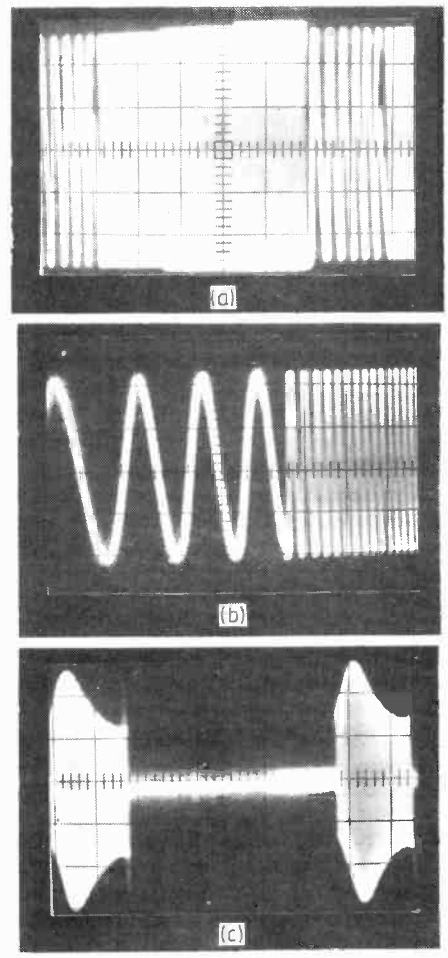
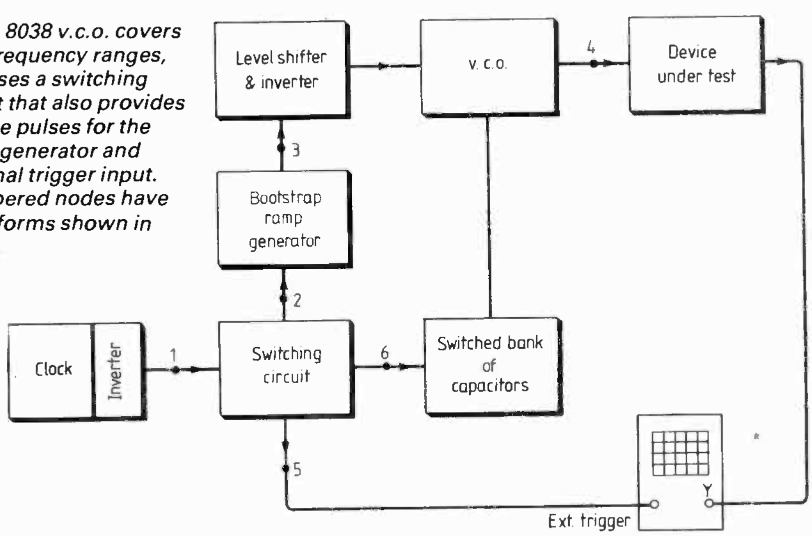


Fig. 3. Full range of analyser is shown at (a), with an expansion at (b). Lower trace shows typical output from a tuned amplifier.

The performance of the analyser is demonstrated in Fig. 3. Photograph (a) shows the full range of v.c.o. and (b) is an expanded partial range. With this was the input to a tuned amplifier, the resulting output was as shown in (c). The detailed circuit is shown in Fig. 4. Design procedure is easily obtained from the data sheets[1].

Fig. 1. 8038 v.c.o. covers four frequency ranges, and uses a switching circuit that also provides retrace pulses for the ramp generator and external trigger input. Numbered nodes have waveforms shown in Fig. 2.



Improvements

For higher resolution, as in a tuned amplifier which requires a part of the frequency

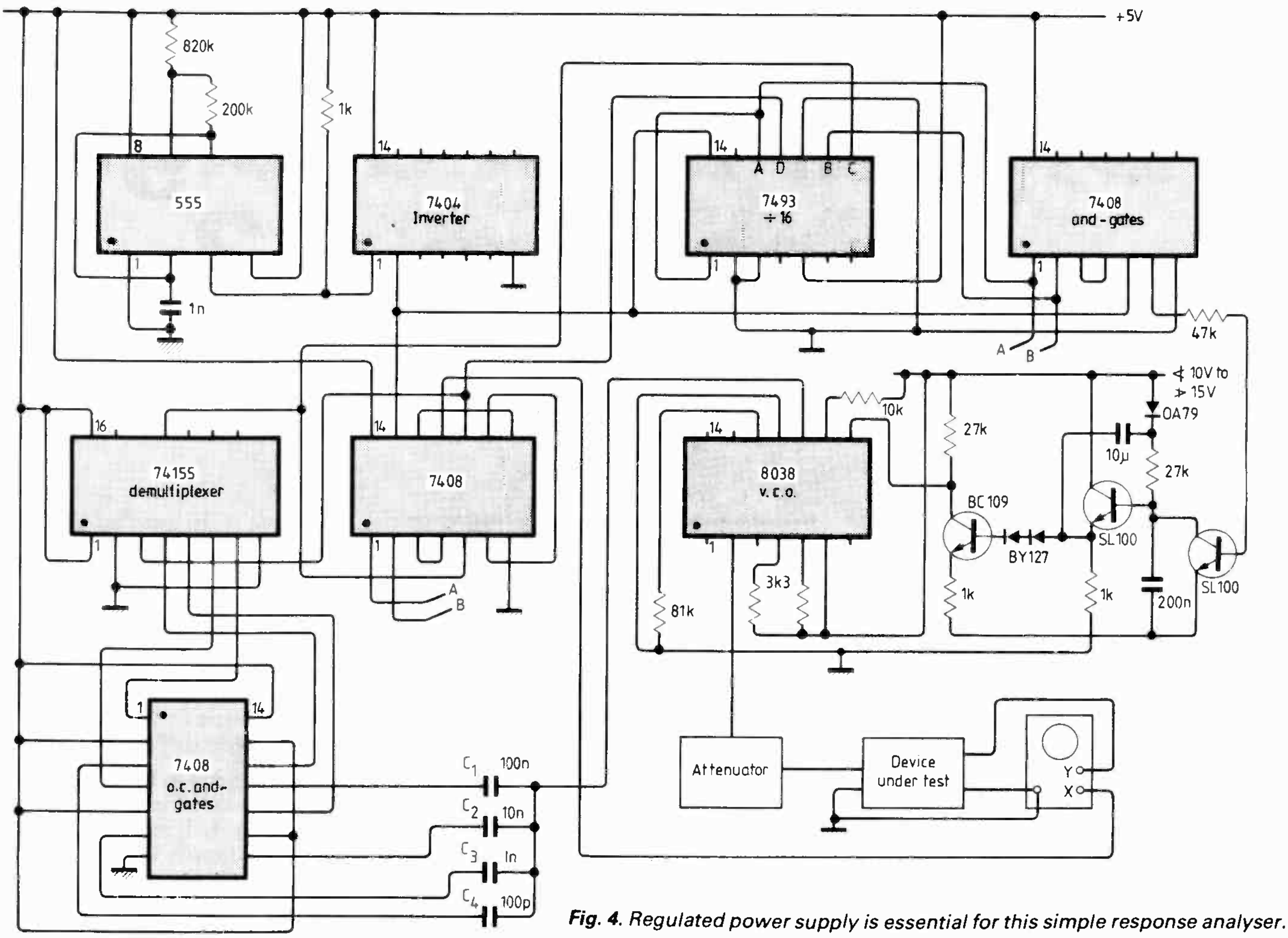


Fig. 4. Regulated power supply is essential for this simple response analyser.

range, it must be possible to divide the entire sweep range into programmable sub ranges, and the above multisweep technique repeated within each sub range.

In the analyser, the sinewave output of the d.u.t. is fed directly to the Y input. For a proper plot a direct voltage must be given to the Y input. It will be necessary to use a wideband average detector with a switched filter for a d.c. output. Switching of filter capacitors is done using the waveforms for switching the v.c.o. capacitors. Other techniques for improving the display can be found in reference 2.

References

1 Intersil application note ICL 8038.

2 Logarithmic audio sweep generator, by A. C. Ainslie. *Wireless World* Sept. 1979.

Parallel-fed voltage multiplier *continued from page 43*

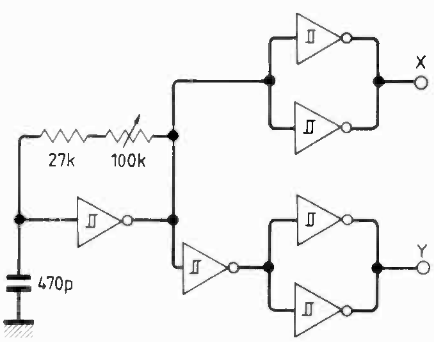


Fig. 3. A simple low power square wave source, using a CMOS hex Schmitt inverter (40106B or 74C14).

sources. For fixed R the output resistance falls with decreasing T or increasing C until T ≪ NCR, when a limiting minimum value $2N^2R$ is reached. The actual value of capacitance used is largely immaterial, as a compensatory change in T can always be made.

In low power operation c-mos gates have sufficiently low output resistance (a few hundred ohms) to act as drivers, especially if two or more gates are parallelled, Fig. 3. More effective buffering is needed at power levels greater than about 10mW. A 15-stage multiplier driven by this circuit with T=50μs and C=10nF provided an open-circuit voltage of 137V with a battery drain of 0.27mA. The measured output resistance was 130kΩ. With 30μA drawn from the output, total battery drain was 0.72mA. Overall conversion efficiency (load power/battery power) is 60%, a very satisfactory result in view of the low power level. If miniature polyester layer capacitors are used in the multiplier chain the entire circuit occupies little more volume than the 9V PP3 battery supplying it.

Appendix

When the resistance R of the square-wave sources is not negligible, the waveform at X or Y with the multiplier output short-circuited takes the shape indicated in Fig. 4, in which the amplitude of the swing V_2-V_1 is less than its maximum value V_{dd}, owing to incomplete charging and discharging of the capacitors in

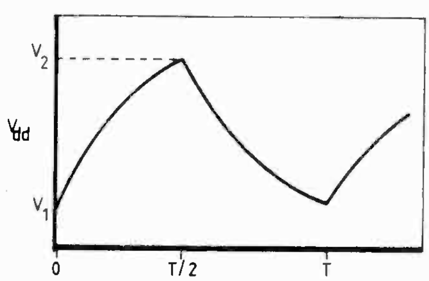


Fig. 4. The waveform seen at point X or Y of Fig 2 when R is not negligible.

each half cycle. The charge transferred from stage to stage in one cycle is $C(V_2-V_1)$ and the average short-circuit current is therefore $C(V_2-V_1)/T$. By inspection of Fig. 4:

$$V_1=V_2e^{-T/NRC}$$
$$V_2=V_{dd}-V_1$$

Hence $V_2-V_1=V_{dd}(1-e^{-T/NRC})/(1+e^{-T/NRC})$
$=V_{dd}\tanh(T/2NRC)$

With ideal diodes the open-circuit output voltage is NV_{dd} and so the output resistance is given by

$$NV_{dd}T/C(V_2-V_1)=(NT/C)\coth(T/2NRC).$$

Digital filter design procedure – 3

Despite its limitations a high-pass digital filter is easily designed by 'inverting' its equivalent low-pass version (July issue). Except for sign changes, pole and zero parameters are the same.

by J. T. R. Sylvester-Bradley M.A.

Previous articles with this title were in the May and July 1983 issues, the first outlining how to design the digital equivalent of an analogue filter where the transfer function can be simply formulated. As an example, the article derived in detail the digital equivalent of a parallel tuned circuit, and one case had pole positions chosen with a simple microprocessor in mind. The second article covered the case where the z-plane transfer function had to be derived from an analogue filter using a bilinear transformation, and a fourth-order low-pass Butterworth filter was used as an example.

One can argue that even in the analogue world a high-pass filter cannot really exist as it is not possible for a circuit to pass signals of an infinite frequency. The Butterworth low-pass filter has a flat response from zero up to its cut-off, but the flat response of the equivalent high-pass filter cannot possibly extend from cut-off to infinity. However, as explained in the previous article, with the digital version of the Butterworth low-pass filter, the digital equivalent to an infinite frequency is the maximum frequency that the digital filter can handle, that is half the sampling frequency.

The same applies to the high-pass digital filter, and within this limitation it can have a flat response from its cut-off frequency up to the digital equivalent of an infinite frequency (f_{max}), see Fig. 1, where the spectra (or more precisely, the Fourier transforms of the impulse responses) of both low-pass and high-pass ideal analogue filters are compared with their digital equivalents. In the last mentioned the spectra are repeated at multiples (harmonics) of the sampling frequency.

Once the limitations of the high-pass filter are recognized, a filter which is the precise equivalent to its low-pass version is easily designed by inverting the position of the low-pass poles and zeros on the Z plane.

Figure 2 shows the spectrum and Z-plane diagram of the high-pass filter designed in this way to be an exact equivalent of the low-pass filter designed in the previous article (Fig. 10 of that article).

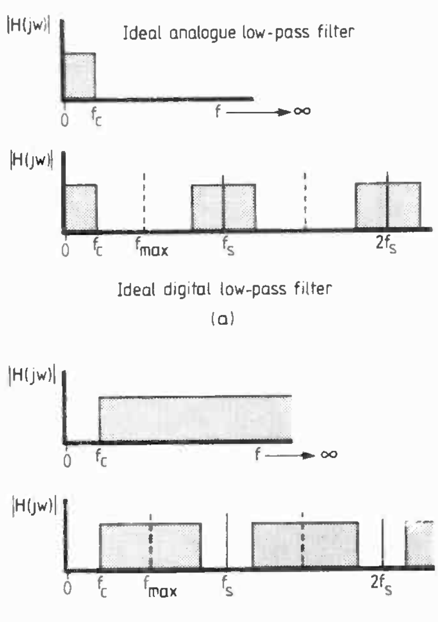


Fig. 1. Spectra of ideal analogue and digital low-pass filters compare as at top diagram (a), while ideal analogue and digital high-pass filters compare at bottom (b). Frequency f_{max} is the digital equivalent to an infinite analogue frequency.

Pole and zero positions

The pole positions for the low-pass filter were

pole 1 $r_1/\omega_1 T = 0.758\angle 137.2°$
pole 2 $r_2/\omega_2 T = 0.458\angle 159.1°$,

with poles 3 & 4 as their conjugates. The four zeros were all located at $1.0\angle 180°$.

The pole and zero positions for the high-pass filter are found by adding 180° to the above positions, giving

pole 1 $r_1/\omega_1 T = 0.758\angle 42.8°$
pole 2 $r_2/\omega_2 T = 0.458\angle 20.9°$,

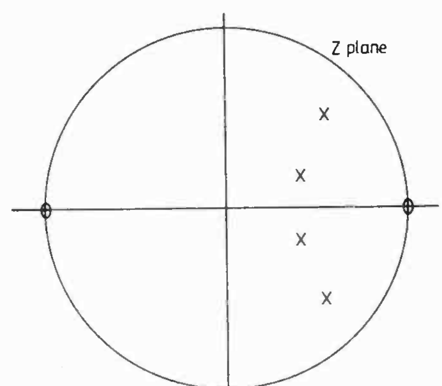
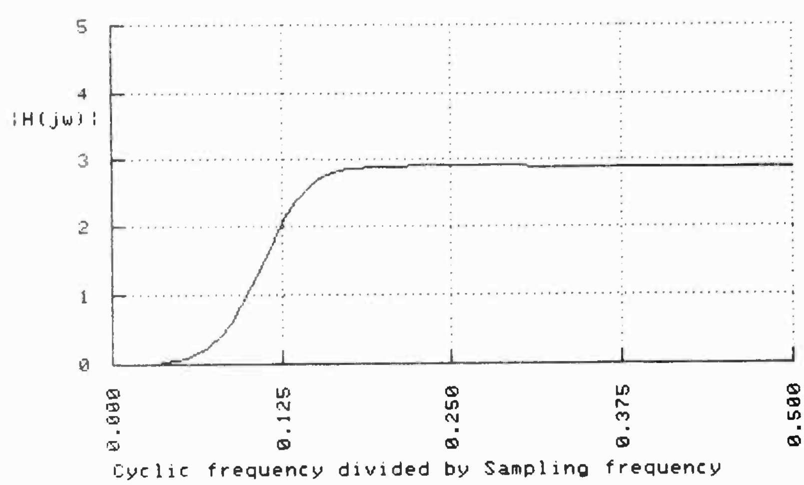


Fig. 2. Spectrum and Z-plane diagram and $|H(j\omega)|$ of digital equivalent of high-pass Butterworth filter.



with poles 3 & 4 as their conjugates, and with the four zeros located at $1.0\angle 0°$.

The spectrum of Fig. 2 shows a flat response from just above the cut-off frequency (f_c) up to f_{max} and

$$f_c = \tfrac{1}{8}f_s = \tfrac{1}{4}f_{max}.$$

Transfer function

For the high-pass filter H(z)=

$$\frac{(z-1)^4}{(z-r_1e^{j\omega_1T})(z-r_1e^{-j\omega_1T})(z-r_2e^{j\omega_2T})(z-r_2e^{-j\omega_2T})} \quad (1)$$

multiply the denominator to evaluate the pole parameters:

$$(z^2-2zr_1\cos\omega_1T+r_1^2)(z^2-2zr_2\cos\omega_2T+r_2^2)$$
$$=z^4-2z^3r_1\cos\omega_1T+z^2r_1^2-2z^3r_2\cos\omega_2T+$$
$$4z^2r_1r_2\cos\omega_1T\cos\omega_2T\ -2zr_1^2r_2\cos\omega_2T+$$
$$z^2r_2^2-2zr_1r_2^2\cos\omega_1T+r_1^2r_2^2.$$

Collect like terms:

z^4	z^3	z^2	z^1	z^0
1	$-2r_1\cos\omega_1T$	r_1^2		
	$-2r_2\cos\omega_2T$	$4r_1r_2\cos\omega_1T\cos\omega_2T$		
			$-2r_1^2r_2\cos\omega_2T$	
		r_2^2	$-2r_1r_2^2\cos\omega_1T$	$r_1^2r_2^2$

From the pole positions,

$r_1=0.758$
$\omega_1T=42.8°\quad \cos\omega_1T=0.7337$

$r_2=0.458$
$\omega_2T=20.9°\quad \cos\omega_2T=0.9342.$

Therefore the pole parameters are

z^4	z^3	z^2	z	z^0
a_0	a_1	a_2	a_3	a_4
1	−1.1123	0.5746		
	−0.8557	0.9518	−0.4917	
		0.2098	−0.2333	0.1205
Σ1	−1.968	1.7362	−0.725	0.1205

The pole parameters, a_n (n=0 to 4) for the high-pass filter above are the same, except for sign changes, as for the low-pass filter designed in the previous article. Some paperwork would therefore be avoidable if the high-pass filter is designed as the inverse of low-pass filter already designed.

The transfer function can now be written to include the pole parameters, and assuming unity gain, H(z)=

$$\frac{(z-1)^4}{z^4-1.968z^3+1.736z^2-0.725z+0.1205} = \frac{Y(z)}{X(z)} \quad (2)$$

In the numerator the zero parameters b_0 to b_4 can be found by expanding $(z-1)^4$ (or from Pascal's triangle):

$$(z-1)^4=z^4-4z^3+6z^2-4z+1.$$

Values for b_n are the same as for the low-pass filter, except for sign changes in b_1

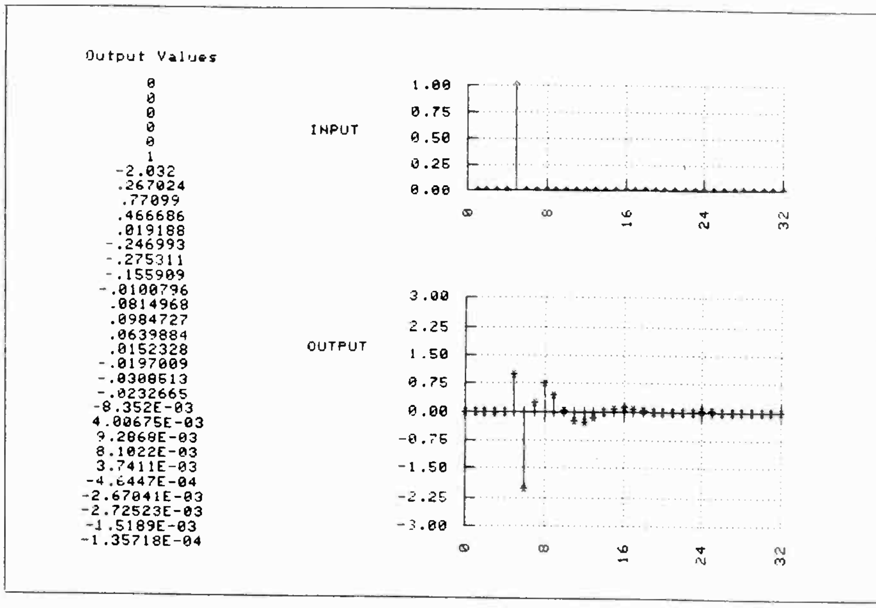
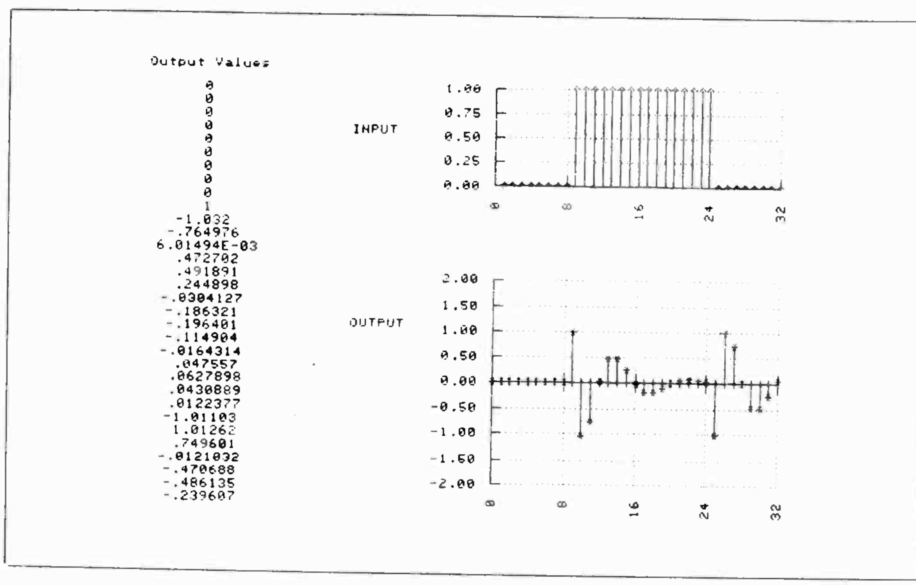
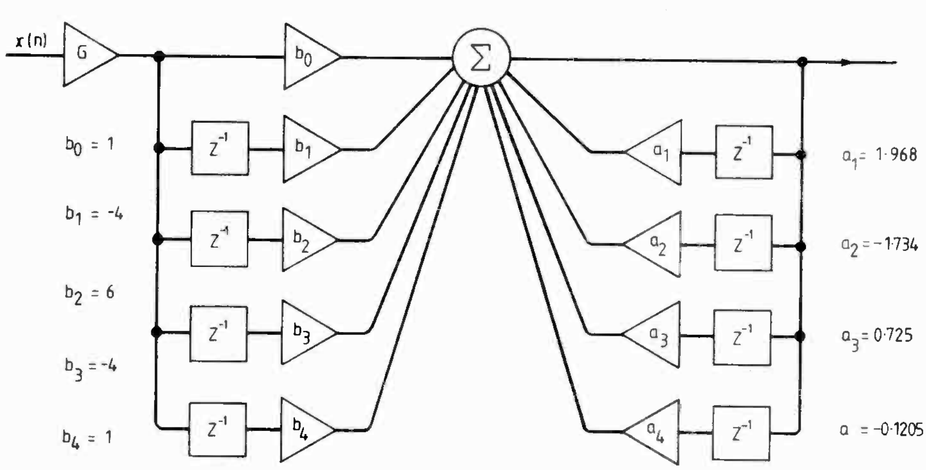


Fig. 4. Impulse response of high-pass digital filter showing "ringing" at ⅛f_s (top).

Fig. 5. Output of high-pass digital filter with a long (16 samples) input pulse (below).

Fig. 3. Realization diagram for the 4th-order Butterworth high-pass digital filter (bottom).





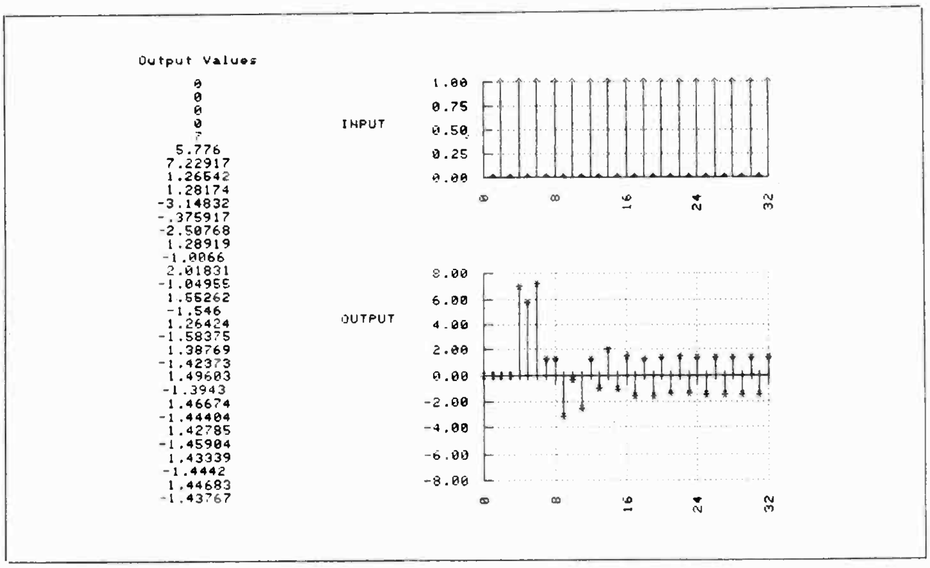


Fig. 6. *After the switching transient, pulses are transmitted but with no d.c. component. Input is at f_{max}.*

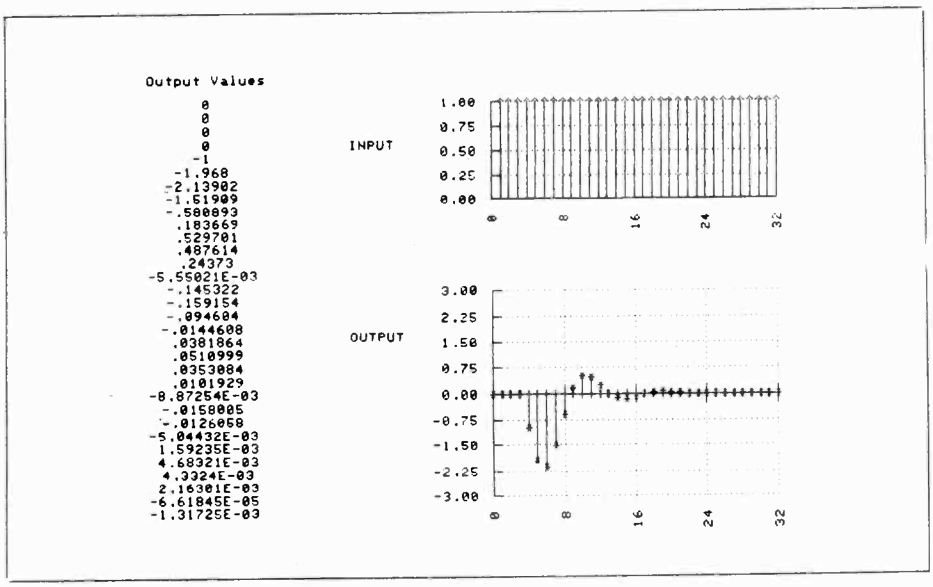
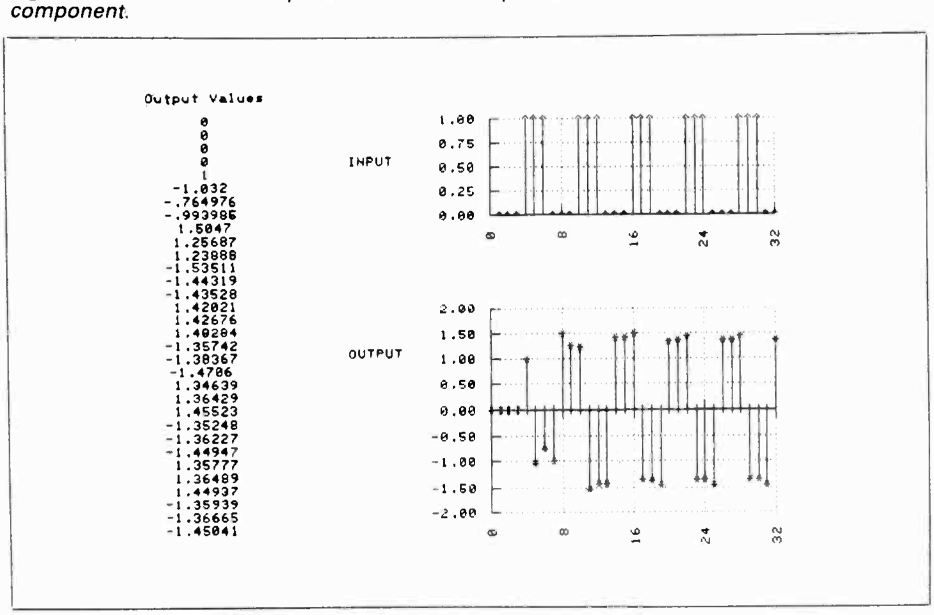


Fig. 7. *In spite of being a "high-pass" filter, it cannot pass frequencies above f_{max}. Here the input is zero (after switching transient) with an input at the sampling frequency.*

Fig. 8. *Pulse train within the passband of the filter passed without distortion but with no d.c. component.*



and b_3. Cross multiplying in the equation for $H(z)$ and dividing by z^4 gives the expression for $Y(z)$:

$$Y(z)=1.968Y(z)z^{-1}-1.734Y(z)z^{-2}+0.725Y(z)z^{-3}+0.1205Y(z)z^{-4}+X(z)-4X(z)z^{-1}+6X(z)z^{-2}-4X(z)z^{-3}+z^{-4}.$$

The recurrence formula is therefore

$$y(n)=1.968y(n-1)-1.734y(n-2)+0.725y(n-3)-0.1205y(n-4)+x(n)-4x(n-1)+6x(n-2)-4x(n-3)+x(n-4)$$

which can be written directly into a computer program to realize the filter. The realization diagram and impulse response are shown in Figs 3 and 4.

The output with a long rectangular input pulse, as in Fig. 5, clearly shows the differentiating effect of the filter, together with some ringing at the cut-off frequency.

With an input at f_{max}, (in Fig. 6 the on/off pulses are at half the sampling frequency) the output soon settles down to passing the pulses, but with their d.c. component removed. The output settles down after the ringing effect of the switching transient is over.

The filter is unable to pass a frequency equal to f_s, Fig. 7.

With a series of rectangular pulses three samples long their frequencies are well within the pass-band of the filter, and at Fig. 8 the pulse train is passed without much distortion (after the switching transient) but with the d.c. component removed. WW

In the July 1983 article, a slip occured on page 43, in which X(z) was inadvertently repeated in the penultimate line.

If you read that article you will no doubt have spotted that the last two lines of text in column one on page 44 should have followed the recurrence formula. – dep. ed.

Who was Fessenden?

When J. D. Parker received the Fessenden Award from the National Marine Electronic Association, he had to confess that he did not know of Fessenden. So the NMEA provided him with an article from the January 1930 issue of *Radio-Craft*. Reginald A. Fessenden, it turned out, worked with Edison as an electrical engineer and as chief chemist. He later became professor of electrical engineering at Western University, Pittsburg and as early as 1895 began experimental work with radio waves. Through his knowledge of sound waves he conceived the idea of modulating a continuously oscillating radio wave and his was the first voice ever to be heard on radio. He invented the rectifying electrolytic detector, the successor to the coherer, and his other inventions included the r.f. alternator and the rotary spark-gap. He suggested the principle of heterodyning but was unable to go further until the development of suitable ocillator valves. He also spent a considerable time working on navigation and signalling at sea.

NEWS

DSP, the next big step

Digital signal processing does the same things that are familiar to computer users. It executes algorithms. However in most computer applications relatively small batches of data are processed and they often do not require immediate processing. Many are familiar with the 'printout will be available next Tuesday' system. D.s.p. offers the ability to process great volumes of data with no observable delay, in 'real time'.

The technique is not particularly new. It has been used in specialized military and aerospace programmes where ultra-fast real-time computation is said to be needed, and used very expensive array processors. What is new is the production of integrated circuits that make it feasible to perform tasks previously too expensive for general use or only possible on analogue equipment.

An example of the use of d.s.p. is spectrum analysis of the vibrations in an engine on test. A. d.s.p. spectrum analyser receives signals from transducers attached to the engine. It converts the analogue signals to digital signals, processed through filters to analyse the frequency content of the vibrations and provide an instant printout or display on the current state-of-health of the engine. Such equipment might now be the size of a personal computer but the new integrated circuits will reduce this to a handful of chips. A car, for example, might be fitted with a self-diagnosed module and a collision-avoidance system. Similarly small packages could be used for speech analysis, speech synthesis or for helping to compensate for hearing, speech or sight impairments.

All d.s.p. algorithms have similar structures. They typically require the multiplication and totalling of strings of numbers. This structure is similar to the totalling of a bill where data (e.g. quantities) and coefficients (e.g. prices) are multiplied together to give subtotals which are, in turn, all added to give a grand total. Such multiplication of data and coefficients is known as array processing. Typical algorithms are digital filtering, which may be used for improving the signal-to-noise ratio; spectral analysis, which uses fast Fourier transforms to determine the frequency content of a signal; correlation, to compare signals; estimation, to decide on the validity of a signal that is incomplete or obscured by noise; and control.

A typical d.s.p. multiplier can complete a multiplication in 150ns, about 1000 times faster than a standard microprocessor. Multipliers are typical building blocks for d.s.p. hardware, others are arithmetic logic units and sequencers.

Belying their name, Analog Devices have launched a 16 by 16-bit multiplier accumulator (mac), the ADSP-1110. This c.mos device provides a 40-bit internal accumulator and yet fits onto a standard 28-pin dual in-line package. This is because it uses only a single port but operating from a 10MHz clock, the mac can alternately load x and y operands and, when instructed, output the result.

The mac can be used as a low-cost computational accelerator in graphics systems where matrix multiplications are used in image manipulation to translate, rotate or zoom the image. Under control of the system's processor, the mac can multiply a four-by-four matrix and a four-by-one vector, requiring 16 operations in less than 4μs. It operates on six-bit instruction words, there are two control lines and an overflow flag. In the event of an overflow there is an eight-bit accumulator overflow register. The ceramic version of the ADSP-1110 is available in sample quantities. It can operate over the temperature range −55 to 125°C. A plastics-housed version with a more modest temperature range, 0 to 75°C will be available soon. Prices are thought to be about £75 each if bought in quantities over 100. Analog Devices Ltd, East Molesey, Surrey KT8 0SN.

Electronic potato

If you have noticed that the potatoes you buy are less battered than before, this may be due to research carried out by the Scottish Institute for Agricultural Engineering (SIAE). They developed an electronic potato made out of plastic foam enclosing an Entran accelerometer, a transmitter and small rechargeable batteries. The transmitter sends out a v.h.f. radio signal, modulated when the transducer is activated. This potato is handled during harvesting and pototo grading along with a batch of real potatoes and the stages when the is at most risk from damage can be monitored. A battery operated receiver and tape recorder are used to record the signals transmitted from the potato and 'voice-over' commentary may be recorded at the same time to identify the stages actually taking place. Machine adjustments, modifications or alterations to the operating speed can all be assessed with the electronic spud. Moreover it can also disguise itself as an apple or an onion which are also subject to mechanical handling. A similar technique has been used to monitor raspberry harvesting with electronic raspberries.

Do you remember Baird tv?

If you do, the Royal Television Society would like to get in touch with you. They are planning an event to mark the 50 years that have passed since the 30-line service was terminated. They would like to identify as many of those 'pioneer viewers' as possible. The honorary secretary of the midland centre of the RTS is John Grantham, at BBC Network Production Centre, Pebble Mill Road, Birmingham, B5 7QQ.

Briton honoured

The tenth Marconi International Fellowship has been awarded to Professor Eric Ash. Dr Ash, Professor of Electronics at University College, London, has been made "in recognition of his outstanding leadership and pioneering work in the emerging technologies of acoustic surface wave device, optical fibre-based communications, acoustic optics and acoustic imaging".

Marconi International Fellowships were founded by Guglielmo Marconi's family and are awarded each year to further research by "a leading world scientist who has made a distinguished contribution to those areas of science and technology that improve the quality of life". Readers may recall that in 1982 the fellowship was awarded to Dr Arthur C. Clarke for first specifying the potentialities and technical requirements for the use of synchronous orbiting satellites for global communications.

High-Com stereo radio

A three month public trial of compressed f.m. broadcasts is under way in Federal Germany. The system had to offer no reduction in quality to the listener without an expander in the receiver and yet when an expander fitted there should be a noticeable difference. Not surprisingly, ARD chose a home-grown product – AEG-Telefunken's High-Com compander system. The system had to be modified to fit the requirements (see German radio show report, November 1983, page 75). After modification only two out of 13 'guinea pigs' could tell any difference between the compressed and uncompressed signal and then only in direct comparisons. Moreover, tests in cars showed that there was an audible improvement in v.h.f. reception of the compressed but unexpanded signals. It is thought that this was because the compressed signal increased the volume of quieter passages which were then more easily heard above the noise background.

Interface to be made in bulk

Swamped by the orders for the IEEE488 Procyon interface for the Acorn/BBC microcomputer, Cambridge Systems Technology have been forced to award an assembly contract for the unit to an outside manufacturer. The contract has gone to CVO Electronics of Stevenage.

The device has found a considerable number of customers in professional, scientific and educational users. A high proportion of scientific test instruments use 488 interfacing especially from such manufacturers as Hewlett Packard, CBM, Philips, and Tektronix, and therefore can be monitored or controlled through a BBC computer fitted with the Procyon unit.

TAT-8 *will* be optical

International agreement between 28 telecommunications authorities has given the go-ahead for TAT-8, which will use hair-thin glass fibres. Two pairs of fibres will be incorporated in the cable. Each pair will operate digitally at 280Mbit/s to give a total capacity of 8000 telephone circuits. This basic capacity can be increased by digital circuit multiplying equipment up to 40 000, although initially only a small proportion of this potential capacity will be used. Monomode transmission will give the cable this high capacity and allow a long spacing, 30 to 55km, between light regenerators, the equivalent of repeaters on wire cables which are needed every 5km.

The American end of the cable will start at Tuckerton, New Jersey and the main part, 5 800km will be provided by AT&T Communications. Near the European continental shelf, a junction box will allow the cable to be split two ways. 520km of cable will be laid by STC to join the junction box to Widemouth Bay, Cornwall, while another 310km will branch off to Penmarche on the Brittany coast of France. The French branch will be the responsibility of a French company, Submarcom.

Cables and satellites share about half each the total capacity of telecommunications across the ocean. At present, including TAT-7, the cable capacity is about 11 200 telephone circuits. TAT-8, expected to come into operation in 1988, will more than double this.

Amongst the facilities at the Daresbury Laboratory of the Science and Engineering Research Council are the world's largest tandem Van der Graaff accelerator and the world's first high energy electron accelerator dedicated to the production and use of synchroton radiation. In experiments to study the details of atomic nuclei, ions are accelerated to energy levels up to 20MeV. Synchrotron radiation is emitted when electron have been accelerated to a peak level of 2GeV and then deflected by the fields of storage ring magnets. It is used in atomic and molecular spectroscopy, X-ray spectroscopy and surface science. Microprocessor monitoring and alarm systems are provided by Sattcontrol of Aldershot.

Home energy monitor

On page 36 of this issue is a project to build a differential temperature integrator to monitor temperature differences in a house. Designed by Bob Everett, a research fellow at the Open University, and engineered by the OU Electronics Common Facility, 100 of them were made and installed in houses in Milton Keynes in the summer of 1981 as part of a series of energy conservation field trials. The Building Research Establishment put the device on its list of equipment suitable for such monitoring.

The device has proved to be useful and reliable and the OU has had a continuous stream of letters from architects and research students who would like to borrow one or have the circuit. But the potential for making them commercially is small: "The design will surely be superseded within a year or so by a suitable c.mos processor," says Bob Everett. The current cost of the components for the integrator excluding the p.c.b. and the box is a little over £100, whereas current competitive commercial systems is mainly restricted to microprocessor systems for ten or single channel ram-based devices at £400. "Although the world is full of well-intentioned people who would like to monitor the energy performance of their houses," says Everett, "there are few who are prepared to fork out that much money or harness the i/o port of their home computers to temperature monitoring for six months solid.

"It would be nice if it were possible to get the integrator as a kit," he commented, "the Open University would have no problems in selling the two double-sided circuit boards required, and the whole thing would have the blessing of the Department of Energy, though it could be of more interest to countries such as Denmark and France where energy conservation research is not quite as unfashionable as it is here."

In brief

Giotto, the space probe which is to intercept Halley's Comet in 1986, has undergone a comprehensive check-out on its electrical and electromagnetic characteristics. The tests, on this European Space Agency project, have been carried out by British Aerospace Dynamics group, Bristol. The circular test chamber is 14m in diameter and 12m high, where the vehicle has been subjected to r.f. tests from 0.1Hz to 18GHz.

The formation of a new computer company and a new computer has been announced. The first product of Compass Computers, of Tetbury, Gloucestershire, will be the Compass 32. This is a multi-user computer which will run CP/M, MS-Dos, or Unix under the DEC operating systems. Each user will have a Z80 or an 8088 processor and 64KBytes of ram. Winchester disc memory will be available. The company is also planning a variety of add-on devices for the DEC range of computers which will include communications boards, mass storage systems, etc.

LETTERS

AMATEUR BAND JAMMING

Under the heading "Moral persuasion" (Communications Commentary, August issue) the claim is made that China has ceased to operate broadcast stations in the 7000 to 7100kHz amateur band. Whilst it may well be true that Chinese broadcast stations in this band are not heard in Europe, it is completely incorrect to say that these stations have quit the so-called amateur-exclusive band at 7000-7100kHz.

As coordinator of the New Zealand Intruder Watch, and as coordinator for the Region 3 IARU Monitoring Service, I daily handle many complaints from amateurs regarding the use of this band by the Chinese broadcasting services – and others! My records for September and October show the following frequencies to be in current usage by the Chinese Service: 7010, 7025, 7030, 7035, 7040, 7045, 7050, 7055 and 7095kHz.

With reference to the 7010kHz frequency it appears that some rearrangement of schedules may have been made but the frequency is still used by China. The People's Liberation Army station on the nominal frequency of 7025kHz, and the regular Radio Beijing station on 7055kHz, hop around between the above noted frequencies depending on the degree of jamming they are being subjected to by the Russians.

The "hopping" from one frequency to another, without warning and often in the middle of an item, brings into question – at least in my mind – the value, if any, of this type of broadcasting.

Resolution 641 of WARC 1979 calls upon stations using this band to vacate it. To date this resolution has been ignored by China – using the "reservations" procedure of the ITU Convention, and simply ignored by Albania with its Radio Tirana on 7065, 7075 & 7090kHz.

Albania at least does have the excuse that it is not a signatory to the ITU Convention, not so China and the USSR, although we "down under" do wish somebody "up there" would show the Albanians how to operate their transmitters without the resultant daily high level 2nd harmonics on 20 metres.

The USSR at times re-broadcasts one of its Mayac (home service) programmes on top of Radio Beijing – grossly over modulated – as a jamming technique, and has the lower sideband of its 7100kHz transmissions in the amateur band. To say nothing of the intense jamming, with 2nd and 3rd harmonics appearing on other amateur bands.

The "footnoting" into the 7000-7050kHz portion of this band by the fixed services of 13 countries plus its unauthorized use by the Russian fixed service, and the broadcast service as noted above, brings into mockery the whole concept of an "exclusive" band for the amateur service.

A recent random check of this band by the WIA Intruder Watch, and later confirmed by the NZART Intruder Watch, showed that between the hours of 1900 to 1925 u.t.c. on the 13th July 1983 there were 11 broadcast stations present in this band plus seven jammers, and that the activities of these stations accounted for 70.7% of the available 100kHz. At this date (28-11-83) the situation has not changed appreciably!

We can only hope that the 1984 WARC for h.f. broadcasters will go some way to alleviate the current situation on this band.

R. E. Knowles, ZL1BAD/ZL61W
Coordinator NZART Intruder Watch
Tuakau
New Zealand

RADIO SOFTWARE

With regard to your picture coverage of our Computer Programme, Datarama, and the subsequent reponse from our colleagues at BBC Radio Leeds claiming that they were the true pioneers of Radiosoftware, I should like to make a few salient points.

Firstly, we are not in the business of claiming firsts: we believe the true originators of Radiosoftware as a broadcasting fact to be The Dutch Hobby Scoop Programme,* which began doing it in 1978.

Secondly the Datarama team, unlike it would seem the BBC Leeds team and others who've followed suit, conducted its own 'experimental data transmissions' under controlled conditions and out of broadcasting hours, i.e. not during programme time. When the first series of Datarama went on air in March 1983, Radiosoftware, at least in our hands had passed beyond the stage of experiment and was a properly researched piece of broadcast material. Within the current series, Radiosoftware forms as natural a part of the programme, as does conversation. There is no more experimentation necessary. It is time to get on with it.

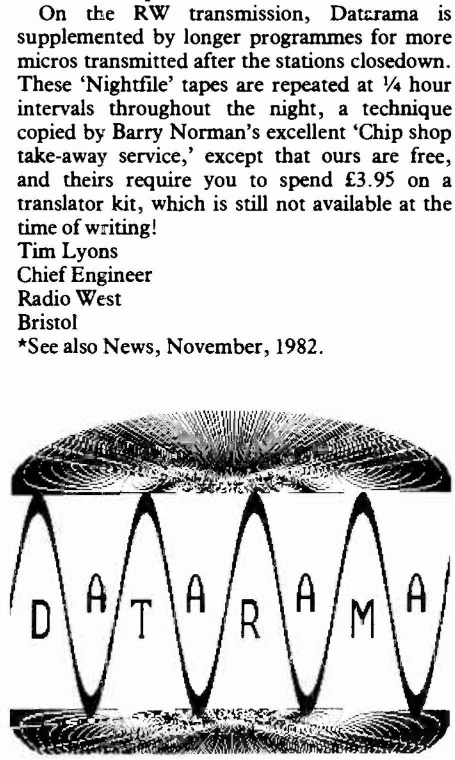
Thirdly, in conjunction with the IBA , we have produced outline specifications which we hope will form the basis of future technical specifications for any station wishing to broadcast Radiosoftware. These should be available from local IBA officers in all regions.

Datarama is broadcast weekly on Radio West (in the Avon area), and on Wiltshire Radio (Swindon/W. Wilts) and very shortly on CBC Radio (Cardiff). Since its inception, each programme has included Radiosoftware for at least one microcomputer.

On the RW transmission, Datarama is supplemented by longer programmes for more micros transmitted after the stations closedown. These 'Nightfile' tapes are repeated at ¼ hour intervals throughout the night, a technique copied by Barry Norman's excellent 'Chip shop take-away service,' except that ours are free, and theirs require you to spend £3.95 on a translator kit, which is still not available at the time of writing!

Tim Lyons
Chief Engineer
Radio West
Bristol

*See also News, November, 1982.



ENERGY SAVING

I read Mr MacHarg's article and the subsequent correspondence with interest. Several of my colleagues have an interest in optimizing heating systems, and many lunch-time conversations have taken place, during which useful exchanges of ideas occur. Many different ideas are aired; individuals rate different aspects of a system with varied importance. To my mind it is necessary to get back to basics if we are to make decisions which enable us to optimize a system.

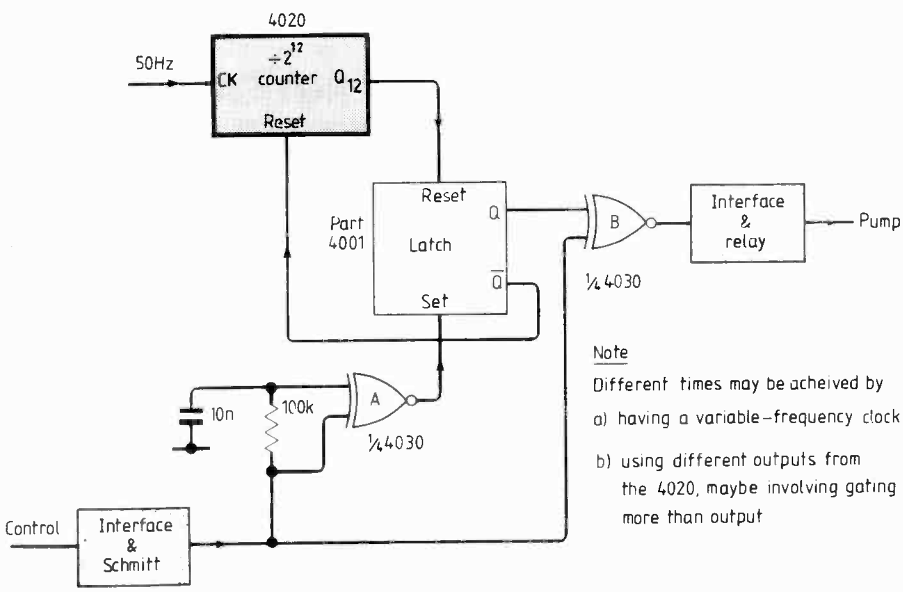
The object of a heating system is to burn fuel, thereby warming the house. A stable situation exists when heat input equals heat loss. Therefore the better insulated the property, the less energy we have to put in. This may seem very obvious, but is the first step.

Assuming, for the moment, that boiler efficiency is not affected by flame height, then in theory we could adjust the flame height to provide water at a constant temperature, so that the heat lost by the radiators was equal to the heat lost by the house to the outside world.

The usual type of system does not work this way; we rely on a variable burner duty cycle followed by the integrating effect of large thermal masses to iron out the discontinuity. Having said this we next need to define the areas of waste. There is the basic loss of heat from the building, and there is heat loss up the boiler flue. If the boiler was 100% efficient, all the heat would go into the house. Because of the effects of integration, the temperature will rise before a control thermostat operates, but continue to do so afterwards. It is recognised that the thermal inertia is normally too great to allow a simple thermostat to be used, which is why the "accelerator" heating resistor is fitted into the majority of room thermostats.

Taken in isolation, this arrangement, if operating in a constant temperature, is a duty-cycle control device. By allowing a passage of air through this device the duty cycle is modified by ambient temperature as well as by manipulation of the control. Provided that the rate of heating by the accelerator resistor can be adjusted to suit the thermal inertia of the system, a simple means of optimization is available. Unfortunately, most proprietary items do not have such a facility, so a basically sound principle is nearly always subject to maladjustment in a particular installation.

I believe that it is undesirable to have a boiler cycle continuously, particularly when only the pump is controlled by a thermostat. Unfortunately Mr Ball, whose system employs a room thermostat to control both pump and boiler simultaneously, seems to have received short shrift from Mr MacHarg in the correspondence column. This is probably because Mr Ball has not gone into as much analysis of his simple system as is desirable. I have used a similar, but not identical, system for several years. The system operates successfully because not only does it avoid excessive cycling of the boiler, but also keeps the boiler temperature as low as possible consistent with providing adequate heat, as advocated by Mr Hargis. The less required, the shorter the duty cycle becomes (controlled by the thermostat with accelerator resistor) and consequently, the lower is the maximum water temperature attained throughout the cycle. Therefore the heating effect on the surrounding air is a function of both time and rising water temperature – a point which did not emerge in Mr Ball's letter.



The colder the weather, the greater the heat loss from the house, the longer will be the thermostat (and therefore, boiler) on duty cycle and the hotter the radiators become. To my mind, this is exactly what a sensible system should do. It is only under the most adverse conditions that I have known the boiler thermostat (set to 77°C) to operate. The system works well because I have taken care to "tune" the accelerator resistor as mentioned earlier, using a modified commercial thermostat, placed in a carefully chosen position.

Economies *can* be made by modifying simple systems as described. First, I have delayed the pump start and stop relative to the controlled boiler cycle. The boiler has a cast-iron heat exchanger, and a pump delay of about 82 seconds enables the boiler temperature to rise quickly, but without overshoot, after ignition and also enables a substantial amount of heat to be extracted from the iron after the flame is extinguished.

Another economy is made by designing the domestic hot water heating facility to latch up, so it is not defeated by the clock. This enables the water heating cycle to be completed before the boiler is turned off. The facility is particularly helpful in summer, when it prevents the need for re-ignition of the boiler at the start of the following day.

I should also point out that I heat the whole house consistently; radiator valves have been adjusted and are never normally touched. Furthermore I use no supplementary heating; this would upset the balance of the system. If supplementary heating is to be used, the subject of control becomes more complex and thermostatic radiator valves are likely to be needed. This would result in changes of heat output in other areas if the duty-cycle system I have described is used.

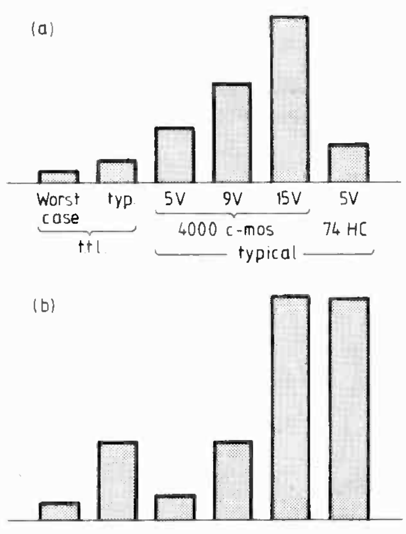
Finally, I believe long electrical time constants to be a potential problem because of the large values of resistance and capacitance needed. The diagram shows the bare bones of the 82 second delay referred to earlier. A ÷ 2^{12} counter counts 50Hz mains pulses, but is normally held in the reset condition. The "go" control signal (which has also fired the boiler) causes the output from the interface and Schmitt to go high. A high or low excursion on this line results in a pulse emerging from 4030A, which sets the latch. Output goes high, maintaining a low at the output of B. Output Q goes low and removes the reset from the counter, which then counts 2^{12} = 4096 pulses at 50 per second; this takes 81.92 seconds. The output from Q12? goes high and resets the latch; B now has only one high on its inputs – its output goes high and the pump starts. Conversely, when the control input goes low, the counter is started again which sets Q high. As the other input to 4030B is now low, the pump keeps running until the circuit times out.

Keith Cummins
Southampton
Hampshire

LOGIC NOISE MARGINS

It is standard practice to talk of noise margins in terms of noise voltage. The meaning of this is, to say the least, vague, although it has its uses. For instance t.t.l. is quoted as having a noise margin of 0.9 volts, so it is obviously asking for trouble to use discrete diodes to expand the fan in, a reasonably common malpractice, because it reduces the margin to 0.2 volts.

The c-mos 4000 series is quoted as having a noise margin of 45% of the supply voltage – clearly superior as compared with t.t.l. – but this is only half the story. When signal lines are short as is desirable and likely within a piece of equipment, they take their impedence from the driving output according to the slogan "Low Z rules, OK?"



Short lines driven by t.t.l. are at an impedance of about 100 and the noise *power* necessary to overcome the noise voltage margin is $V^2/R = 0.9^2/100$ or about 8mW. The output resistance of 4000 series c-mos is 1.5kΩ to 2kΩ, so with a supply voltage of 5V the power needed to raise (or lower) the potential on the line by 45% is $2.25^2/2000 \approx 2.5$mW. The noise power margin of t.t.l. is over three times as great at this supply voltage, see diagram.

It is worth noting that 54HC and 74HC logic has a much lower output resistance and a noise voltage margin of about 1.5 volts. Taking output resistance as 100Ω – it is in that parish though I have not seen it quoted – this requires a noise power of $1.5^2/100$ = 22.5mW to overcome the noise voltage margin.

Using the same noise power concept, 4000 series c-mos requires a supply voltage of 9 volts to match the t.t.l. margin of 8mW, and only at a supply voltage of 15V does it achieve a noise power margin of 23mW, the equal in this respect of 74HCXX.

So far I have been considering short lines which take their impedance from the driving output. Long lines are a different matter. Correct termination is vital to establish the designed (low) impedance of the line and therefore confirm the designed noise power margin of the receiver device. It also performs its well known task of minimising reflection and radiation, two most potent causes of noise and crosstalk. Once again we are specifying and maximizing the noise power margin.

Our evalution is not yet quite complete. An additional factor to be taken into account is the frequency response of the logic. 4000 c-mos just does not have time to propagate a noise spike of width 10ns, so its tardiness has considerable advantage if the system can be run at a frequency suitable to this logic family. The noise is effectively band limited and this is where 4000 c-mos really scores in noise immunity. The old 4049 buffer was particularly good in this respect, having a frequency limit of about 180kHz. Updated versions have a propagation delay of 60ns. Modern fast logic has a much greater bandwidth and is therefore vulnerable also to high frequency noise. So we are concerned with a balance of two factors; the noise power margin and the noise power bandwidth, both here defined by the characteristics of the logic. It is desirable to arrive at a figure of merit for noise immunity, taking both factors into account and expressed in terms which are, ideally, self-explanatory. I would welcome comments on the subject.

Tim Hartigan
Ballsbridge
Dublin

FORTH PROCESSORS

In his article and letter in November Wireless World Mr Woodroffe is less scrupulous than the Intel benchmark report that he obliquely criticises. This report, which compares the 68B09 with the 8088, can only really be faulted on the grounds that no allowance is made for code frequency in averaging out relative execution times and code sizes. It indicates, quite correctly, that re-entrancy is handled faster by the 6809.

By contrast, the table presented in his article by Mr Woodroffe can be faulted on several grounds. First, it omits the Texas 9995 processor, which competes in the same market sector as the 6809 (64k address, nonsegmented). I wonder why? The 9995 has a non-multiplexed bus and fast 16-bit parallel onboard ram; for 450ns access time its bus cycle is 670ns, versus

800 for the 8088 and 1000 for the 6809. It also makes use of prefetch.

Second, and more serious, some funny arithmetic occurs before the bottom line. The relative speeds for the 6809 and the 8088 are given as 4.11 and 3.19 respectively although the 8088 actually executes its code faster. This is derived from this "speed for 450 nanosecond access memory." I have news for Mr Woodroffe; in the real world it is not desirable to run a processor with a bus cycle allowing 695ns access at a speed which gives 450ns access. It tends not to work. In the real world the 8088 is faster by nearly 30%. Of course it would be perfectly practical to use a faster 6809 – the 68A or B 09 options – but then he should say so. If he is not actually using these faster devices in his own computer, he should tell us what access time his hardware actually requires, and recalculate his last line on that basis.

The third objection, however, is that in reality the 8088 programmer is unlikely to use the "JMP NEXT", as this requires that NEXT be within 127 bytes, necessitating numerous NEXTs scattered throughout the code rather like Underground stations (I nearly wrote public conveniences) in London. He or she will accept the 9-byte inline code (typical 6809 code is twice as long as typical 8088 code), losing 15 clocks and giving 8.6 microseconds. This execution time is slightly less than for the 6809 running at 1.5MHz with a comparable memory access time. The point, surely, is that the 8088 is the more expensive device, and the time and effort required to use features like segmentation mean that they are likely to be wasted in a small domestic microcomputer. There is no point in buying unused silicon.

The comments about code usage I agree with, except as regards the very arbitrary 80/20 ratio, seen quoted elsewhere as 75/25, ⅓/⅔ – it is true that in most high level languages most of the time is spent pushing garbage to keep the system happy. This is why high level languages waste silicon and time while keeping programmers employed. However, the picture can change dramatically as soon as real arithmetic starts to happen, especially when trigonometry is involved. The makers of home computers assume, generally correctly, that most users will never stretch the resources of the mathematics. I would have thought, however, that electronic engineers differed in this respect; in the days when I was limited to a programmable calculator I remember calculations that exercised the poor little thing for hours on end, leading me to wish a bleeper had been fitted to announce the result. For this reason I would have thought that, again, the TMS9995 would have been a strong contender for a CPU because of its ability to handle 16 bit signed and unsigned multiplication and division in the instruction set.

Perhaps I should add that I am in no way connected with any semiconductor manufacturer.

Martin D. Bacon
Taunton
Somerset

WORLD TIMING

I am pleased that Dr J. D. H. Pilkington, head of the time department at Royal Greenwich Observatory, provided better background to the subject of "World Timing" than we were authorized to in our article on the subject; *WW* October 1983.

In our laboratory we make use of the special transmissions which disseminate UTC and CAT (co-ordinated atomic time) for calibrating and monitoring frequency sources and transmissions. Therefore, one of the purposes of our article was to draw attention to the less tightly co-ordinated h.f. broadcast (and m.f.) frequencies by broadcasters since as we said, "errors of frequency can in fact be more of a nuisance than an error of time".

Indeed, in an European Broadcasting Union Report (SBP66) entitled "A study of technical questions of interest to the WARC 1979", it was pointed out (paragraph 1.4) that the then frequency tolerance of l.f./m.f. and h.f. transmitters was unnecessarily generous, and that the stability of all carriers should be within 1Hz of the nominal assigned frequency by 31 December, 1984. It would appear from Dr Pilkington's letter that some broadcast authorities could have a busy year.

R. C. V. Macario
Department of Electrical and Electronic Engineering
University College of Swansea

IMPLANT FOR BLADDER CONTROL

You may be interested to know that since the article on the electronic implant for bladder control was published (January issue) the device is continuing to be used to help paraplegic patients. The MRC workers who developed the implant tell me that 36 patients have now been fitted with this neurological prosthesis.

May I please correct a couple of small errors which came into the article during your preparation for publication? First, the article should have stated that the patient's hand-held transmitter (Fig. 8) was developed by T. A. Perkins of the MRC Neurological Prostheses Unit. Secondly, reference 3 should be to *Proc. IEE*, and not *IEEE*.

Tom Ivall
Staines
Middlesex

BEHIND THE MICRO

I've just read your articles 'Behind the micro' with interest, since I am thinking of expanding my interests in that direction.

Interesting . . . Well, yes, but I feel the writers haven't ever been in an actual shop to make enquiries!

The problem is, alas, compatibility. It's all very well to say that peripherals are available, but if I plug a device made by X into Y's computer, will it work – or will I get a cloud of smoke?

Don't tell me to 'consult the literature'!

So far as I can see, it is deliberately written in such a way as to discourage any such experiments!

I know what I want . . . but to do it I need to join together gadgets from SIX different makers! But can I, I just don't know!

Ronald G. Young
Peacehaven
East Sussex

DEAD WATCH TIMERS

To cope with just the sort of situation referred to by A. Roscoe under "Thunderstruck" (*Letters* February) we routinely include a "dead watch timer" in most of our new products. We also recommend our clients to use a power supply that outputs an advance warning of impending failure. These two hardware features when well integrated into the software enable mains-related problems to be dramatically reduced, provided a third and equally vital facility is incorporated: an area of battery-backed ram to hold critical variables.

The basic idea of the dead watch timer is to have the software periodically trigger a, retriggerable monostable. As long as the software does this the monostable is prevented from reaching time out. If this happens a maskable interrupt is forced into the microprocessor. This causes activation of a special restart routine.

These facilities are essential when the system is required to "remember" long-term accumulating variables e.g. p-i-d controllers.

Steven Harris
Lodge Associates
Portslade
East Sussex

INDUCTANCE MEASUREMENT

I don't know whether the subtitle 'Simple practical method, hard to find in the textbooks' is due to the author, D. R. Fownes, or to you, but while I agree with the first half of it I think I have reason to be surprised by the second. From the sales and library loans, I venture to claim that the obvious textbook in which to look for simple practical methods of measuring inductance is my 'Radio & Electronic Laboratory Handbook', and Mr Fownes's method has been described in every edition of it from the first in 1938 (issued then by WW) to the 9th dated 1980. It was entitled 'The Three-voltages Method'.

I am obliged to Mr Fownes for deriving a simple formula for calculating the inductance. On the other hand most iron-cored inductors need to be measured with known variable amounts of d.c. flowing through them, and my measuring circuit has always shown this. Perhaps nowadays my stress on the voltmeter taking negligible current is no longer needed.

By the way, my letter in your October issue questioning the appropriateness of the term 'current dumping' having evoked no defence of it, I infer that there is no defence, and it is yet another misuse of a word in electronic terminology (e.g. 'slew rate', 'mixer' and 'attenuation distortion').

M. G. Scroggie
Bexhill
East Sussex

THE NEW BUREAUCRACY

Engineers will be regretful, but not surprised, that only one programmer in the country failed the von Neumann loyalty test. (*Wireless World* Letters, August and October 1983.)

However, D. W. Scott then writes,

> "He – and MAPCON – still have not realised that machine architecture need have little to do with its technological implementation."

This statement beautifully illustrates the blocking position taken by programmers, preventing advances in the art. If, for instance, we can simulate a cam in a ram, then why should we ever want to build a cam? (If we can get there by horse and carriage, then why do we need a motor car?)

Ivor Catt
St. Albans
Hertfordshire

Apple Macintosh

The latest Apple computer is to be launched in the UK in April. Known as the Macintosh, it offers similar facilities to the Apple Lisa; it is menu driven from a display resembling a desk top where the facilities that a business executive may need can be pointed to with a cursor and selected for use by the push of a button. So notes may be scribbled on a pad, memos, expenses sheets, calculator, graph pad etc. are all available on the screen. They are selected by moving the cursor with a 'mouse', a small rolling box whose movements across the desk top are reproduced on the notional desk-top on the screen.

Macintosh uses a 16/32-bit Motorola MC68000 processor and includes 64K of rom and 128K of ram. A 512K version is due later in the year. The operating system is both rom and disc based and the computer includes a 3.5in disc drive. Each disk has a capacity of up to 400Kbytes. There is a port for an optional additional disc drive, two RS232C/422 serial ports for attaching printers or for communicating through a modem. Sound facilities give polyphonic sound over more than 12 octaves and are capable of reproducing human speech through the built-in speaker. Apple is developing a point-to-point interconnection bus and the interface is already built in to Macintosh. The integral 9in c.r.t display offers a bit-mapped 512 by 342 pixel resolution. There is a clock/calendar chip. Although not intended as a portable computer, it does have a carrying handle and at 7.7kg it weighs less than many so-called portables.

The price of Macintosh has not yet been fixed, though in the US it is likely to be about $3,000.

Apple have produced two software packages for Macintosh; MacWrite word processing and MacDraw graphics. Lotus have developed a Macintosh version of 1-2-3, a spread-sheet and filing system and a number of software houses are preparing programs. Apple Computer (UK) Ltd, Eastman Way, Hemel Hempstead, Herts HP2 7HQ.

WW 303

WW 303

Oric Atmos

The Oric 1 computer at the cheap home computer end of the market was never very successful. The makers made a mistake in providing prototypes rather than complete machines to the computer press who were very unkind to it. A cynical definition of the Oric 1 was "prototype for the Oric 2". The faults were compounded by the non-appearance of many promised additions and peripherals; a disc drive, a communications modem with a teletextdecoder, a rom cartridge with "super extended Basic as powerful as the BBC".

The principal difference between the Oric 1 and the Atmos is the new version of the rom operating system which has, according to Oric, not only ironed out the Oric bugs but also some others inherent in the Microsoft software. A number of additional commands have been added; especially to the cassette routines so that programs can now be verified after they have been saved. Arrays can now be stored and recalled without recourse to machine code.

The Basic is adequate and most of the commands that you would expect to find are there. We were surprised to note that there has been no attempt to improve on the abysmal line editing facility. In this respect many other computers also claiming to use 'extended Microsoft Basic' are much better (for example the Dragon and the Tandy Color Computer). Serial attributes, to change the colour or style of characters on the screen, take some getting used to but have the advantage of taking up very little memory space.

Also provided is a cassette which has a graphics display program showing how good the display facilities are. Included is an animation of a flying duck which is very impressive especially as it is written in Basic. The program may be broken in to and listed to show how a particular effect is achieved. Also on the tape is a machine-code facility to overcome some of the frustrations of program loading mentioned above; it enables the user to override the error-checking routine. This overcomes the most common problems caused by errors inthe 'header' and leading portion of the tape, which have no relevance to the actual program.

The specification for the Atmos includes a 6502A processor running at 1MHz, 48K ram, 16K rom, 57 keys and a concealed reset button for a 'warm' reset; i.e. one that does not lose any data. The screen format offers eight foreground and the same eight background colours for a text screen of 40 columns of 28 lines and a character set very similar to teletext (and BBC Mode 7) with standard ascii characters, double height and flashing characters and up to 80 user-defineable characters. High-resolution graphics offer 240 by 200 pixels in eight colours and there are line, circle and point facilities. Areas of the screen may be "filled" with a chosen colour. Three channels of sound over eight octaves with additional white noise and envelope control are output through a powerful internal speaker or may be output to a hi-fi system. There is an expansion port for the addition of some peripheral equipment, such as disc drives or a-to-d converters, a Centronics printer port, a modulated tv output as well as an RGB output for a colour monitor.

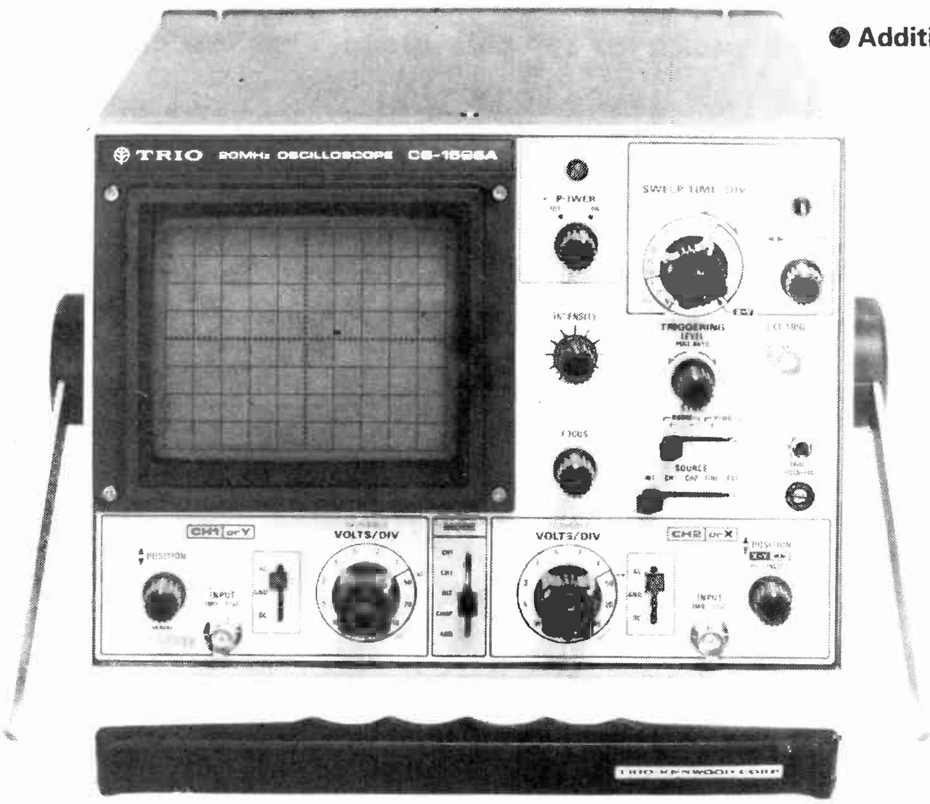
The Oric printer/plotter using four-coloured ball point pens has been re-styled to match the Atmos colour scheme and the long-promised 3in disc drive with 160Kbytes per side and a transfer rate of 250Kbit/s has been announcedbut at the time of writing we have not been able to get hold of one.

Those who already have an Oric 1 need not despair or throw it in the bin. Oric are looking "very seriously" at the possibility of providing an upgrade kit to turn an Oric 1 into an Atmos. This could cost about £50. 160 000 Oric 1s were sold so this could be a major operation. Oric Products International Ltd, Coworth Park, London Road, Ascot, Berks SL5 7SE.

WW 304

20MHz+5mV/Division

TRIO



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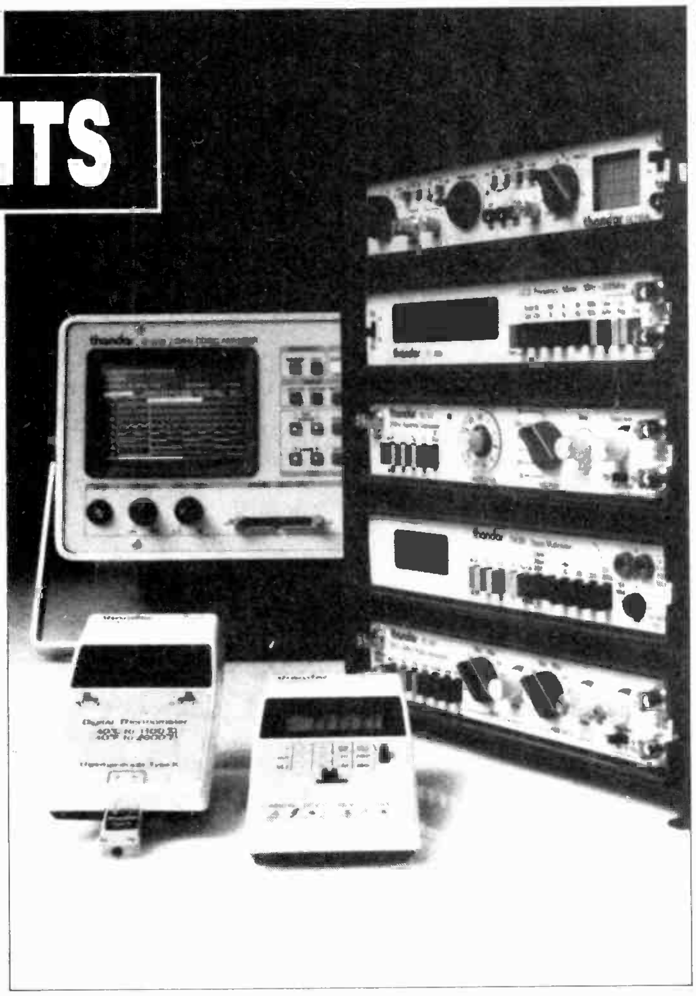

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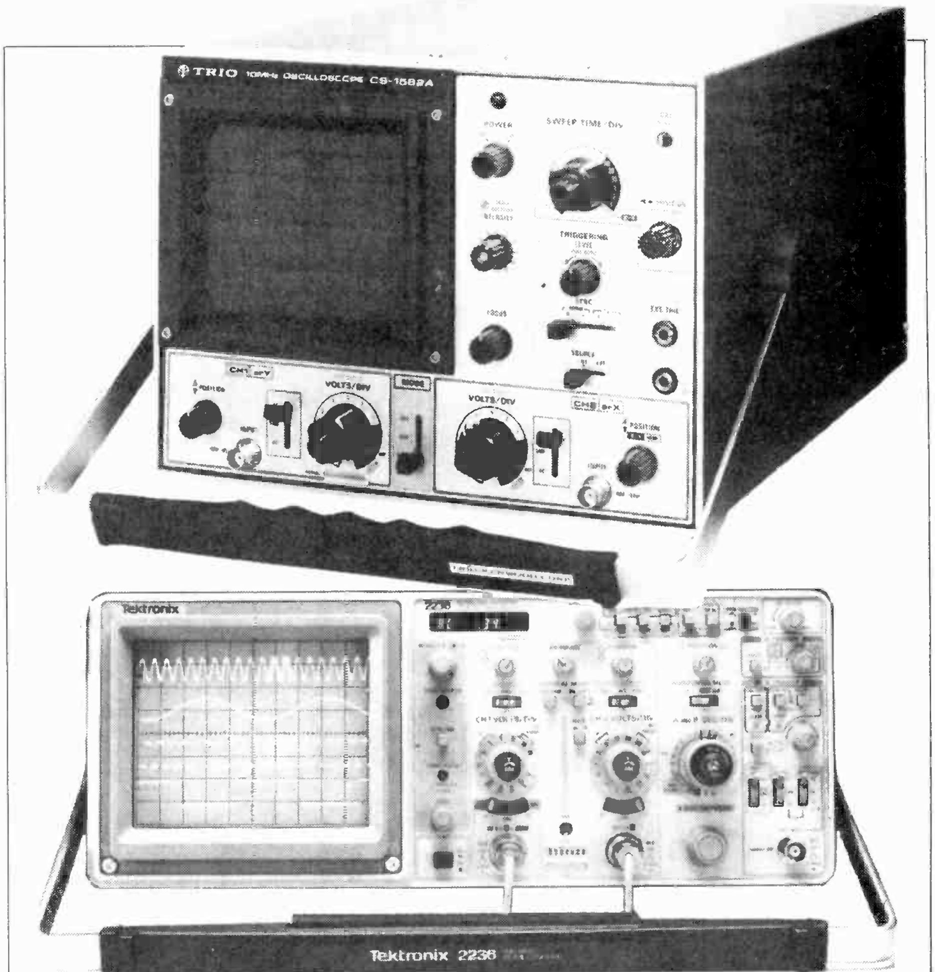
Non-storage oscilloscopes up to 100MHz

Instruments currently available on the UK market

In the time since the last oscilloscope review appeared in *Wireless World* – a survey of portable types – it has become unnecessary to classify them in such a way, since the majority are now easily portable. Indeed, it is becoming increasingly difficult to classify oscilloscopes in any way at all: some of the functions of the more modern test instruments are those of an oscilloscope, but in some cases form only a small part of the instrument's repertoire. Logic analysis, spectrum analysis, waveform recording and even computing are now taken in hand by the latest, high-end equipment and the distinctions become blurred.

Not many instruments now exist of the type intended solely for displaying a trace. Very extensive measuring facilities in both axes are offered and, in the case of digital oscilloscopes, these can be made to an extremely high level of accuracy, sometimes with the result displayed on the screen.

To enable readers who may be out of touch with modern oscilloscope design and the characteristics and facilities provided, the terms used in manufacturers' data sheets need explanation. The first part of this survey is therefore devoted to a glossary of terms.



10MHz Trio CS1562A (top). Tektronix 2236 100MHz oscilloscope, with digital display and multimeter function.

Signal path

Bandwidth is the passband of the Y amplifier or amplifiers, measured at the -3dB points. Normally, oscilloscope amplifiers are directly coupled, so that the amplitude response extends to zero frequency: a capacitor can usually be switched in to allow small events on a large d.c. level to appear on the screen, the bandwidth then being limited to around 10Hz rather than zero.

In some cases, it is possible to offset the d.c. by means of a panel control to achieve the same effect without loss of low frequencies. The bandwidth of the Y amplifier is the characteristic used to indicate the kind of oscilloscope under consideration.

Rise-time is the response time of the Y amplifier to an infinitely steep step. If the amplifier's frequency/amplitude response has a smooth roll-off at high frequencies, as they all do, then the rise time in nanoseconds can be found from the bandwidth in megahertz by the expression $t_r=350/f$. A bandwidth of 100MHz will give rise to an amplifier rise time of 3.5ns. Since, however, voltage steps are not infinitely steep, the displayed rise time (taken from 10% to 90% of the excursion) will always be longer than this, and is equal to $\sqrt{t_{ra}+t_{rs}}$, where t_{ra} is the amplifier rise time and t_{rs} is that of the step itself.

Deflection factor is often termed Y sensitivity and is the amount of vertical deflection of the spot on the screen for a given input voltage to the amplifier. It is measured in millivolts per division of the graticule or per centimetre. A common figure is 5mV/div and may not be constant over the whole bandwidth of the amplifier: sometimes an increased sensitivity can be obtained by sacrificing bandwidth and rise time. The sensitivity is controlled at the front panel by a switch, working in the 1, 2, 5 sequence, and often there is a two-position auxiliary switch to increase the sensitivity by a factor of 10. When a continuously variable gain control is fitted, the amplifier is not calibrated unless the control is at the end of its travel.

Display modes describe the way in which the input signals are presented on screen, in dual-trace oscilloscopes. A front-panel control selects for display channel 1, channel 2 (one of which can often be inverted), ch1 and ch2 alternately, ch1 and ch2 effectively simultaneously by chopping from one to the other at high speed so that

Model	Y bandwidth (MHz)	Y sensitivity (mV/div)	Channels	Max sweep rate (ns/div)	Dual sweep sweep delay	Y delay line	TV sync	Screen	Acceleration potential	Price		Reply card number
BK/Dynascan												WW501
1590	100	5 (x5)	4	20 (x10)	●	●	●	8x10cm	16kV	1780	V-mode trigger	
1570	80	5 (x5)	4	50 (x10)	●	●	●	8x10cm	12kV	1285	V-mode trigger	
1560	60	1 (CH3-0.1)	3	500 (x10)	●	●	●	8x10cm	16kV	1139	Trig. holdoff. Auto focus. XY operation. V-mode	
1540	40	1	2	100 (x10)	●	●	●	8x10cm	12kV	941	XY. V-mode	
1522	20	1	2	200			●	8x10cm	6kV	670	XY. V-mode	
1466A	10	1	1	500 (x10)			●	8x10cm	2kV	380	XY	
1476A	10	1	2	500 (x10)			●	8x10cm	2kV	460	Dual-trace version of 1466A	
1535A	35	2	2	100 (x5)		●	●	8x10cm	6kV	745	Variable trigger hold off. Differential	
1479B	30	5	2	200 (x5)		●	●	8x10cm	6kV	700	XY. R.f. detector triggering	
1477	15	10	2	500 (x5)			●	8x10cm	2kV	453	XY	
1405	5	10	1	1000 aprx.						188	Free-running time base, synchronized	
1420	15	10	2	1000 (x10)			●	4x5cm	1kV	650	Mains/battery	
1435	15	2	2	500 (x5)			●	4.8x6cm	1.5kV	677		
Crotech												WW502
3337	30	5	2	200 (x5)		●		8x10cm	10kV	405	XY	
3132	20	2	2	500 (x5)			●	8x10cm		283	XY. Tester for passive and active components	
3034	15	5	2	500 (x2.5)			●	5.3x6.6cm	2kV	370	Battery. XY. Battery saver	
3033	15	5	1	500 (x2.5)				5.3x6.6cm	1kV	287	Battery saver	
3030	15	5	1	500 (x2.5)				5.3x6.6cm	1kV	154	Component tester	
3035	10	5	1	500 (x2.5)				8x10cm	2kV	174	Component tester	
Datacheck												WW518
1200B	2.5	50	1	2000 (x10)				5x4.2cm	1.8kV	4223	Modular. Up to 7 units plugged into rack. Dual, selectable inputs	
1200B(S)	2.5	50	1	20,000 (x10)				5x4.2cm	1.8kV	4545		
Farnell												WW503
DT12-5	12	5	2	500 (x5)			●	8x10cm	2kV	245	XY	
DTV 12-14	12	5	2	500 (x5)			●	8x10cm	2kV	265	More flexible Y display options. Fine X and Y controls	
DTC-12	12	5	2	500 (x5)			●	8x10cm	2kV	359	Component tester	
DTS-12	12	5	2	500 (x5)				8x10cm	2kV	795	Digital storage version of DT12-5. Max. event speed 100kHz. Max. sample rate 0.5MHz.	
Gould												WW504
OS300	20	2	2	500 (x10)			●	8x10cm		325		
OS8100	100	2	2	50	●	●		8x10cm	16kV	8400	Micro-controlled. Menu display. Auto calculations	
Hameg												WW505
HM103	10	5 (x2.5)	1	500 (x2.5)			●	6x7cm	1.8kV	158	Component tester	
HM203	20	5 (x2.5)	2	500 (x12.5)			●	8x10cm	2kV	264	Component Tester	
HM204	20	5 (x2.5)	2	500 (x2.5)			●	8x10cm	2kV	365	Trig. delay	
HM605	60	5 (x5)	2	50 (x10)		●	●	8x10cm	14kV	487	Trig. Delay. Trig. hold off	
HM705	70	5 (x2.5)	2	50 (x10)		●	●	8x10cm	14kV	588	Trig. delay	
Hewlett-Packard												WW521
1980	100	2	2	5	●	●		10x12cm	22kV	8516	XY Trig-view. Trig delay. Auto-ranging trig-level, deflection factor and sweep speed	
Hitachi												WW506
V-212	20	5(x5)	2	200 (x10)			●	8x10cm	2kV	295	XY. V-mode	
V-222	20	5 (x5)	2	200 (x10)			●	8x10cm	2kV	340	D.c. offset for small signal viewing in presence of d.c. Avoids a.c. coupling. V-mode	
V-422	40	5 (x5)	2	200 (x10)		●	●	8x10cm	12kV	510		
V-203F	20	5 (x5)	2	200 (x10)			●	7.5x9.5cm	2kV	355	Trig. delay	
V-353F	35	5 (x5)	2	200 (x10)		●	●	7.5x9.5cm	5.2kV	495	Trig delay	
V-1050F	100	5 (x10)	4	20 (x10)	●	●	●	8x10cm	20kV	1200		
V-650F	50	5 (x5)	3	50 (x10)	●	●	●	8x10cm	10kV	750	A-trigger view on third channel	
V-509	50	5 (x5)	2	100 (x10)		●	●	5x6.3cm	12kV	995	A.c.-d.c. Trig. delay	
V-209	20	5 (x5)	2	500 (x5)			●	5x6.3cm	1.5kV	525	A.c.-d.c.	
Iwatsu												WW519
SS5702	20	5(x5)	2	100 (x5)			●	8x10cm	2kV	290	XY. Ac/dc	
SS3510	50	2 (x5)	2	100 (x10)	●	●	●	5x6.4cm	12kV	1250	Batt/mains, 8.25x4x11.875in. 8.6lb	
SS5710	100	1	4	20 (x10)	●	●	●	8x10cm	20kV	745		
SS5711	60	1	4	50 (x10)	●	●	●	8x10cm	15kV	1150		
Kikusui												WW511
COS6100	100	5 (x5)	5	20 (x10)	●	●	●	8x10cm	20kV	1145	XY. Displays CH1, CH2, CH3, A trig, B trig and add simultaneously. Trig. hold off	
COS3010	15	5 (x5)	2	500 (x5)			●	7.6x6.4cm	1.5kV	395	Mains/battery. Trig. hold off. XY	
COS5060	60	5 (x5)	3	50 (x10)	●	●	●	6in rect.	12kV	735	8 traces. XY	
COS5041	40	5 (x5)	2	200 (x10)	●	●	●	6in rect.	12kV	535		
COS5040	40	5 (x5)	2	200 (x10)		●	●	6 in rect	12kV	445	XY. Trig. hold off	
COS5021	20	5 (x5)	2	200 (x10)	●		●	6in rect	2kV	395	Trig. hold off. XY	
COS5020	20	5 (x5)	2	200 (x10)			●	6in rect	2kV	280	XY	
Leader												WW507
LBO514A	15	5 (x5)	2	500 (x5)				8x10cm	1.8kV	323		
LBO522	20	5 (x10)	2	200 (x5)			●	8x10cm	2	349	Trig. hold off	
LBO523	35	5 (x10)	2	200 (x10)		●	●	8x10cm	7kV	501	XY	
LBO524	35	5 (x10)	2	200 (x10)	●	●	●	8x10cm	7kV	615	XY	
Non-Linear												WW520
MS215	15	10	2	100				2.5x3.2cm	700V	445	Batt/mains (110V a.c.) Measures 2.9x6.4x8in.	
MS230	30	10	2	50				2.5x3.2cm	700V	540	Batt/mains (110V a.c.)	
Philips												WW512
PM3262	100	2	3	50 (x10)	●	●		8x10cm	17kV	1695	Trig. hold off. Trig. view	
PM3267	100	2	3	50 (x10)	●	●	●	8x10cm	10kV	1250		
PM3264	100	2	4	50 (x10)	●	●		8x10cm	17kV	3550	Trig. view on fifth channel	
PM3263	100	2	2	50 (x10)	●	●		8x10cm	17kV	3030	Trig. view. Dual delay for time interval measurement	
PM3254	75	2	1	50 (x10)	●	●		8x10cm	10kV	1145	Trig. view on third channel	
PM3256			2							1245	As3254 with two channels	
PM3215	50	2	2	100 (x10)		●	●	8x10cm	10kV	695	XY. Trig. hold off	
PM3217	50	2	2	100 (x10)	●	●	●	8x10cm	10kV	850	As 3215 with delayed time base	
PM3233	10	2	2	200 (x5)		●	●	8x10cm	10kV	960	Dual beam	
PM3211	15	2	2	500			●	8x10cm	4kV	660		
PM3207	15	5	2	500 (x5)			●	8x10cm	2kV	325	X and Y sensitivity equal	

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Model	Y bandwidth (MHz)	Y sensitivity (mV/div)	Channels	Max sweep rate (ns/div)	Dual sweep sweep delay	Y delay line	TV sync	Screen	Acceleration potential	Price		Reply card number
Rohde & Schwarz												WW508
BOP	30	5	2	200 (x10)		●	●	8x10cm	6kV		Displays eight traces, with trig. view	
BOL	100	5	4	20 (x10)	●	●	●	8x10cm	18kV			
Scopex												WW509
14D-10V	10	2	2	1000 (x5)			●	8x10cm		325	XY. Tv line delay. Tv & video servicing	
14D-15	15	5	2	1000 (x10)			●	8x10cm	2kV	285	XY	
Scopextra FC	15	5	2	1000 (x10)			●	8x10cm	2kV	365	As 14D-15 with add-on function generator	
Scopextra PS	15	5	2	1000 (x10)			●	8x10cm	2kV	385	As 14D-15 with add-on dual power supply	
Bridage												
SB121	5	50	1	1000				5x6cm		175		
DB242	5	50	2	1000				5x6cm		195	As SB121 but two channels	
Siemens												WW513
D1004	50	2	2	10	●	●	●	8x10cm	11kV	1150	XY	
				Rest of Siemens range under revision								
Solartron												WW510
5220	100	5	2	50 (x10)	●	●		8x10cm	12kV	1545	Dig. time measurement	
5224	100	5	4	50 (x10)	●	●	●	8x10cm	12kV	1881	As 5220 but four channels	
5222	50	5	2	100 (x10)		●	●	8x10cm	10kV	1279	XY. Trig. delay	
5013	15	5	2	1000 (x5)			●	8x10cm	2kV	477	XY	
5023	15	5	2	1000 (x5)			●	8x10cm	2kV	448	As 5013, with fine gain adj. and A±B	
5024	10	5	4	1000 (x5)			●	8x10cm	2kV	988	A.c./d.c. XY	
5025	25	5	2	200 (x5)		●	●	8x10cm	4kV	778	XY	
5500						●		10x12.5cm	20kV	2633	XY. Mainframe with probe power. R version rack mount	
5522	175	5	2							1208	D.c. offset. 5500 plug-in	
5532	85	2 (x5)	2							895	5500 plug-in	
5523	1	0.02	2							778	Differential amp. for 5500. C.m.r.r. 100dB at 20μV and 100kHz	
5533	85	1	2							1416	Diff. comparator for 5500. C.m.r.r. 86dB at 1mV and 100kHz	
5546				20 (x10)	●					964	Dual time base for 5500	
5539	>1GHz	2 (x2.5)	2	0.02		●				2264	Sampling plug-in for 5500	
Tektronix												WW514
2337	100	5 (x2.5)	2	50 (x10)	●	●		6.4x8cm	18kV	2695	Trig. view. Trig. hold off. XY. D.v.m. Diff. time	
2336	100	5 (x2.5)	2	50 (x10)	●	●		6.4x8cm	18kV	2274	As 2337 without d.v.m.	
2235	100	5 (x2.5)	2	50 (x10)	●	●		6.4x8cm	18kV	2122	As 2336 without diff. time measurement	
2213	60	2	2	50 (x10)		●	●	8x10cm	10kV	880	Trig. hold off. Trig. delay	
2215	60	2	2	50 (x10)	●	●	●	8x10cm	10kV	1063		
335	35	10	2	200 (x10)	●	●		6.4x8cm	12kV	2796		
T422R	15	2	2	200 (x10)		●	●	8x10cm	12kV	765	XY. Rackmount	
308	5	5	2	1000 (x10)				5x6.3cm	2kV	333	D.v.m.	
221	5	5	1	1000 (x10)				3.1x5.2cm	1kV	1826	Mains/battery	
213	1	5	1	2000 (x5)				3.1x5.2cm	1kV	2327	D.v.m. display on screen. Mains/battery	
212	0.5	1	2	5000 (x5)				3.1x5.2cm	1kV	1645	Mains/battery	
7104	1GHz		2	0.2 max		●		6.8x8.5cm	12.5kV	19821	Mainframe. V and I calibrator	
				Y plug-ins from 75 MHz to 1GHz, from 1m V/div.								
				Y plug-ins from 0.2ns/div, delayed sweep, programmable								
5440	50 max		2	10max		●		9x12cm	15kV	2438	Mainframe	
5A38	35	10 (x2.5)	2							596	5440 Y plug-in	
5A48	50	1 (x2.5)	2							879	5440 Y plug-in	
5B40				100 (x10)						614	5440 X plug-in	
5B42				100 (x10)	●					1131	5440 X plug-in	
465	100	5	2	200 (x10)	●	●		8x10cm	18kV	2852	Trig. view	
Thandar												WW515
SC110A	10	10	1	100			●	3.2x2.6cm			D.c. or a.c. adaptor	
Trio												WW516
CS2110	100	5 (x5)	4	20(x10)	●	●	●	8x10cm	20kV	1499	Four channels, eight traces	
CS2070	70	5 (x5)	4	50 (x10)	●	●	●	8x10cm	12kV	949	V.c.r. and video disc work	
CS1577A	35	2	2	100 (x5)		●	●	140mm tube	6kV	499	Trig. hold off. XY	
CS1830	30	5 (x2.5)	2	200 (x5)		●		140mm tube	6kV	583	Trig. delay. Trig. hold off. XY	
CS1010	10	1	1	500 (x10)			●	8x10cm	2kV	269	V-mode	
CS1012	10	1	2	500 (x10)			●	8x10cm	2kV	289	As 1010, but two channels	
CS1020	20	1	1	200 (x10)			●	8x10cm	6kV	339		
CS1022	20	1	2	200 (x10)			●	8x10cm	6kV	359	As 1020, but two channels	
CS1566A	20	5	2	500 (x10)			●	140mm tube	2kV	349	XY	
CS1820	20	5 (x2.5)	2	200 (x5)			●	140mm tube	6kV	442	Trig. hold off. Trig. delay	
CS1720	20	2	2	200 (x5)		●	●	7.6x9.5cm	6kV	1674	Programmable functions	
CS1352	15	2	2	500 (x5)			●	75mm tube	1.5kV	431	Mains/batt. XY	
CS1560A	15	10	2	500 (x5)			●	130mm tube	2kV	325		
CS1562A	10	10	2	1000 (x5)			●	130mm tube	2kV	279		
CS1559A	10	10	1	1000 (x5)			●	130mm tube	2kV	265		
CS1575	5	10	2	500				130mm tube		358	Displays CH1, CH2, Lissajou and 0° phase simultaneously	
Vu-data												WW51
4100	100	5	2	50 (x10)		●		2x2.5cm	6kV	1850		

the chopping is invisible, ch1 minus ch2 and ch1 plus ch2.

The 'alternate' and 'chopped' presentations perform roughly the same function. At low and middle frequencies, chopping between channels occurs many times during the time-base sweep and is generally not phase-related: it cannot, therefore, be seen and the two traces appear simultaneously. At higher frequencies, the chopping may occur only a few times during a sweep and may become visible, so that each trace must then be triggered alternately to give once again an effective simultaneous display of the two signal channels.

Input impedance at the Y inputs is usually 1MΩ with 20-30pF in parallel. In the event that the signal under inspection is from a high-impedance source and would be deformed by this input arrangement, most makers provide as an accessory a probe which, at the expense of a decrease in sensitivity by a factor of 10, gives 10MΩ and 2pF at the probe tip. Even better performance is provided by probes with a field-effect transistor source-follower, which can give 1MΩ and around 1pF even when the input of the oscilloscope is a 50Ω coupling – often found with high-frequency instruments.

Input coupling selects a coupling capacitor when the d.c. component of a signal is too high to allow inspection of small features which need a high sensitivity. It is usually marked AC, DC and GND, the latter earthing the input to provide a 0V reference on the display.

Delay line allows inspection of the leading edge of a transient. Since the signal itself normally triggers the time-base, and since the time-base takes a certain amount of time to fire after the trigger, the leading edge would have occurred before the sweep started, without the delay line.

With the line in the signal path, the signal is delayed by a fraction of a microsecond until the time-base is operative. The delay line does not deform the signal.

Time-base

Modern time-bases are of the triggered variety – they run when triggered by a pulse. The rate at which the spot sweeps across the screen is controlled from a front-panel switch, usually in a 1-2-5 sequence, and by an uncalibrated variable control. The fastest sweep provided must spread the rise-time of the Y amplifier over a useful part of the screen; for example, if the bandwidth is 100MHz, giving a rise time of 3.5ns, the highest sweep speed should be around 2 to 5ns per division or per centimetre. It may be that the fastest sweep on the control is ten times slower than this, at around 50ns per division, in which case there will probably be provision to magnify the sweep amplitude to overscan the screen by a factor of 10, effectively multiplying the sweep speed by 10. The result is roughly the same.

Horizontal modes

In dual-trace instruments, delayed sweeps with a number of display modes are commonplace. In essence, the main (A) sweep traverses the whole area of investigation relatively slowly, small events being identifiable but not easily seen. By means of a delay control, the second (B) sweep is triggered just before the area of interest and, since it is set to run much faster than the A sweep, covers only that part. During this time the A sweep only is displayed, the part covered by the B sweep being brightened up.

When the delay and the duration of the B sweep are adjusted as required, the B sweep is displayed across the whole screen, the aforementioned small event now being magnified horizontally. The front-panel mode selector is labelled A, A intensified by B, B, or words to that effect. On some instruments, the delayed and delaying sweeps can be mixed to display both simultaneously. It might be possible to see the small occurrence in the normal way with sweep magnification, if it were near the trigger pulse, but a large magnification on a small trace would almost certainly result in a jittery display: the delaying method avoids this problem.

Triggering

A variety of triggering modes is usually provided. 'Normal' is the condition when the Y signal signal provides a trigger pulse for the time-base, which does not sweep unless the trigger is present. In the 'automatic' mode, the time-base free runs, providing a base-line on the screen in the absence of a Y signal, and locks to an applied signal: it is somewhat similar to the method used many years ago when free-running time-bases were synchronized with the Y signal. A 'single-sweep' facility is sometimes provided, when the timebase fires once on the next trigger after a front-panel button is pressed. Trigger hold-off is useful when, say, one cycle in a long train is to be viewed. It would normally not be easy to trigger the sweep just before the wanted cycle, since as far as the trigger circuit is concerned, all the cycles are identical. With trigger hold-off, pulses can be inhibited until the part to be investigated is reached, whereupon the next trigger fires the time-base, which can then run at the desired speed.

Since the Y signal itself normally provides the trigger, it is necessary to select the exact point on a waveform at which the trigger pulse is generated. The 'level' control sets this in the vertical direction and the 'slope' determines whether the trigger is taken from a positive or negative-going edge. It is usually possible to use an external trigger, selectable from the front panel. Vertical-mode triggering (V mode) enables two traces of differing frequencies to be viewed alternately – normally, triggering from one would give an unlocked display of the other.

In the table, sensitivity and sweep-speed figures are given without taking into account the multipliers shown in brackets. Prices quoted are exclusiive of v.a.t.

For more complete information, insert the **WW No** on the Reader Service Card facing page ££. WW

Manufacturers

BK/Dynascan. B & K Precision, P.O. Box 27, 39 Whitby Street, Hartlepool, Cleveland TS24 7BR. 0429 75750.

Crotech. Crotech Instruments Ltd, 5 Nimrod Way, Elgar Road, Reading, Berks. RG2 OEB. 0734 866945.

Datacheck. RMR Measurements, 138 Lime Crescent, Cumbernauld G67 3PQ. 02367 28170.

Farnell. Farnell Instruments Ltd, Sandbeck Way, Wetherby, West Yorks. LS22 4DH. 0937 61961.

Gould. Gould Instruments Division, Roebuck Road, Hainault, Essex IG6 3UE. 01-500 1000. Electroplan Ltd, P.O. Box 19, Orchard Road, Royston, Herts ST8 5HH. 0763 45145.

Hameg. Hameg Oscilloscopes Ltd, 74-78 Collingdon Street, Luton, Beds LU1 1RX. 0582 413174. Lawtronics Ltd, 139 High Street, Edenbridge, Kent TN8 5AX. 0732 865191.

Hewett-Packard. H.P. Ltd, Nine Mile Ride, Easthampstead, Wokingham, Berks RG11 3LL. 03446 3100.

Hitachi. Hitachi Denshi (UK) Ltd, 13-14 Garrick Industrial Centre, Garrick Road, Hendon, London NW9 9AP. 01-202 4311.

Reltech Instruments, New Road, St. Ives, Huntingdon, Cambs. PE17 4BG. 0480 63570.

Iwatsu. STC Instrument Services, Edinburgh Way, Harlow, Essex CM20 2DF. 0279 29522.

Kikusui. Telonic Instruments Ltd, 2 Castle Hill Terrace, Maidenhead, Berks SL6 4JP. 0628 73933.

Non-Linear Systems. Lawtronics Ltd, 139 High Street, Edenbridge, Kent TN8 5AX. 0732 865191.

Leader. Thandar Electronics Ltd, London Road, St. Ives, Huntingdon, Cambs PE17 4HJ. 0480 64646. Also Electroplan Ltd, P.O. Box 19, Orchard Road, Royston, Herts. SG8 5HH. 0763 45145.

Philips. Pye Unicam Ltd, York Street, Cambridge, CB1 2PX. 0223 358866. Electronic Brokers Ltd, 61/65 Kings Cross Road, London WC1X 9LN. 01-278 3461.

Rohde und Schwarz. R & S GmbH&Co KG. D-8000 Munchen 80, Mühldorfstrasse 115, West Germany. (089) 4129-1.

Scopex. Scopex Electronics Ltd, 63-65 High Street, Skipton, N. Yorks. BD23 1EF. 0756 69511.

Siemens. Siemens Ltd, Siemens House, Windmill Road, Sunbury-on-Thames, Middlesex TW16 7HS. 09327 85691.

Solartron. Solartron Schlumberger, Victoria Road, Farnborough, Hants GU14 7PW. 0252 544433.

Tektronix. Tektronix UK Ltd, P.O. Box 69, 36/38 Coldharbour Lane, Harpenden, Herts, AL5 4UP. 05827 63141. Also Electroplan Ltd, P.O. Box 19, Orchard Road, Royston, Herts SG8 5HH. 0763 45145.

Thandar. Thandar Electronics Ltd, London Road, St. Ives, Huntingdon, Cambs. PE17 4HJ. 0480 64646.

Trio. House of Instruments, Clifton Chambers, 62 High Street, Saffron Walden, Essex CB10 1EE. 0799 24922. Also Lawtronics Ltd, 139 High Street, Edenbridge, Kent TN8 5AX. 0732 865191.

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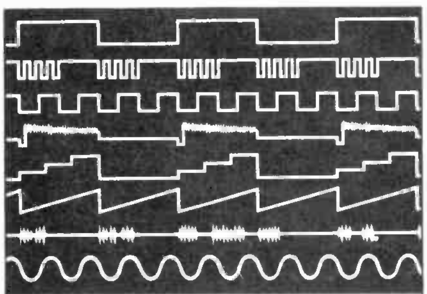

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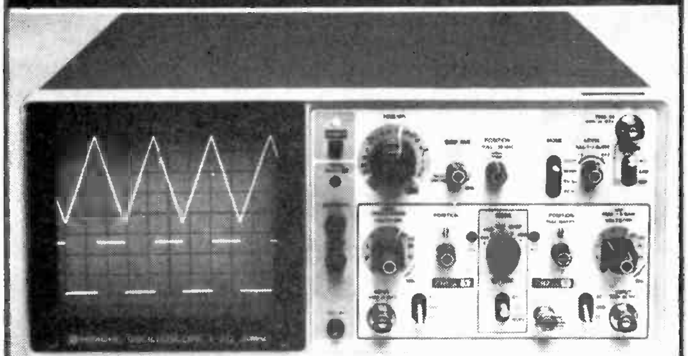

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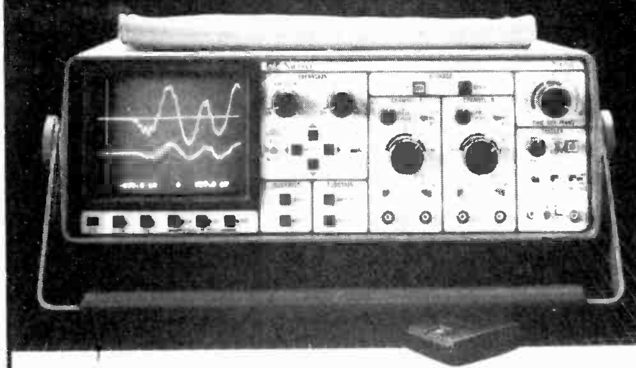

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Designing with the 68008 microprocessor

Ideal for use in low-cost, high-volume applications like personal computers and small business machines, the 68008 is an eight-bit microprocessor with a 32-bit architecture. This two-part article describes its main features and how it's used with other microcomputer components like rom, ram and peripheral devices.

All of the microprocessors in the M68000 family of high-performance processors and peripherals, including the 68008, are based on the same 32-bit architecture. The 68008 has an eight-bit external data bus; others have 16 or 32-bit buses. The once-clear divisions between eight, 16 and 32-bit microprocessors are becoming blurred; with the 68008 the designer is now able to have a high-performance microprocessor with a 32-bit architecture in small cost-effective systems using eight-bit data buses.

The architecture of the 68008 is identical to the original member of the family, the 68000, a processor with a 16-bit external data bus. From the programmer's point of view the two processors look identical, so that the 68008 is completely code-compatible with the 68000. This means that any program developed for one processor will run on the other. This is true for object code as well as source code. Other 68000-family microprocessors such as the 68010, virtual memory version of the 68000, and the 68020, very high performance 32-bit mpu, have achitectures which are upward-compatible with that of the 68008, making it easier to upgrade 68008-based systems. For example, any user program written for the 68008 will execute correctly on the 68000, 68010 and 68020 without need for modification.

Using standard rams and roms a smaller minimum-sized system can be constructed with the 68008 than with the 68000. Cost savings are made by producing the 68008 in a 48-pin dual-in-line package as opposed to the 64-pin version for the 68000. Eight pins are saved by halving the reduced data bus. Other minor hardware differences allow more pins to be shed (Fig. 1), for instance a few of the high-order address lines of the 68000 are not brought off-chip on the 68008. Even so, this still allows direct addressing of over one megabyte of memory – huge compared to that of conventional eight-bit microprocessors and more than enough for the low-end applications for which the 68008 is intended.

The 68008 is as fast as the 68000 when

by A. J. Barth

accessing byte-sized operands. However, because of its byte-sized data bus the 68008 needs to access 16-bit words as two successive bytes. As a result, the overall throughput of the 68008 is less than that of the 68000. For the same processor clock and for a typical mix of instructions, the 68008's performance is about 60% of that of the 68000. This is still a lot of raw processing power and will meet a need for low-end applications.

Because the architectures of the 68000-family microprocessors are so similar, knowing the 68008 means knowing much about the other processors. The 68008 is characterized by its 'clean', regular and consistent structure and in particular, emphasis was given to the architecture to make it regular with respect to the registers, instructions, addressing modes and data types.

Register set

The 68008 programming model has a large number of general-purpose 32-bit data and address registers, Fig. 2. There are eight general-purpose 32-bit data registers, D_0-D_7, for byte (8-bit), word (16-bit), and long word (32-bit) operations. Seven address registers A_0-A_6 and two system stack pointers A_7, may be used as software stack pointers and base address registers. In addition these registers may be used for word and long-word address operations. All 17 registers may be used as index registers.

High-performance microprocessors are expected to rapidly handle complex functions having a large number of parameters. The 68008 can maintain most or all of these parameters in processor registers, which is both fast and makes the programs efficient and elegant. Microprocessors with only a few registers in such situations need to continuously swap parameters between registers and external memory.

As the 68008 has general-purpose registers, the programmer and not the microprocessor-chip designer decides which registers are used. It does not dictate that certain instructions use certain registers. This not only eases the task of the assembler language programmer but also makes high-level language compiler-generated code more efficient. Many of the instructions and addressing modes which

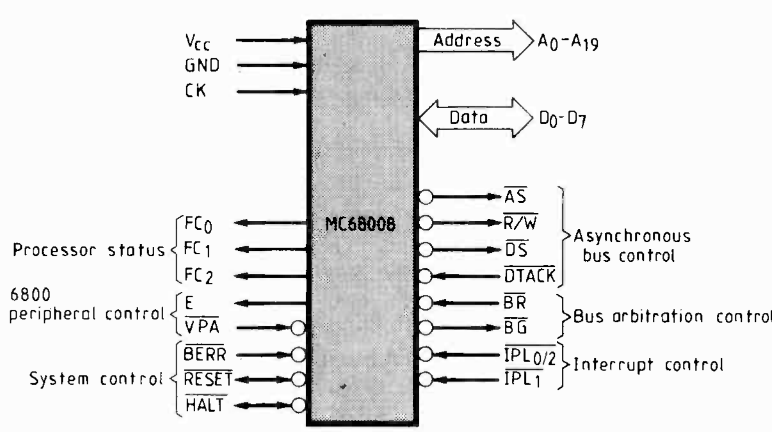


Fig. 1 68008 signal lines. The microprocessor has an internal 32-bit architecture and an eight-bit external data bus. Packaged in a 48-pin package the 68008 has non-multiplexed buses and a non-segmented 1 megabyte address space.

operate on the address registers may also be used with the 32-bit program counter. This makes it easy to write position-independant software that will execute correctly no matter where the code is loaded in memory.

The 68008 has a 16-bit status register which consists of two parts: a user byte and a system byte. The user byte is accessible by any program and contains the usual condition code flags associated with the execution of instructions, condition like Negative, Zero, Carry, Overflow, etc. The system byte of the status register is accessible only by a supervisory program (usually the operating system) and is used to control the operating mode.

Addressing range

The 68008 has a large linear addressing range. It can directly access one megabyte of external memory without paging or segmentation. Many microprocessors are able to access fairly large memory space but need to do so via a narrow window called a segment or page. This may be useful in a few applications, but in most situations it is an irritating handicap because the programmer is obliged to keep repositioning the window to access the desired location.

Like other Motorola microprocessors the 68008 has memory-mapped i/o. This enables the programmer to use the m.p.u's sophisticated instructions and addressing modes to operate on i/o as well as memory.

Instruction set

The 68008 has a powerful, flexible and easy-to-use instruction set. There are 56 basic instructions (Table 1). This is actually less than the ten-year-old 6800 microprocessor. However because of the regularity of the 68008 architecture, those instructions which use registers may use any register with almost any addressing mode and data type. These permutations yield many thousands of useful operations, compared to less than 100 for the 6800; the 68000 family philosophy being to provide a small number of easy-to-remember and flexible general-purpose instructions.

The instruction set covers the following classes of operations:

- data movement
- integer arithmetic
- logic
- shift and rotate
- bit manipulation
- binary-coded decimal
- high-level language support
- program control and
- system control.

Operations on data in registers and memory are independent of the data size and usually involve a source and a destination operand. The programmer need only remember one mnemonic for each type of operation and then specify data size and addressing modes for both the source and destination operands. Consistency is maintained as all data registers and memory locations may be a source or destination for most operations on integer data.

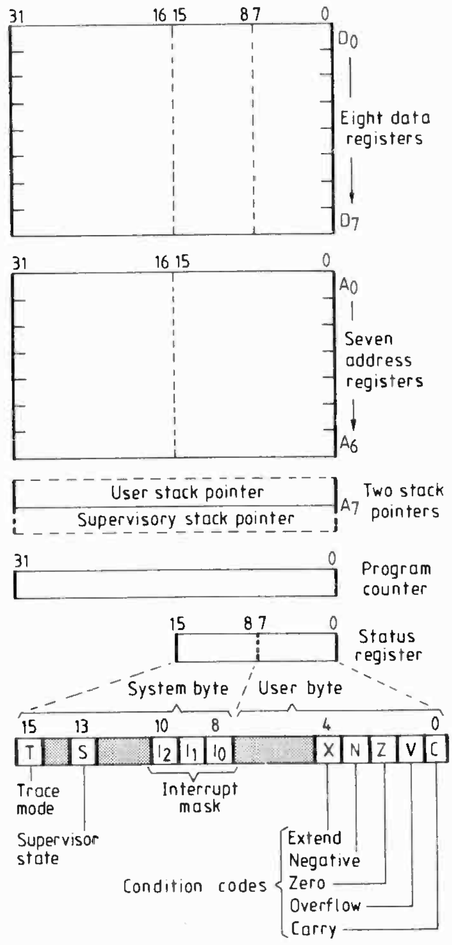


Fig. 2 68008 programming model: eight general-purpose data registers for 8, 16 and 32-bit operations, seven address registers, and two system stack pointers for software stack pointers and base address register. All 17 maybe used as index registers.

Like all M68000 microprocessors the 68008 instructions are implemented by microcode rather than random logic, so that, for example, the execution of undefined instructions no longer leads to unpredictable results.

Data types

The 68008 operates on five main data types. Operations may be on bits, b.c.d. digits, bytes, words and long-words. For integer arithmetic the programmer need not remember different instructions for different data sizes. The required data size is simply appended to the instruction as the program is written.

Addressing modes

An addressing mode is the method by which the data or other operand is accessed by the processor. The availability of powerful and flexible modes usually means performing an operation with just one instruction which would otherwise take many. This results in programs executing faster, being smaller, easier to read and to maintain. The 68008 has 14 powerful addressing modes (See Table 2). They operate consistently and are independent of the instruction itself.

Program privilege scheme

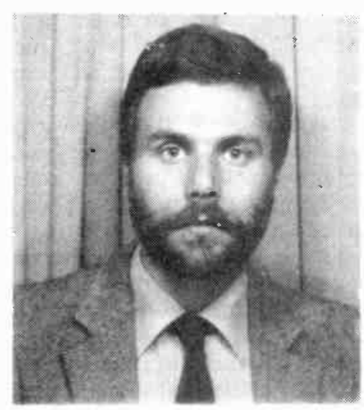
A two-level program privilege scheme provides security and high reliability. Programs should access only their own code and data areas, and ought to be restricted from accessing the information which they do not need and must not modify. Such a scheme not only prevents the deliberate tampering with data but also guards against a faulty program running wild and altering other programs.

The 68008 operates at one of two privilege levels, the supervisor level or at the user level. At the supervisor level programs have access to all processor resources and can execute any instruction or access any register. Normally, only the controlling operating system or its kernel runs at this level. This code is normally relatively small, well-tested and therefore reliable. All the rest of the software, which includes both the utility and application programs, executes at the user level and has access only to a subset of the total processor unit resources, the resources governing control of the system being protected from these programs. If a user-level program attempts to execute a 'privileged' instruction or to access a supervisor register, control is immediately taken away and given to the controlling supervisor program which can take some corrective action.

Interrupt structure

In most applications, programs are seldom executed instruction-after-instruction without a break. The need frequently arises to respond to an event or exception. Such exceptions may be the hardware interrupts caused by external logic, or the software interrupts caused by the recognition of some condition internal to the processor unit. High-performance microprocessors must be able to respond rapidly to a large variety of exceptions with varying degrees of priority.

Three levels of priority are provided for external hardware interrupts. By use of the three-bit interrupt mask in the 68008 status register (Fig. 2) the supervisor program may postpone handling external interrupts with priorities less than that contained in the mask. When an interrupt



Andrew Barth is a senior staff engineer with Motorola's systems engineering group in East Kilbride. He graduated in physics from Leeds University and since 1976 has worked in microprocessor systems design in Germany and the USA, as well as in the UK.

Table 1. 68008 instruction set

Mnemonic	Description
ADBC	add decimal with extend
ADD	add
AND	logical and
ASL	arithmetic shift left
ASR	arithmetic shift right
B_{CC}	branch conditionally
BCHQ	bit test and change
BCLR	bit test and clear
BRA	branch always
BSET	bit test and set
BSR	branch to subroutine
BTST	bit test
CHK	check register against bounds
CLR	clear operand
CMP	compare
DB_{CC}	test condition, decrement & branch
DIVS	signed divide
DIVU	unsigned divide
EOR	exclusive or
EXG	exchange registers
EXT	sign extend
JMP	jump
JSR	jump to subroutine
LEA	load to effective address
LINK	link stack
LSL	logical shift left
LSR	!ogical shift right
MOVE	move
MOVEM	move multiple registers
MOVEP	move peripheral data
MULS	signed multiply
MULU	unsigned multiply
NBCD	negate decimal with extend
NEG	negate
NOP	no operation
NOT	one's complement
OR	logical or
PEA	push effective address
RESET	reset external deuces
ROL	rotate left without extend
ROR	rotate right without extend
ROXL	rotate !eft with extend
ROXR	rotate right with extend
RTE	return from exception
RTR	return and restore
RTS	return from subroutine
SBCD	subtract decimal with extend
S_{CC}	set conditional
STOP	stop
SUB	subtract
SWAP	swap data register halves
TAS	test and set operand
TRAP	trap
TRAPV	trap on overflow
TST	test
UNLK	unlink

is recognised the processor performs an interrupt acknowledgement sequence (IACK). During IACK the peripheral being acknowledged may indicate that program control should be given to any one of 256 interrupt service routines (vectored interrupt method), or to one of three service routines corresponding with the hardware interrupt priority level (autovector interrupt method). Most of the M68000-family peripherals use the vectored interrupt method in which the peripheral provides an eight-bit vector number on the data bus. The 68008 uses this vector number to determine which of the 256 interrupt routine addresses in its interrupt vector table to use. The less sophisticated peripherals use the autovector interrupt method which have seven vectors reserved for them. In either case the external hardware needed to interface both kinds of perpherals to the 68008 is minimal.

Some 68008 instructions are designed to cause internal interrupts, some always and others only upon detection of certain conditions. An example of the last is the execution of a 'privileged' instruction. If a supervisor-level program executes such an instruction, the instruction will execute normally and no exception will occur. However, if a user-level program attempts to execute it, a prividege violation exception occurs and program control is given immediately to the appropriate interrupt service routine.

A number of exceptions correspond to error conditions, either those detected by external hardware or by the processor itself. For example, the Bus Error input (BERR) may be used by external hardware to cause the 68008 to abandon the current bus cycle and give program control to the Bus Error interrupt routine, or, by the simultaneous use of BERR and HALT, to retry the current bus cycle.

A very useful feature is the trace exception, which enables a supervisor-level program to step through a target program on an instruction-by-instruction basis. Each time the target program executes an instruction, no matter which instruction it may be, control is returned to the supervisory program. No external hardware is required to implement the program tracing as it is part of the processor architecture.

Asynchronous data bus

Like most of the other Motorola microprocessors, the 68008 data bus is not multiplexed – the m.p.u. pins used for the data bus are not shared with other signals. Some microprocessors multiplex the data and address buses onto the same pins to reduce the total number of pins. Non-multiplexed microprocessors such as the 68008 require more pins and sometimes a more expensive package. However, non-multiplexed buses have many advantages: they can operate much faster, dissipate less chip power, and do not require external demultiplexing hardware. Analysis shows that multiplexed microprocessor systems are more costly than non-multiplexed systems because the microprocessor and demultiplexing i.cs together cost more, occupy more board space and have more pins overall.

The 68008 has an asynchronous data bus. The time taken to transfer data to or from a memory or peripheral device via the data bus is variable. The memory or peripheral device signals the processor when it is ready to make the data transfer by use of a special handshake line called data transfer acknowledge (DTACK). The advantage of this asynchronous scheme is that each bus cycle can be fine-tuned to the speed of the particular device being accessed. If the device is rather slow, the processor simply marks time until the device is ready. In this way the 68008 runs at the fastest rate that memory and peripherals can go, which maximizes system throughput.

Most M68000-family peripherals have a pin for the DTACK handshake signal, and interfacing such parts to the 68008 microprocessor is simple. Even those peripherals originally designed to work with synchronous processors, like the 6800 or 6809 microprocessor units, may be interfaced to the 68008 with minimal hardware. This is because the 68008 has several signal pins specially for this purpose. By use of these signals, the M6800-type peripheral device signals the processor to perform the current bus cycle synchronously, making the 68008 behave like a synchronous microprocessor for this one bus cycle.

The 68008 m.p.u. uses a two-line bus arbitration scheme which enables the data bus to be shared efficiently with other microprocessors unitss in a multiprocessor system and with other bus masters such as d.m.a. controllers. WW

To be continued with interfacing details.

Table 2. 68008 addressing modes

Mode	Generation
Register direct addressing	
Data register direct	$EA=D_n$
Address register direct	$EA=A_n$
Absolute data addressing	
Absolute short	EA=(next word)
Absolute long	EA=(next two words)
Program counter relative addressing	
Relative with offset	$EA=(PC)+d_{16}$
Relative with index and offset	$EA=(PC)+(X_n)+d_8$
Register indirect addressing	
Register indirect	$EA=(A_n)$
Postincrement register indirect	$EA=(A_n),\ A_n \leftarrow A_n+N$
Predecrement register indirect	$A_n \leftarrow A_n-N,\ EA=(A_n)$
Register indirect with offset	$EA=(A_n)+d_{16}$
Indexed register indirect with offset	$EA=(A_n)+(X_n)+d_8$
Immediate data addressing	
Immediate	Data=next word(s)
Quick immediate	Inherent data
Implied addressing	
Implied register	EA=SR, USP, SP, PC

EA effective address
A_n address register
D_n data register
X_n address or data register used as index register
SR status register PC program counter
d_8 eight-bit offset (displacement)
d_{16} sixteen-bit offset (displacement)
N=1 for byte 2 for words and 4 for long words
( ) contents of
← replaces

16-line p.a.b.x with options

Hints on construction complete Jaap Kuiper's description of a versatile electronic/electromechanical exchange

Current passing through the telephones has to be kept within acceptable limits. Having used 700Ω relays throughout the O relay requires a 470Ω, 1W series resistor (at 45V supply). As relays O, G, II, EI and R are all controlled from the individual stations they must switch positively. Typical values for limiting resistors turned out to be 390Ω, 1W for II, EI and R, and 1kΩ, 1W for G relays and others working off the 45V supply. Relays using the 12V rail don't need series resistors and so operate economically and reliably. The limiting resistor for G relays, if required fits between the G-bus and contacts gh_2/gi_2 in the external control section.

Most Continental telephones include a ground key but where not, momentary push-buttons may be fitted and connected directly to the set's a-line. The original switches, if available, may be fitted in the space provided on top of UK sets in front of the cradle. Holes for the leds have to be drilled or melted in a suitable position and are also connected directly to the a-line. Previous diagrams gave details for both Continental and UK sets.

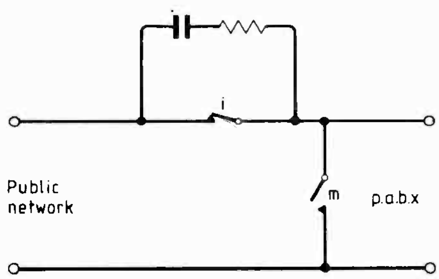
Special mounting plates (RS Components RS349-119) are available for fitting Siemens/Varley type relays. Each plate holds six relays. Joining these plates together allows daisy-chain wiring of the bussed contacts. The mounting plates have each station's O, T and G relays grouped together for ease of wiring with ribbon cables running to the T-drivers. Terminator, oscillators and line interface were constructed on home-made p.c.bs and 30-way connectors were used to plug in the various telephones.

Resistors in the ground-key toggle have to be approximately the same value as the relay coil and must be capable of dissipating the full power during switching (1kΩ, 5W). The muting i.c. is an LM311 which is rated at 36V maximum, so a voltage divider was included to reduce the supply. These are resistors ra and rb. The reference point is connected through a 1MΩ resistor so as not to affect proper operation of EI which has to follow dial pulses. At 700Ω EI coil value and a telephone presenting 300Ω when operating, the reference voltage will be approximately 31.5V. Therefore divider rc/rd has to be adjusted to provide around 35V. As soon as the dial is moved the reference point goes to the full supply voltage; the 1MΩ resistor protects the i.c. The LM311 will switch up

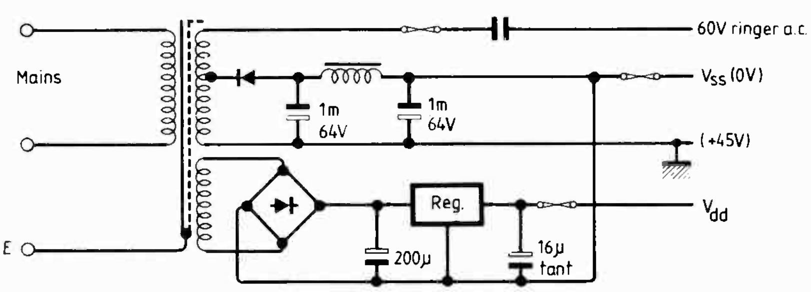
by J. H. Kuiper

to 40V so the additional transistor was included for protection.

With the introduction of more and more d.t.m.f. (system X) exchanges it is sensible to construct the line interface on a separate p.c.b. so that when change-over is required only the line interface needs replacing. A dual tone circuit (Exar application note AN-08) then feeds the 4514 latch. Wiring to the individual sets is by standard four-core cable as each station's b and



Automatic dialling by computer requires two buffered output ports each driving a relay. Additional hardware requirements are minimal as shown here.



Power supply diagram. Current of the 33V secondary producing 45V direct is 1.5A. Using higher impedance coils will reduce this. Current from the 9V secondary is 100mA; a 12V regulator is used on this supply. The 1μF, 250V ringer-line capacitor is not needed for UK sets.

Born in Friesland in 1949 and having lived in Holland since 1960, Jaap Kuiper completed his study of electrical engineering and electronics at Alkmaar Polytechnic in 1970 after which he worked as a buyer re-exporting equipment to Indonesia and Singapore. Since 1977 he has run a small import/wholesale business specialising in audio accessories and computer peripherals.

ground-key wire have to be discrete throughout. This largely applies to the a-wire as well to avoid speech induction to unwanted sets. Led-lines may, however, be joined together at convenient places to reduce the number of leads.

The line isolating and matching transformer is available from RS Components (RS217-826). The RC shunt across the interruptor contact consists of a 1μF, 250V capacitor and a 560Ω, 1W resistor on the Continent and 2μF, 250V and 600Ω, 1W in the UK. In view of interface requirements relays EI and M should be new types as they must have a contact bounce of less than 4ms and contact resistance of less than 200mΩ. All other relays may be surplus types. Diodes are general-purpose high-speed silicon types. Many diodes used combine or separate switching actions to reduce the number of relay contacts; these are rated at 100mA (BA155). Diodes used in the oscillator circuits and sections working at 12V may be rated lower.

Note that in stations not requiring the muting-inhibit action the g_4 contact becomes redundant. Since relays usually come with two or four contacts, a component can be reduced by omitting the diode between contact t_2 and the G coil and connecting spare contact g_4 directly from t_2 to ground (marked with asterisk on page 63 of November issue). WW

NEW PRODUCTS


WW 305

Micro-floppy

Following other Japanese manufacturers, Teac have announced the availability of FD-30A, a 3in floppy disc drive that has all the same characteristics as their 5.25in drives; capacity, format, density, disc rotation speed, transfer rate and power and data interface connections are all identical. This makes it fully compatible and a direct replacement for its larger cousin. With a brushless d.c. direct-drive motor, the drive is claimed to be very durable and electrical noise is eliminated. Available in the UK through Tekdata Electronics, Federation Road, Burslem, Stoke-on-Trent ST6 4HY.
WW 305

Transistor tester

An addition to their range of hand-held test units is the Osgorne 4500 transistor tester. Completely self-contained, it can be used easily to check p-n junctions of discrete semiconductors whether in or out of circuit. It features a series of leds which indicate the junction status; p-n-p or n-p-n, open or short circuit can be instantly identified and it will work reliably even when parallel circuits have values approaching 270 ohms or 33 microfarads. Osborne Electronics, Binstead Road, Ryde, Isle-of-Wight.
WW 306

Voice digitizer

A voice digitizer may be used to enable the transmission of voice and data down the same telephone line. An American model, the Switchco TSP series 1000 works at a very low data rate of 2400bit/s which makes it easy to use with data modems or, by using a multi-port modem it can transmit four voice conversations over the same line. It is distributed by Vanderhoff Communications Ltd, Haunchwood Estate, Bermuda Road, Nuneaton, Warwicks CV10 7QF.
WW 307

Conduct heat —not current

Another American product is a thermally-conductive dry filled silicone rubber that provides 2000V isolation between power semiconductors and heat sinks. The low-cost Aarvid Rubber-Duc pads are vulcanised onto the heatsinks in the factory and eliminate mica washers and grease or silicone rubber pads and adhesives, while offering better thermal conductivity than either. Configurations suitable for TO-3, TO-66 and plastic power devices as well as DO-4 and DO-5 diode washers. Warth International Ltd, Oxted, Surrey.
WW 308

Shaft cutter

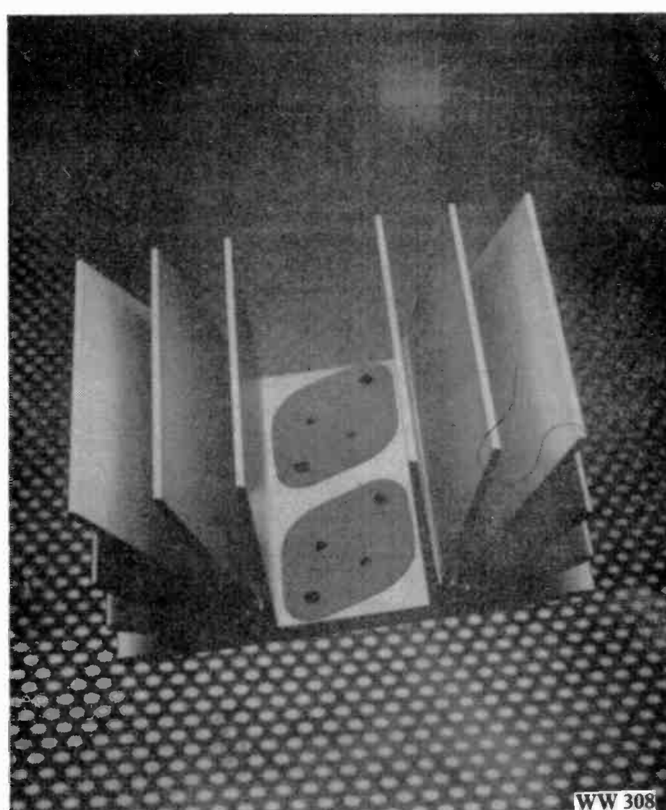
The cutting of shafts on potentiometers, rotary switches and variable capacitors has been made much easier by the introduction of the Telpro shaft shear. This guillotine-type tool will cut copper, aluminium, mild and stainless steel, and plastics rods of diameters up to 0.25in or 6mm. It does not transmit any shock or vibration and may be used on such delicate components as helical trimmers, providing a clean cut with no need for further filiing or finishing. It is claimed that the tool will pay for itself by cutting as few as half-a-dozen shafts because of the reduction in time and damage to components. Electronic and Computer Workshop Ltd., 171 Broomfield Road, Chelmsford, Essex CM1 1RY.
WW 309

Laser for communication

A new high-frequency GaAlAs diode laser with a modulation bandwidth of 6GHz is mounted in an impedance matched high frequency module which includes an integral power-monitoring photodiode for the automatic control of carrier wave output power. The laser diode can be used for the transmission of analogue or digital signals from d.c. up to microwave frequencies over long or short optical links. For a complete high-speed link, there is a matching photodiode with a 7GHz detection bandwidth. The small size, light weight and very low power consumption of the laser make it suitable for airborne or remotely powered system use. Typical applications include multi-channel communications, phased array antennae, or radar signal transmission. Walmore Electronics Ltd, 11 Betterton Street, London WC2H 9BS. **WW 310**

Polyester capacitors

An alternative to the multi-layered ceramic capacitor in decoupling application is offered by the Suflex range of metallized polyester capacitors. The SUF168 is a sub-miniature device that allows for high packing density and is printed on the top to allow identification of values when closely mounted. Values range from 1000pF to 1μF with ratings of 50, 60 and 100V d.c. Suflex Ltd, Risca, Newport, Gwent NP1 6YD. **WW 311**


WW 308

Sinclair goes into business

WW 301

No modesty has been exercised by Sinclair Research in the naming of their latest computer which they have called the QL for Quantum Leap. It certainly is a leap into an entirely different world from that occupied by the ZX81 or the Spectrum. The QL is being promoted as a purely business machine and is provided with four business-oriented software packages; a word processor, a database, a spreadsheet and a graphics program for the production of graphs and charts. The computer is based on Motorola MC68000 processor which Sinclair claim is a 32-bit processor. The 68000 has 32-bit internal architecture but uses 16-bits externally and the 68008 version used in the QL has an 8-bit data bus. So it's really an 8/16/32-bit processor depending from where you look at it. A second processor, Intel 8049, is used to control the keyboard, generate the sound and act as an RS232C receiver. QL has 128K of ram and there will be a 0.5Mbyte plug-in ram module as an optional extra. Program storage is on Sinclair Microdrive, a tape cartridge medium with 100Kbytes of storage on each of the two built-in drives. There is an expansion slot for up to six further drives.

Sinclair have designed their own operating system, called QDOS, although no discs are involved. QDOS is a single user, multi-tasking system which has the ability to run several programmes concurrently and to display the result simultaneously in different windows on the screen. The operating system uses a new version of Sinclair Basic, called SuperBasic, which is claimed to be so superior to 'normal' Basic as to constitute a different language. It has the ability to define procedures written in individual blocks. A 'constant execution speed' is claimed, that does not get slower if a program is longer.

The computer has a full typewriter-pitch keyboard with 'real' keys, 65 of them, including cursor-control keys and five programmable function keys.

The display facilities are from a wide choice of character sets with a normal format of 84 columns by 25 lines. Two modes of high-resolution graphics are offered; 512 by 256 pixels with four-colour (red, green, black and white) display, and 256 by 256 with an eight-colour display. A 'stipple' command allows the mixing of foreground and background colours to add to the palette. In both modes a varying grey scale is produced on a monochrome monitor. The quality of the display is such that a high-resolution monitor is necessary to take full advantage of the system. Much would be lost by using a tv receiver even though a tv modulated output is provided.

A number of interfaces are built in; two RS232C interfaces, two analogue joystick ports, a rom-cartridge slot, a u.h.f modulated tv output as well as an RGB monitor output. There is a general-purpose expansion slot which may be used to plug in a ram module, or other peripherals as they become available. There are also two local area network ports and up to 64QLs and/or ZX Spectrums may be daisy-chained together sharing such facilities as a printer or a data base. Data may be transmitted along the QLAN at 100K baud and there is a handshake protocol to ensure that a receiver station is 'listening'.

The QL is due to be issued to customers toward the end of February. As is usual with Sinclair new products, it will be available on mail-order only and may appear in retail shop after about six months. There is a £7.95 charge for postage and packing and users are invited to join a users' group or QLUB, for an additional £35 a year. Members will get software up-dates and news of all additions.

Planned enhancements already under development include a C comiler, 6800 assembler, emulation of a main-frame terminal, a-to-d converter, a hard disc interface, a modem, a parallel printer interface, and an IEEE-488 interface.

Sinclair Research Ltd, Computer Division, Stanhope Road, Camberley, Surrey GU15 3PS.

WW 301

Wren for £1,000

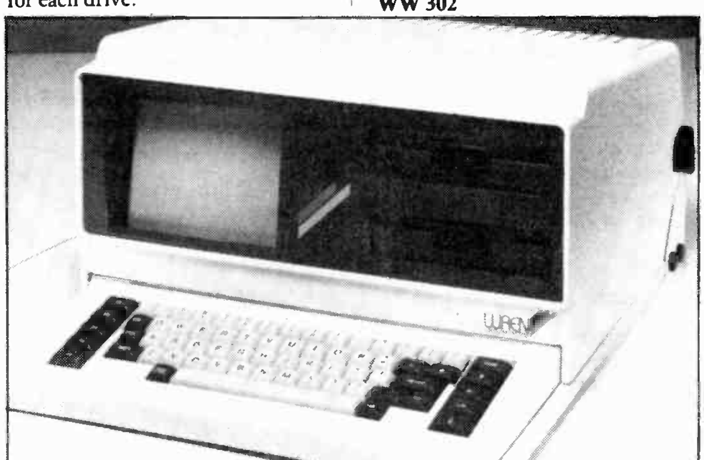
Designed by Transam for Prism Business Systems, the Wren computer is based around a Z80B processor running at 6MHz. It has 64K or ram exandable to 256K, with a diagnostics rom of 8K. A real-time clock is included as is a 50byte c.mos ram, both with battery back-up. It includes a 7in monochrome amber display c.r.t with 36K of screen memory, three selectable screen formats; 80 columns by 24 lines, 40 columns by 24 lines Prestel format, or 512 by 256 elements high-resolution graphics. Although the internal display is monochrome, full colour graphics are supported and there is an RGB output to a colour monitor. The keyboard, which is not detachable, has 67 full size qwerty keys with separate cursor keys and five function keys which allow up to 15 different programmable operations. Two 5.25in disc drives are included with 200Kbyte storage for each drive.

There are a number of interfaces; an RS232 serial port, a Centronics parallel printer port, two analogue inputs for paddle cursor controls, a hard disc interface, and a built in autodial modem which is Prestel and CCITT compatible. Software may be downloaded from Micronet 800 through the inbuilt download facility. For transport, the screen and disc drives in the upper section slide forward over the keyboard, revealing a sturdy carrying handle at the back, it weighs "under 20 lb" (9kg).

The software includes a Z80 version of BBC Basic, a desk-top facility which includes a diary, an address file, a system for creating simple documents such as memos, or expense forms, a filing system, a calculator and it may be used in conjunction with a printer as a typewriter. Perfect Writer, Perfect Calc and Perfect Filer are included along with CP/M 3.

Prism Business Systems Ltd, 18 Mora Street, London EC1V 8BT.

WW 302



WW 302

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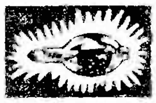

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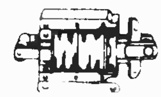

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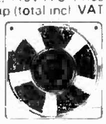

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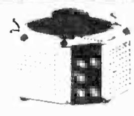

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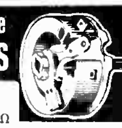

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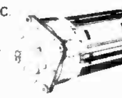

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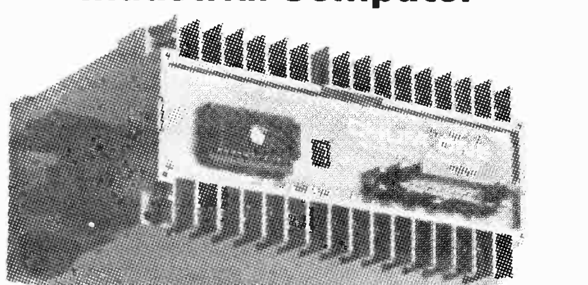

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0.33 μF	100V		100 sent for £8.20 + £1 P&P (£10.58 inc. VAT)
0.47 μF	100V		100 sent for £10.00 + £1 P&P (£12.65 inc. VAT)
0.68 μF	100V	10%	100 sent for £12.00 + £1 P&P (£14.95 inc. VAT)
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0.11 μF	250V		100 sent for £5.50 + £1 P&P (£7.48 inc. VAT)
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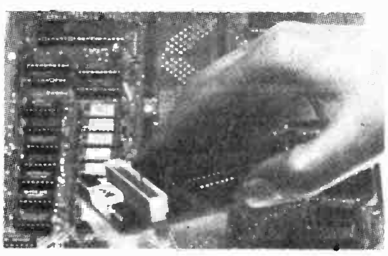

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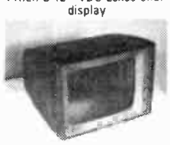

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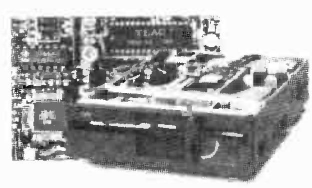

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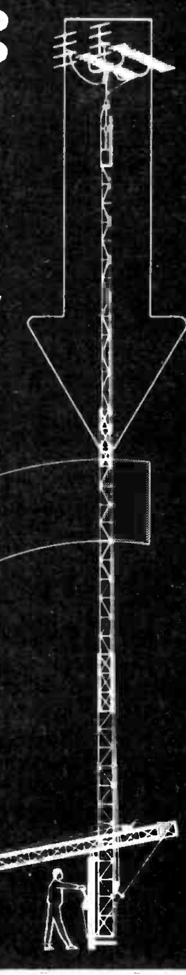

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8	4	8.98	1.60
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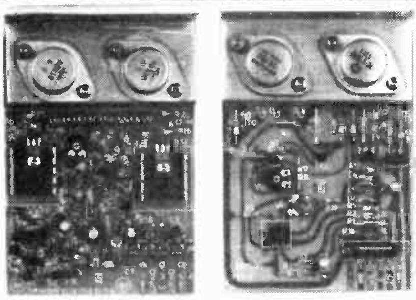

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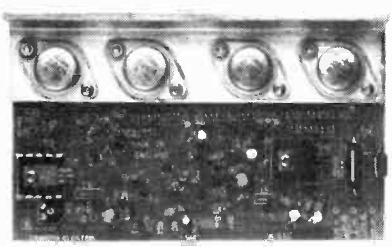

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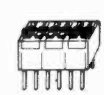

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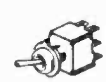

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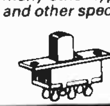

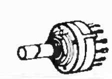

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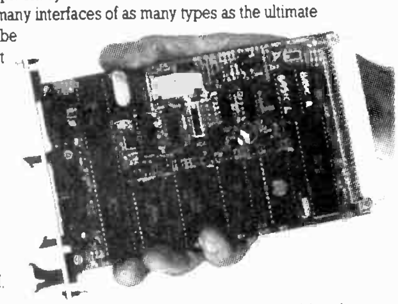

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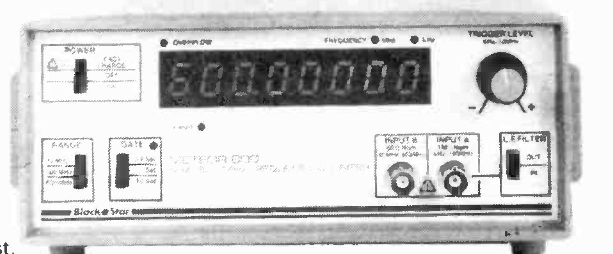

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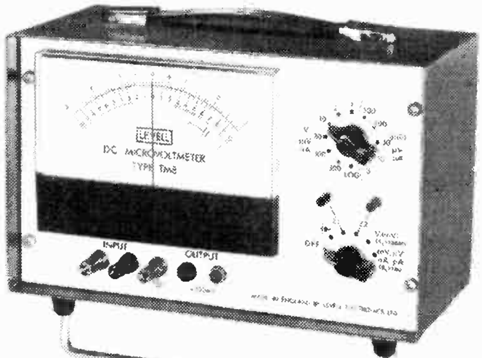

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GOODMANS	HB WOOFER	8in	60	8	£12.50	£1
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	Price	Post		Price	Post
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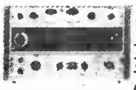

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Cat. No. 98A. Noise weighting filters for CCIR/ARM signal-to-noise ratio measurements. As new units. **£40** each (+£1 p&p).

BECKMAN TURNS COUNTER DIALS

Miniature type (22mm diam.). Counting up to 15 turn "Helipots". Brand new with mounting instructions. Only **£2.50** each.

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Stoddart Model NM52A. RF Noise & Field intensity measuring receiver. 375MHz-1GHz c/w power supply unit.

KAY SOUND SPECTROGRAPH

Model 6061B with Amplitude Display, scale magnifier. 85Hz-16kHz. Complete sound spectrograph in excellent condition.

★★ STEPPER MOTORS ★★

Brand new stock of 'ASTROSYN' Type 20PM-A055 stepper motors. 28V DC. 24 steps per rev. 15 oz-in torque @ 100PPS. Body length 2½", diameter 2", shaft ¼" diam × 4¼" spirally threaded. Weight 16oz. Price each **£15** (p&p 50p). Connections supplied.

★ MILLI-VOLT MEASUREMENT, ANALOGUE ★

MARCONI TF2600. Twelve ranges 1mV-300V FSD. Wide-band to 10MHz.
MARCONI TF2603. Frequency range 50kHz-1.5GHz. High Sensitivity from 300uV.
MARCONI TF2604. Electronic Multi-meter. AC/DC 300mV Full scale to 300V (1kV DC). Resistance ranged. AC Frequency range 20Hz-1500MHz.

★★ CONSTANT VOLTAGE TRANSFORMERS ★★

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P. F. RALFE ELECTRONICS

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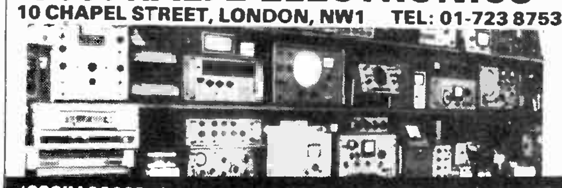
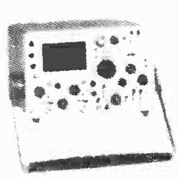


'OSCILLOSCOPES' PLEASE PHONE FOR CURRENT STOCK



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HEATHKIT AW1U Audio Power Meters 5mW-50W **£25** pp £1.
METROHM 500V Insulation Testers Transistorised **£40** pp £1.50.
BRUEL & KJAER Heterodyne Voltmeter 0.5-240MHz.
AIRMEC Display Oscilloscope 279, 4-trace, 14x10" CRT **£195.**
RIKADENKI 3-channel Chart Recorder, Model B-341.

★ AVO SIGNAL GENERATORS AFM2 ★

We have in stock a quantity of AVO type AFM2 signal generators supplied in fully tested working condition complete with accessories. Spec as follows: 0.45MHz-225MHz in 8 bands, AM all bands plus FM on two bands covering 20-100MHz. Output 1uV-50mV and 200mV High O/P setting, m/c set level meter, scale shift for accurate frequency calibration, variable mod etc. PRICE EACH JUST £55 + VAT. Carriage each + £4.

★ SWEEPERS ★

TELONIC Sweep generator system type 2003. Fitted with Marker, attenuator, Detector plug-in units and Generator covering 800-1500MHz. **£325**

★ MUIRHEAD FACSIMILE UNITS ★

MUFAX 'COURIER' facsimile receiver type K441-CH and transmitters K400 AMCH in stock in excellent condition **£250** per pair.

PLEASE NOTE. All the pre-owned equipment shown has been carefully tested in our workshop and reconditioned where necessary. It is sold in first-class operational condition and most items carry a three months' guarantee. For our mail order customers we have a money-back scheme. Repairs and servicing to all equipment at very reasonable rates. PLEASE ADD 15% VAT TO ALL PRICES.

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8" FLOPPY DISK DRIVES

DRE (Data Recording Equipment) Model 7100 Single-sided floppy disk drives in stock now at vastly reduced prices. Supplied BRAND NEW in manufacturers sealed cartons. CAPACITY 0.8MBytes. Hard/Soft sectoring ANSI/ECMA Standards compatible. Measures 4½×8½×14". Weight 13lbs. PRICE £150 + VAT. Securicor despatch if required + £10 + VAT. 7200 (Double-sided) **£250**

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United Peripherals type 3100 Minidisc Drives CAPACITY over 19MBytes. Power supply requirements 5V.DC at 4A. +24V. DC at 3A. Measures 17×8×7". Limited quantity only available in BRAND NEW condition. £250 each + VAT. Carriage details as above.

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Data Recording Equipment 4000-Series exchangeable IBM-type 5440 Disks. Units available ex-stock and BRAND NEW. Please call us for our lowest ever quotation.

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Surplus BASF 12-Sector RK05 cartridges available . . . small quantity only remaining at **£15** each. Carriage each £1.50.

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The following DC power supplies are available now from stock in limited quantities. All fully tested and guaranteed.

3.5V @ 10 Amps	**£15**	5V @ 10 Amps	**£15**
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+15V, −12V & +5V @ 11A, 4A and 40A **£50**
All prices + VAT please. Carriage + £2 each

★ CENTRIFUGAL BLOWERS ★

'TORIN' Type U62B1. 230V Cap'Start (supplied), very powerful (200W. 3,000rpm) centrifugal fans for large rack cooling or enclosure extraction applications. Overall dimensions 20x12 cms, outlet 6x4 cms. BRAND NEW. Surplus stock. **£15 each inc.** VAT, pp **£1.50.**

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Supplied in fully tested excellent condition, as follows:
115V, 4½×4½×1½" **£5.** 230V same size **£5.50.** 115V 3×3×1½" **£4.** 230V 3" size, brand new **£6.** Also small quantity 115V 4½" size, brand new **£6.** Postage each + 50p please.

WW10

WW – 059 FOR FURTHER DETAILS

Gateways to the World Outside

The CST PROCYON opens a lot of doors to your BBC microcomputer – lifting it right out of the "home computer" league. The CST PROCYON provides full IEEE 488 interface, enabling your BBC micro to operate professional plotters and printers, frequency counters, voltmeters, disc drives etc, and to communicate with other IEEE-ported machines, such as Commodore, Sirius, Osborne, Hewlett-Packard or Tectronix computers.

The CST PROCYON comes with a highly efficient IEEE filing system, supplied in EPROM, and responds to any high level language, including LISP, FORTRAN, FORTH, APL and BASIC. A specially-written Commodore data-exchange routine, allows you to link your BBC micro to CBM machines and disc drives.

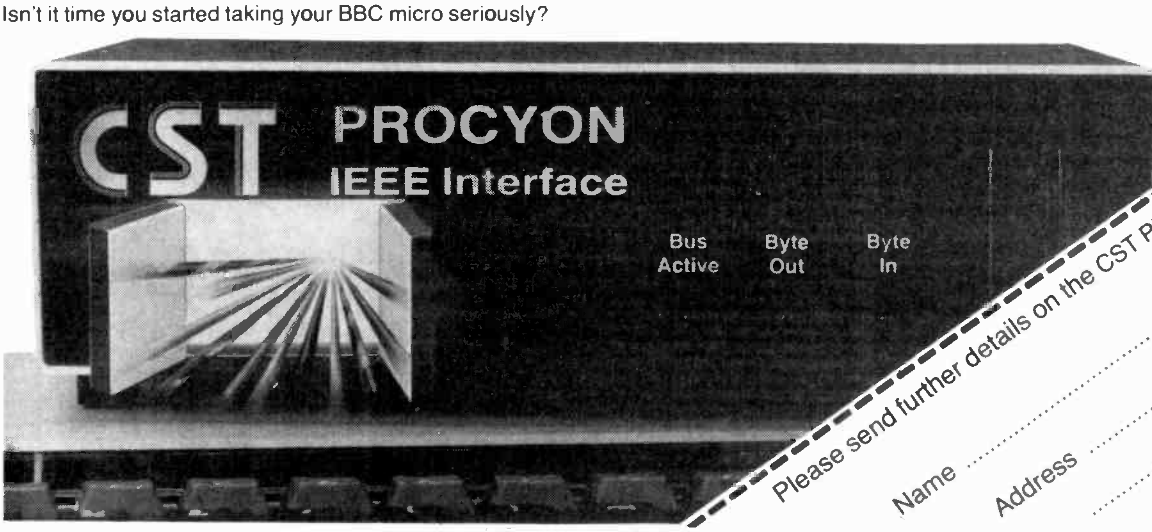
At 70k bytes of information per second, the CST PROCYON channels data quickly and efficiently between up to sixteen devices, responding to standard system commands as well as specialised filing instructions. Its capabilities are fully documented in a straightforward but comprehensive manual.

Isn't it time you started taking your BBC micro seriously?

- **Full multiple controller implementation**
- **Extensive "HELP" facilities**
- **Interactive debugging**
- **Visual Display of operating status**
- **Internal switched and socketed power supply**
- **Comprehensive error checking and indicating**

The CST PROCYON from
Cambridge Systems Technology
30 Regent Street, Cambridge
Tel: (0223) 323302

ENQUIRIES FROM DEALERS WELCOME



Please send further details on the CST PROCYON IEEE Interface

Name ....

Address ....

Tel. ....

WW3

WW – 069 FOR FURTHER DETAILS

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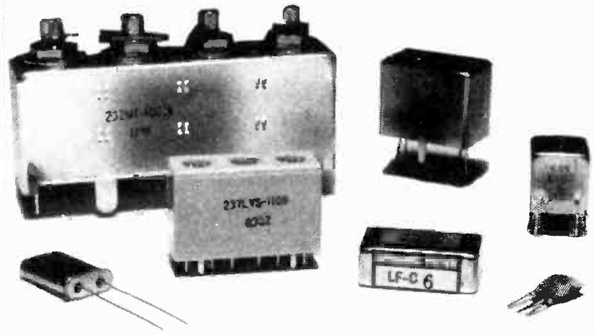
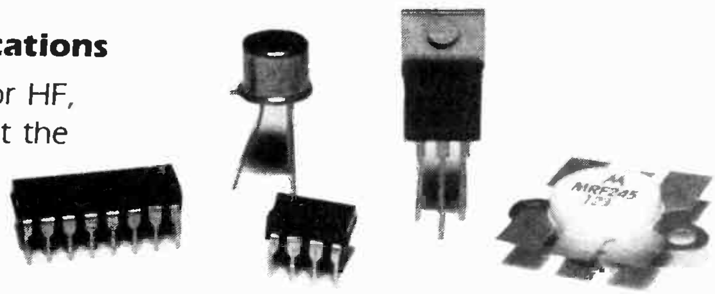


Coils, crystals, filters

TOKO coils, filters chokes. UNI crystals, filters, NTK and Murata ceramic filters. Probably the broadest stock ranges of these types of component in the world, and a full service from AMBIT INDUSTRIAL MARKETING to support the OEM with custom requirements.

Semiconductors for radio communications

ICs, Varicaps, FETS, MOSFETS, RF Power for HF, VHF, UHF. A broad selection that will meet the majority of requirements in receiver and transmitter designs



High Performance Coax Relays, switches etc. PC and connector relays engineered to the highest standards, plus a broad range of electro-mechanical support including push, toggle, and keyboard switches, rotary switches, plugs sockets etc.

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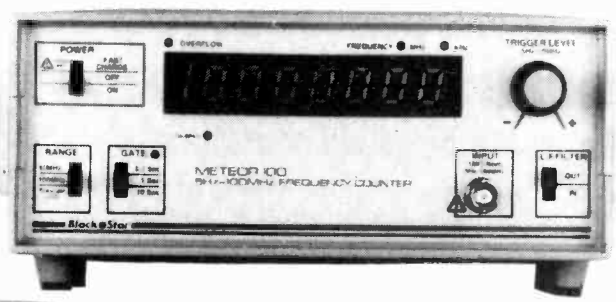
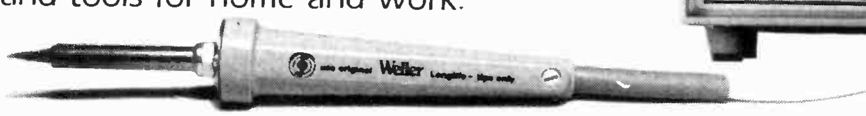
New Black Star Frequency counters, Weller and Antex soldering tools, plus a wide selection of all types of equipment and tools for home and work.





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(and professional)

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Parts, Project Packs, Test Gear
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WW – 084 FOR FURTHER DETAILS

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Advertisements accepted up to 12 noon Tuesday, March 6, for April issue subject to space available.

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BOX NUMBERS: £5 extra. (Replies should be addressed to the Box Number in the advertisement, c/o Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS).
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(1926)

Applications Engineering

(Dolby Stereo sound consultant)

Dolby Laboratories Inc. require a young sound engineer with solid technical background and the ability to deal with people. Practical experience as a mixing or recording engineer is essential. A foreign language would be useful. Based in London with some international travelling.

Competitive salary according to experience and good general benefits.

Apply in writing to John Iles.

Technician

With audio experience, probably City and Guilds electronics or similar education. Ability to work without day-to-day supervision is important for this in-house position within the marketing department.

Competitive salary according to experience and good general benefits.

Apply in writing to David Watts.

Dolby®
Dolby Laboratories Inc.
346 Clapham Road
London SW9 9AP
Tel No. 01-720 1111

(2457)

London College of Furniture

ilea

HEAD OF DEPARTMENT OF MUSICAL INSTRUMENT TECHNOLOGY (BURNHAM GRADE IV)

Applications are invited for the above post.
The position demands an appropriately qualified person in the field of music and instrument making, coupled to organisational ability and an understanding of the developments in further and higher education.
The College's Department of Musical Instrument Technology has become a unique establishment, offering an expanding range of advanced and non-advanced courses in instrument making validated by BTEC and the City and Guilds.
Salary: On an incremental scale within the range of £14,148 – £15,849 plus £987 Inner London Allowance.
Further details and application forms are available from The Clerk of the Governors at the College.
LONDON COLLEGE OF FURNITURE
41/71 Commercial Road, London E1 1LA. Tel: 01-247 1953
ILEA is an equal opportunities employer.

Box number replies should be addressed to:

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c/o Wireless World
Quadrant House
The Quadrant
Sutton, Surrey, SM2 5AS

AN OPPORTUNITY FOR SELF-EMPLOYED ENGINEERS

We have a steady flow of customers seeking repairs to Hi-Fi, Radio, TV and Video equipment.
If you offer a service in London in these fields call:
MR PATTERSON
242 4000

(2465)

Appointments

Antenna Test Specialists

The Satellite Division of Marconi Space and Defence Systems is about to commission the UK's most advanced satellite test facilities. There is an immediate requirement for an Antenna Range Test Superintendent and for an Antenna Test Systems Supervisor.

The Superintendent will institute test runs and be responsible for range personnel, test procedures, safety, the integrity of test equipments, and will also contribute to the development of the test range facility. Applicants should have an HNC as a minimum qualification and at least 5 years experience of R.F. and antenna testing utilising computer based systems.

The Supervisor will be responsible to the Range Superintendent for the implementation of test runs and generally contribute as a member of the range test team. Applicants for this should possess ONC in electronics plus at least 3 years computer based test experience of R.F. equipments.

Appropriate salaries and other attractive benefits form a first-class package anticipated from a large market-leader employer.

Telephone Portsmouth (0705) 674019 for an application form or write direct to Derek Withers, Marconi Space and Defence Systems Limited, Browns Lane, The Airport, Portsmouth, Hants PO3 5PQ quoting reference BL 152.

(All posts are open to men and women)

Marconi
Space & Defence Systems

(2458)

WANDSWORTH HEALTH AUTHORITY

Atkinson Morley's Hospital: Department of Medical Physics

ELECTRONICS TECHNICIAN

A technician is required to design, build and develop microprocessor-based instruments including both associated hardware and software.

The person appointed will join a small team of scientists and technologists providing a service to Atkinson Morley's Hospital and to other Hospitals in the District and Region.

Educational standard will be at least H-TEC or HNC with a minimum of five years' appropriate experience, including work with microprocessors. The appointment will be in the grade of Medical Physics Technician II.

The starting salary will be £8,009, with increments up to a maximum of £9,835 including London Weighting. Post available from April 1984.

For further information please contact Ian Eversden, Principal Physicist.

Application form and job description available from:

Hospital Administrator
Atkinson Morley's Hospital
Copse Hill, Wimbledon
London SW20. Tel: 01-946 7711

(2479)

Electronic Opportunities !

- ★ RF and DIGITAL DESIGN
- ★ ATE APPLICATIONS
- ★ SALES and MARKETING
- ★ TEST and REPAIR

For details of these and our many other permanent and contract vacancies apply to:

D/M Technical Services
13 Station Approach
Northwood
STD: 09274 21622

(2489)

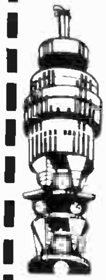
PICCADILLY RADIO
seeks an

ENGINEER

Qualified to HNC/HND to perform varied tasks in a friendly and challenging environment. No broadcasting experience required – training will be given. Good salary, shift allowance and bonus.

Apply:
Chief Engineer, Piccadilly Radio
P.O. Box 261, Manchester

Piccadilly Radio – An Equal Opportunities Employer (2449)



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If you have HNC/TEC or higher qualifications and are looking for a job in design, test, customer service, technical sales or similar fields:

Telephone now for our free jobs list
We have vacancies in all areas of the UK
Salaries to £15,000 pa

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(291)

UNIVERSITY OF ABERDEEN

Department of Bio-Medical Physics and Bio-Engineering

ELECTRONIC ENGINEER or PHYSICIST

of practical bent required in department of international reputation, to maintain electronic imaging equipment containing computers, particularly two X-ray CT Scanners in modern teaching hospital. Training will be provided.

Salary within Grade 1A Scale for Other Related Staff, £7,190 – £11,615 per annum, depending on qualifications and experience.

Further particulars and application forms from The Secretary, The University, Aberdeen with whom applications (2 copies) should be lodged by 15 March 1984. (2461)

ELECTRONIC ENGINEERS

Due to promotion, two Electronic Engineers, qualified to a minimum of HNC level, are required for our Electronic Maintenance Department.

Electronic Maintenance

One opportunity is to join the section responsible for repair to component level of studio broadcast equipment, including Video Switching and Processor Systems, Field Synchronisers, Telecine and Cameras. Applicants should be familiar with colour television technology and have experience in fault finding on analogue, digital or microprocessor based hardware.

Routine Maintenance

The second vacancy is within a team which ensures that the Industry Code of Practice is met through a comprehensive policy of measurement and routine maintenance of the electronic broadcast systems on the station. Test engineering experience on such systems with a television company or equipment manufacture is essential.

Starting salaries will be in a range up to £13,000, depending on qualifications and experience, plus overtime payments.

Applications in writing to:

Personnel Officer (Recruitment)
Yorkshire Television Limited
The Television Centre, Leeds LS3 1JS

(2475)

YORKSHIRE TELEVISION

VIDEO ENGINEERS

Rediffusion Consumer Manufacturing Ltd is seeking an intermediate and a senior video engineer with OND, HND or similar qualifications, together with a knowledge of modern consumer electronics circuitry techniques, to join a small team looking after Rediffusion's mammoth investment in domestic video recorders and video disc players.

In addition to analysis of performance and long term reliability factors, assessment reporting is an important part of the team's function and the ability to express oneself verbally and in writing is essential. Our laboratories are situated at Chessington within easy commuting distance of the Surrey countryside. Attractive salaries and the usual big company benefits, which include assistance with relocation expenses, are offered to suitably qualified and experienced engineers. If you believe you can make a significant contribution to our video projects please write to or phone:-

Harry Brearley,
Rediffusion Consumer Manufacturing Ltd.,
Fullers Way South,
Chessington, Surrey. KT9 1HJ.
Telephone: 01-397-5411.

REDIFFUSION

(2407)

Advanced telecommunications:

careers with extensive scope at Cheltenham

Join the Government Communications Headquarters, one of the world's foremost centres for R & D and production in voice/data communications ranging from HF to satellite – and their security. Some of GCHQ's facilities are unique and there is substantial emphasis on creative solutions for solving complex communications problems using state-of-the-art techniques including computer/microprocessor applications. Current opportunities are for:

Telecommunication Technical Officers

Two levels of entry providing two salary scales:
£6262-£8580 & £8420-£9522

Minimum qualifications are TEC/SCOTEC in Electronics/Telecommunications or a similar discipline or C & G Part II Telecommunications Technicians Certificate or Part I plus Maths B, Telecommunication Principles B and either Radio Line Transmission B or Computers B or equivalent: ONC in Electrical, Electronics or Telecommunications Engineering or a CIE Part I Pass, or formal approved Service technical training. Additionally, at least four years' (lower level) or seven years' (higher level) appropriate experience is essential in either radio communications or radar, data, computer or similar electronic systems. At the lower entry level first line technical/supervisory control of technicians involves "hands-on" participation and may involve individual work of a highly technical nature. The higher level involves application of technical knowledge and experience to work planning including implementation of medium to large scale projects.

Radio Technicians – £5485-£7818

To provide all aspects of technical support. Promotion prospects are good and linked with active encouragement to acquire further skills and experience. Minimum qualifications are a TEC Certificate in Telecommunications or equivalent plus two or more years' practical experience.

Cheltenham, a handsome Regency town, is finely endowed with cultural, sports and other facilities which are equally available in nearby Gloucester. Close to some of Britain's most magnificent countryside, the area also offers reasonably priced housing. Relocation assistance may be available.

For further information and your application form, please telephone Cheltenham (0242) 32912/3 or write to:

GCHQ

Recruitment Office, Government Communications Headquarters,
Oakley, Priors Road, Cheltenham,
Gloucestershire, GL52 5AJ.

(2452)

CAREER IN MUSIC ELECTRONICS

Music Electronics company specialising in the design of electronics for music industry requires an engineer to join design team.

Duties will include design and test, knowledge of digital, analogue, C.A.D., microprocessors.

Ability to work on own initiative. Knowledge of music and sound would be appreciated but not necessary. Ideal candidate will have HTC or HTD, HNC/HND degree or equivalent.

Sound knowledge of business administration will be expected. Excellent promotional prospects.

Salary negotiable. Position would suit ambitious graduate.

Applicants write with full C.V. to:

MUSIC ELECTRONICS CO.
c/o Kynastons (Business Consultants)
Block D, Metropolitan Wharf
Wapping High Street, London, E.1
Telephone: **01-265 0722** (24-hour phone)
or **01-806 5127** (Evenings)

(2418)

Appointments

Move up with a world leader

We have designed, developed and manufactured a series of products which have brought enormous advancements in data communications and established our dominance in international markets.

Now, due to expansion, we're looking for highly competent Repair Engineers to fill the following positions:

Senior Base Repair Engineer
(Message Switching Equipment)

Experience in the repair and testing, down to component level, of mini-computers and peripherals, micro-processors on 6800 and Winchester tech. disc systems is preferable.

Senior Base Repair Engineer
(Data Communications)

A sound background in data communications and experience of repairing and testing equipment, down to component level, is essential. The ability to program and some knowledge of Texas 9900 and Motorola 6800 micro-processors would be advantageous.

Probably in your mid 20's you must be able to demonstrate sufficient experience in a similar environment to equip you for these demanding and responsible positions. Competitive negotiable salaries, depending on the extent and relevance of your experience, are offered.

Our company's continuing success and exciting plans for the future create excellent prospects for career advancement and mean that we can offer a generous range of benefits, including bonus and profit share.

To apply, please write to, or telephone, Chris Burns at:

CASE

Computer and Systems, Engineering plc, Caxton Way, Watford Business Park, Watford WD1 8XH. Hertfordshire. Tel: Watford 33500.

(2488)

GUY'S HOSPITAL

DEPARTMENT OF CLINICAL PHYSICS AND BIOENGINEERING

This active, well-established and well-equipped Department provides a physical sciences service for a number of clinical departments in the hospital. We require a technician to join our electronics servicing group. This work includes the maintenance and servicing of a varied range of medical electronic equipment, and covers all aspects of patient orientated equipment from fixed installations to small portable instruments.

Experience in this type of work would be an advantage, but candidates with HM Forces experience, or a good background of TV servicing are encouraged to apply.

An ONC/HNC or equivalent qualification, plus at least three years' technical experience is essential.

The appointment will be on the Medical Physics Technician Grade 3 scale.

Salary: £7,174 to £8,968 p.a. inclusive.

Application forms are available from the Personnel Department, Guy's Hospital, London SE1 9RT. Tel: 01-407 7600, Ext. 3471. Please quote Ref: P/2. Closing date for completed application forms, March 30, 1984.

(2482)

LOGEX ELECTRONICS RECRUITMENT

Specialists in Field & Customer Engineering appointments, all locations and disciplines.

Logex House, Burleigh, Stroud Gloucestershire GL5 2PW

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(24 hours)

Inner London Education Authority
LEARNING RESOURCES BRANCH
Television Centre, Thackeray Road, London SW8 3TB

TECHNICIAN (ST1/2)

A Technician is required to work in the Schools TV Workshop to share in the operation and maintenance of its facilities. The colour studio enables students to make practical use of television equipment.

Candidates should have educational as well as relevant technical experience and should be able easily and quickly to establish a helpful relationship with visitors.

Salary £5,517-£8,316 plus £1,284 London Weighting

Further details and application form from EO/Estab 1b, Inner London Education Authority, Room 365, The County Hall, London SE1 7PB.

The closing date for receipt of completed application forms is **29th February, 1984.**

This vacancy is suitable for job sharing.

All applicants will be given equal consideration irrespective of sex, age, disabilities, race, colour, ethnic or national origins, marital status, sexual orientation, family responsibility, trade union activity or political belief.

(2456)

British Antarctic Survey

Radio Officers (Marine)

Vacancies exist for Radio Officers (Marine) to serve on the Survey's research vessels. Successful applicants would be required to commence duties on August 1, 1984. Voyages are normally seven months long and vessels sail from the United Kingdom in the autumn.

The Survey's vessels re-supply Antarctic land stations, support scientific parties in the field and in addition undertake shipborne research.

Candidates should possess valid certificates of proficiency recognised by the Department of Trade and have served the necessary sea time to work a single-handed station.

Starting salary in a scale up to £8,640, rising to £10,917 per annum. In addition an allowance of £1,200 per annum is payable for periods of service spent south of Montevideo.

For further details and an application form, please write, stating full qualifications and experience, to: The Establishment Officer, British Antarctic Survey, High Cross, Madingley Road, Cambridge CB3 0ET. Please quote ref: BAS 5. Closing date: March 14, 1984.

NATURAL ENVIRONMENT RESEARCH COUNCIL

(2492)

Appointments

Engineering Opportunities

As world leaders in the supply of communications, navigation and entertainment equipment to the mercantile marine and offshore industry, we need additional professional men and women to help us meet the demand for our expanding product range.

SYSTEMS PLANNING/ PROJECT ENGINEER

Would you like to be technically involved with the planning of communication systems to meet specific marketing requirements? If so this position has good prospects with an ultimate objective to engineer and manage major projects. You should be aged 30 to 40, a good organiser, of graduate level or equivalent, with a sound knowledge of communication systems both in a practical and theoretical sense.

DEVELOPMENT ENGINEERS

Radio Communications

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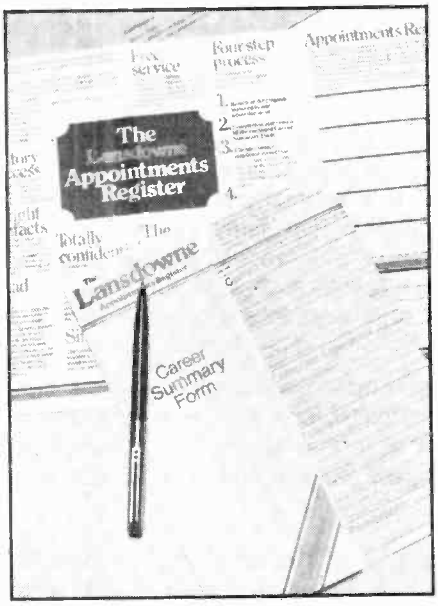

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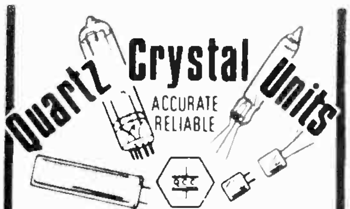

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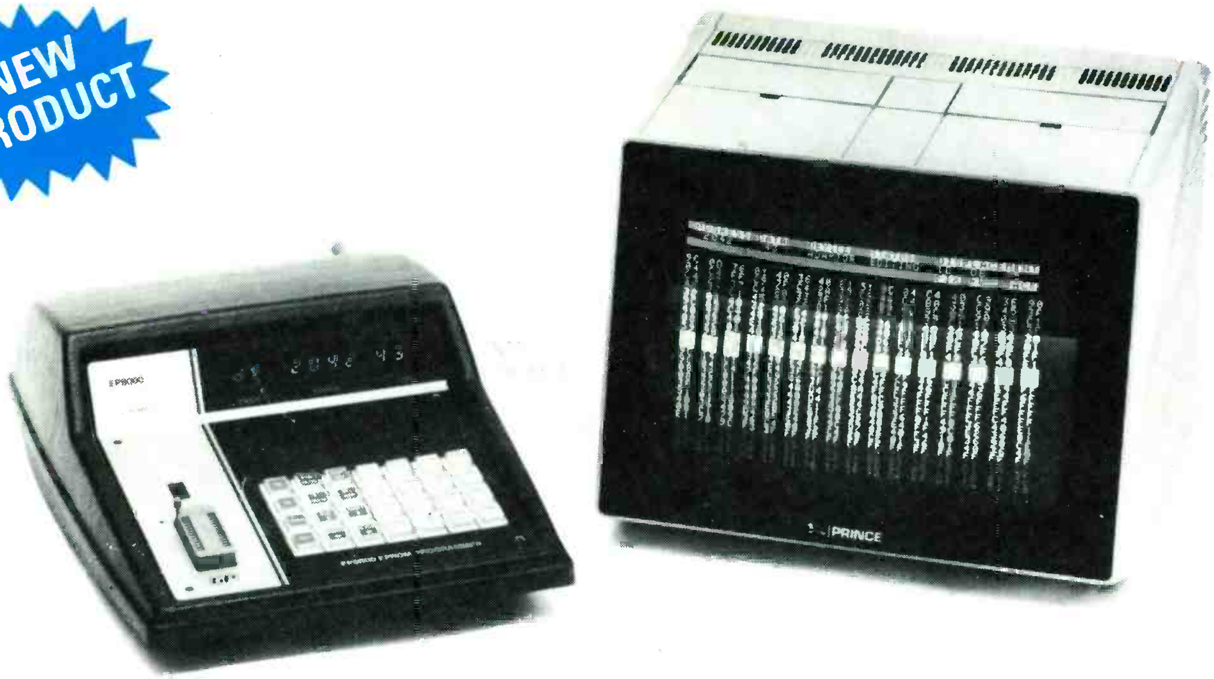

The new microprocessor controlled EP8000 Emulator Programmer will program and emulate all EPROMs up to 8k x 8 sizes, and can be extended to program other devices such as 16k x 8 EPROMs, Bipolar PROMs, single chip microprocessors with external modules.

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FEATURES

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- Built-in LED display for field use.
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