MARCH 1985 99p

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TRACKING:
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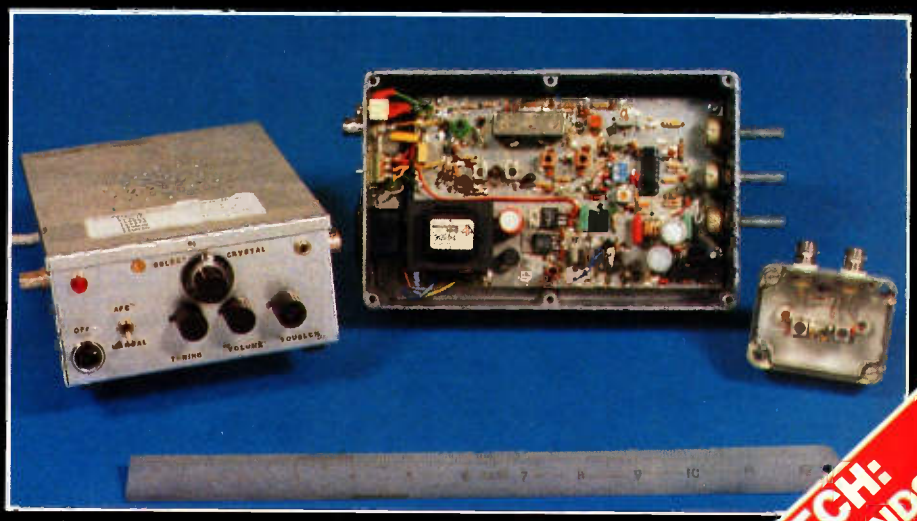
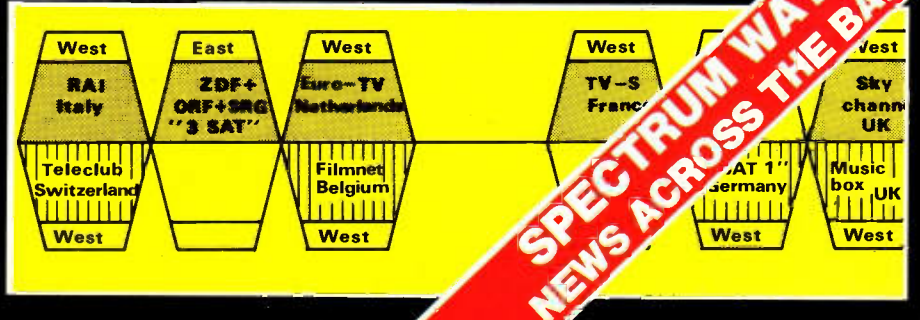
DATA FILE:
MORE CIRCUITS FOR 7-SEGMENT DISPLAYS

SW NEWS:
ALL THE LATEST FOR DXers

COSMOS & Co:
SOFTWARE FOR RUSSIAN SATELLITES





SPECTRUM WATCH: NEWS ACROSS THE BANDS

EAST CORNWALL COMPONENTS

TRANSISTORS DIODES

Type	Price (£)	Type	Price (£)
AC126	0.35	BC108	0.10
AC127	0.30	A B or C	0.12
AC128	0.30	BC113	0.14
AC128K	0.34	BC114	0.12
AC132	0.55	BC115	0.12
AC141	0.26	BC116	0.15
AC141	0.26	BC117	0.22
AC141K	0.40	BC118	0.17
AC142	0.26	BC119	0.30
AC142K	0.48	BC125	0.12
AC151	0.45	BC140	0.28
AC152	0.45	BC141	0.42
AC176	0.28	BC142	0.30
AC176K	0.46	BC143	0.30
AC187	0.42	BC147	0.08
AC187K	0.48	A or B	0.10
AC188	0.44	BC148	0.08
AC188K	0.50	A or B	0.10
ACY40	0.88	BC149	0.09
AD142	1.10	BC157	0.10
AD143	1.10	BC158	0.10
AD149	0.96	BC159	0.10
AD161	0.42	BC160	0.30
AD162	0.42	BC161	0.30
AD161/AD162	0.98	BC168B	0.12
AF106	0.48	BC169C	0.10
AF114	2.10	BC170	0.14
AF115	2.10	BC170B	0.12
AF116	2.10	BC171	0.10
AF117	2.10	BC171	0.10
AF118	0.85	A or B	0.08
AF121	0.62	BC172	0.08
AF124	0.48	A or B	0.12
AF125	0.48	BC177	0.20
AF127	0.48	BC178A	0.22
AF139	0.68	BC182	0.08
AF178	0.68	A B or C	0.09
AF239	0.68	BC182L	0.09
AF279S	0.72	A B or C	0.09
AL100	2.50	BC183	0.09
AL102	5.90	A B or C	0.10
AL113	2.20	BC183L	0.06
ASY80	1.75	A B or C	0.12
AU110	1.40	BC184	0.10
AY102	4.32	A B or C	0.10
BA102	0.34	BC207	0.15
BA110	0.67	BC208	0.16
BA121	0.40	BC212	0.09
BA129	0.38	A B or C	0.10
BA148	0.16	BC212L	0.08
BA154	0.08	A B or C	0.10
BA155	0.10	BC213	0.09
BA156	0.08	A or B	0.10
BA157	0.28	BC213L	0.10
BA164	0.14	A or B	0.10
BB104B	0.52	BC237	0.11
BB105B	0.30	BC236	0.12
BB105G	0.48	BC239	0.14
BB110B	0.42	BC251	0.12
BC107	0.10	A B or C	0.14
A or B	0.12	BC301	0.30
BC302	0.32	BD244A	0.65
BC303	0.32	BD375	0.32
BC307	0.10	BD410	0.76
BC308A	0.10	BD434	0.68
BC323	0.99	BD436	0.68
BC327	0.14	BD437	0.76
BC328	0.14	BD438	0.75
BC337	0.12	BD439	0.68
BC338	0.12	BD507	0.48
BC350	0.14	BD508	0.53
BC440	0.30	BD509	0.54
BC441	0.32	BD510	0.48
BC461	0.32	BD517	0.56
BC547	0.12	BD520	0.68
BC548	0.12	BD699	1.25
BC549	0.12	BD707	0.88
BC550	0.18	BDX18	2.35
BC550C	0.18	BDX32	2.10
BC557	0.12	BF115	0.32
BC558	0.12	BF117	0.54
BCX34	0.27	BF119	0.82
BCY70	0.15	BF120	0.38
BCY71	0.17	BF123	0.40
BCY72	0.18	BF125	0.42
BCZ10	1.68	BF127	0.38
BCZ11	1.45	BF152	0.16
BD124P	0.80	BF154	0.23
BC130Y	0.68	BF157	0.40
BD131	0.34	BF158	0.22
BD132	0.34	BF159	0.24
BD131/BD132	0.96	BFR160	0.23
BD135	0.32	BF167	0.30
BD136	0.36	BF173	0.25
BD137	0.36	BF177	0.42
BD138	0.38	BF178	0.30
BD139	0.38	BF179	0.32
BD140	0.38	BF180	0.35
BD144	160	BF181	0.35
BD145	1.82	BF182	0.32
BD150A	0.51	BF183	0.32
BD159	0.65	BF184	0.32
BD160	1.65	BF185	0.32
BD165	0.45	BF194	0.08
BD175	0.60	BF195	0.10
BD182	1.00	BF196	0.10
BD183	1.10	BF197	0.10
BD184	1.20	BF198	0.14
BD201	0.72	BF199	0.16
BD202	0.87	BF200	0.48
BD204	0.80	BF222	0.48
BD222	0.80	BF224	0.20
BD225	0.86	BF224J	0.16
BD232	0.45	BF240	0.20
BD233	0.60	BF241	0.26
BD234	0.62	BF244	0.26
BD235	0.63	BF244A	0.28
BD236	0.63	BF244C	0.24
BD237	0.66	BF245A	0.26
BD238	0.56	BF254	0.15
BD241	0.60	BF256	0.40
BD243A	0.80	BF257	0.32
BF258	0.30	BT101/300	1.15
BF259	0.32	BT101/500	1.25
BF262	0.30	BT102/300	1.35
BF263	0.30	BT102/500	1.65
BF270	0.30	BT106	1.50
BF271	0.26	BT108	1.30
BF273	0.18	BT109	1.18
BF274	0.32	BT116	1.25
BF323	0.92	BT119	3.62
BF336	0.26	BT120	3.60
BF337	0.26	BT121	3.02
BF338	0.26	BT138/600	1.30
BF355	0.42	BT151/560R	0.90
BF363	0.82	BT151/300R	1.15
BF367	0.24	BTY79/400R	2.80
BF371	0.27	BU100A	2.30
BF422	0.38	BU104	2.00
BF450	0.38	BU105	1.20
BF457	0.33	BU105/02	1.56
BF458	0.36	BU108	1.80
BF459	0.44	BU124	1.75
BFR39	0.22	BU126	1.25
BFR40	0.22	BU133	1.80
BFR41	0.22	BU204	1.35
BFR51	0.30	BU205	1.30
BFR61	0.32	BU206	1.70
BFR62	0.28	BU208	1.55
BFR88	0.34	BU208A	1.63
BFR90	1.72	BU208/02	2.05
BFT41	0.38	BU326S	1.75
BFT43	0.36	BU407	1.65
BFW10	0.79	BU407D	1.80
BFW44	0.76	BUX80	3.70
BFX29	0.28	BUY20	1.75
BFX30	0.30	BUY69A	2.60
BFX80	3.56	BUY69B	1.98
BFX84	0.24	DBY101	0.48
BFZ85	0.26	BY118	1.10
BFX86	0.26	BY122	0.68
BFX87	0.26	BY126	0.12
BFX89	0.65	BY127	0.10
BFY50	0.21	BY133	0.16
BFY51	0.21	BY135	0.25
BFY52	0.21	BY164	44
BFY57	0.40	BY179	0.66
BFY90	0.90	BY182	0.87
BFY90S	1.34	BY184	0.40
BR100	0.20	BY187	0.72
BR101	0.44	BY189	4.75
BR103	0.58	BY198	0.44
BRC443	1.76	BY199	0.47
BRY39	0.38	BY206	0.24
BRY56	0.42	BY207	0.24
BRY61	0.86	BY210/400	0.25
BSS17	0.56	BY210/600	0.26
BSS27	0.92	BY210/800	0.30
BSX19	0.34	BY223	1.20
BSX20	0.34	BY227	0.26
BSX59	0.62	BY229	0.30
BSX76	0.29	BY238	0.68
BT100A/02	0.94	BYX10	0.24
BYX36/150	0.22	TIP32	0.40
BYX36/600	0.28	TIP32C	0.60
BYX48/300	0.72	TIP33A	0.63
BYX49/300	0.47	TIP34A	0.72
BYX55/350	0.29	TIP41C	0.46
BYX55/600	0.33	TIP42A	0.52
BYX71/600	1.18	TIP47	0.60
BYZ12	0.42	TIP110	0.88
C106D	0.80	TIP2955	0.60
E1222	0.40	TIP3055	0.60
E5024	0.30	TIS43	0.32
GET872	0.48	TIS88	0.40
ITT44	0.04	TIS90	0.25
ITT2002	0.11	TIS91	0.28
MED402	0.20	ZTX108	0.12
MED404/2	0.24	ZTX109	0.12
MEU21	0.60	ZTX212	0.28
MJ400	1.25	IN4001	0.05
MJ2955	0.90	IN4003	0.05
MJ3000	1.98	IN4004	0.06
MJE240	0.60	IN4006	0.07
MJE340	0.54	IN4007	0.07
MJE370	0.88	IN4148	0.05
MJE520	0.48	IN5400	0.12
MJE2955	0.99	IN5402	0.15
MJE3055	0.70	IN5405	.16
MPSLO1	0.28	IN5406	0.18
OA47	0.10	IN5408	0.20
OA90	0.08	IS920	0.08
OA91	0.09	2N697	0.55
OA95	0.18	2N706A	0.33
OA200	0.06	2N2904	0.28
OA202	0.15	2N2906	0.24
OC25	2.10	2N2926G	0.10
OC26	1.70	2N3053	0.22
OC28	1.50	2N3054	0.58
OC29	2.47	2N3055	0.45
OC35	1.75	2N3702	0.10
OC36	1.75	2N3704	0.10
OC42	0.72	2N3708	0.10
OC42K	1.40	2N3772	1.90
OC44	0.72	2N3773	2.70
OC45	0.58	2N3904	0.16
OC71	0.50	2N3906	0.16
OC72	0.52	2N5294	0.48
OC81	0.68	2N6107	0.71
OC200	2.45	2N6126	0.68
OC202	2.20	2SB337	1.60
OPR12	0.85	2SC1172Y	2.90
R2008B	1.50	2SC1173Y	0.82
R2010B	1.52	2SC1302	1.40
SHG1.5	0.40	40251	0.95
TAG1/100	1.40	40361	0.58
TAG3/400	1.78	40362	0.50
TIC44	0.40	40411	3.72
TIC45	0.45	40530	0.80
TIC46	0.48	40673	0.80
TIC47	0.70	40964	1.54
TIC106A	0.70	2SJ50	5.20
TIP30A	0.46	3SK88	0.66
TIP31C	0.54	3SK125	5.20

VOLTAGE REGULATORS

Type	Price (£)
78L05	0.30
78L08	0.30
78L12	0.30
78L15n	0.30
78M05	0.50
78M08	0.50
78M12	0.50
78M15	0.50
78M24	0.50
7805	0.55
7808	0.56
7812	0.55
7815	0.55
7818	0.55
7824	0.55
7905	0.65
7912	0.65
7915	0.65
7918	0.65
7924	0.65
CA3085	0.95
723C	0.36
LM317K	3.50
LM317T	0.90

74LS SERIES

SN74LSOON	0.28
SN74LSO1N	0.28
SN74LSO2N	0.28
SN74LSO3N	0.28
SN74LSO4N	0.32
SN74LS14N	0.58
SN74LS20N	0.28
SN74LS27N	0.28
SN74LS32N	0.28
SN74LS38N	0.43
SN74LS40N	0.28
SN74LS42N	0.65
SN74LS48N	0.70
SN74LS51N	0.34
SN74LS55N	0.25
SN74LS74AN	0.38
SN74LS78AN	0.45
SN74LS90N	0.54
SN74LS123N	1.15
SN74LS138N	0.45
SN74LS164N	0.93
SN74LS165N	1.20
SN74LS190N	0.98
SN74LS244N	1.00
SN74LS245N	2.00
SN74LS247N	1.15
SN74LS283N	0.93
SN74LS353N	1.20
SN74LS367AN	0.60
SN74LS368N	1.15
SN74LS390N	0.89
SN74LS670N	1.88

VALVES

Type	Price (£)
DY802	0.88
DY86/87	0.75
ECC81	0.85
ECC82	0.65
ECC83	0.75
ECC84	0.65
ECC85	0.90
ECC88	0.95
ECF80	0.90
ECH81	0.75
ECH84	0.75
ECL82	0.75
ECL86	0.98
EF80	0.65
EF86	1.65
EF183	0.75
EF184	0.75
EH90	0.54
EL34	2.50
EL84	0.69
EL509	5.50
EM87	2.55
EY86/87	0.67
EY500A	1.65
PC80	0.50
PCC85	0.65
PCC89	0.74
PCC189	0.85
PCF80	0.75
PCF86	1.25
PCF200	1.55
PCF801	1.45
PCF802	0.85
PCF806	1.20
PCL82	0.90
PCL83	2.50
PCL84	0.90
PCL86	0.58
PCL805/85	1.35
PD500	3.75
PFL200	1.35
PL33	1.50
PL36	1.45
PL81	0.85
PL82	0.75
PL83	0.65
PL84	0.75
PL95	2.00
PL504	1.20
PL508	2.40
PL509/519	7.50
PY88	1.80
PY500A	2.40
U26	1.90
UCH81	0.30
UCL82	1.70
6J5GT	1.75
6SJ7	2.20
30FL12	1.60
6JB6A	4.00

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ZENER DIODES

400mW Plastic 3V-75V **8p each 10/75p**
1.3W Plastic 3V-200V **15p each 10/£1.40**
1.5W Flange 4.7-47V **£1.26 each**
2.5W Plastic 75-75V **64p each**
20W Stud 75-75v **£1.35 each**

INTEGRATED CIRCUITS

	(£) EACH		
AN240P	3.42	SN76530P	1.40
AN214Q	3.88	SN76533N	1.60
AN715Q	2.90	SN76650N	1.05
CA3065	1.75	SN76660N	0.75
CA4031P	2.88	SN76666N	0.80
CA4102	3.30	STK015	6.50
CA4250	3.50	TA7108P	3.20
CA4400	2.98	TA7120P	2.20
CA4422	3.07	TA7129AP	3.65
LC7120	5.33	TA7130P	1.65
LC7130	5.26	TA7172	1.80
LC7137	5.16	TA7193	5.50
LM380N	0.80	TA7172P	1.80
LM1303N	2.52	TA7176	2.50
HA1151P	3.12	TA7202P	4.18
MC1307P	1.85	TA7204P	1.86
MC1310P	1.85	TA7205AP	1.50
MC1312P	2.25	TA7208P	3.25
MC1327P	1.75	TA7210P	.50
MC1330P	0.83	TA7222P	1.88
MC13449P	1.85	TA7223P	3.68
MC1350P	1.20	TA7227P	5.60
MC1351P	2.50	TA7310P	1.80
MC1352P	1.50	TA7609P	4.28
MC1357P	.88	TA7611AP	2.88
MC1358P	1.30	TAA263	2.46
MC1496L	1.15	TAA310A	2.68
ML231B	2.10	TAA550	0.50
ML232B	2.10	TAA570	1.99
ML237B	2.30	TAA611A12	3.50
NE555	0.25	TAA611B12	2.85
C-mos 555	0.88	TAA630S	3.90
NE556	0.80	TAA661B	1.70
SAA1024	5.35	TAA700	2.80
SAA1025	8.40	TAA840	3.38
SAS560A	2.50	TAD100	2.80
SAS560S	1.85	FM FILTER	1.20
SAS570S	1.85	TBA120A	1.00
SAS580	2.82	AS,S,SA,SB	1.30
SAS590	2.82	Q,T,U,UQ	1.32
SC9503P	1.10	TBA120B	1.30
SL432A	4.00	TBA231	1.45
SL901B	5.20	TBA281	2.65
SL917B	6.25	TBA395	1.20
SL1327Q	1.10	TBA480Q	1.50
SN76003N	2.44	TBA400	2.30
SN76013N	1.90	TBA510	2.60
SN76023ND	2.90	TBA510Q	2.60
SN76033N	2.45	TBA520/Q	1.60
SN76110N	1.12	TBA530/Q	1.30
SN76115N	2.00	TBA540/Q	1.40
SN76131N	1.65	TBA550/Q	1.52
SN76226DN	1.80	TBA560C	1.70
SN76227N	1.10	TBA560CQ	1.60
TBA570	1.50	UPC1032H	0.90
TBA651	2.80	UPC1156H	4.20
TBA673	2.40	UPC1158H	0.76
TBA700	2.85	UPC1163H	0.98
TBA750	2.80	UPC1181H	1.60
TBA800	1.60	UPC1185H2	3.75
TBA810P	1.10	UPC1212C	1.30
TBA810S	1.20	UPC1230H	3.90
TBA820	1.60	UPC1350C	4.25
TBA890	3.88	UPC1367C	3.40
TBA920/Q	3.00	UPC1378H	4.40
TBA950/2A	3.05	UPC2002H	2.60
TBA970	4.05		
TBA990	1.88		
TCA160C	3.90		
TCA270S	4.00		
TCA270SA	4.02		
TCA800	3.10		
TCA940	1.90		
TDA440	3.80		
TDA1002	1.90		
TDA1003A	5.50		
TDA1004A	2.90		
TDA1006A	2.40		
TDA1035S	4.50		
TDA1044	4.30		
TDA1170S	3.00		
TDA1190	3.50		
TDA1200	2.98		
TDA1270Q	3.70		
TDA1327A	1.58		
TDA1352A/B	1.56		
TDA1412	1.20		
TDA2002	2.80		
TDA2020	4.60		
TDA2030	2.78		
TDA2140	5.90		
TDA2521	4.10		
TDA2523	3.50		
TDA2530	2.70		
TDA2540	3.60		
TDA2541	3.60		
TDA2560	3.50		
TDA2571A	2.50		
TDA2581	3.20		
TDA2590	3.20		
TDA2591	2.98		
TDA2593	2.98		
TDA2610	3.20		
TDA2611A	1.94		
TDA2640	2.90		
TDA2680	3.40		
TDA2690	3.50		
TDA3950/A/B	2.60		
UPC554C	1.32		
UPC557H	0.90		
UPC566H	2.95		
UPC575C2	3.20		
UPC1018C	1.10		
UPC1025H	2.90		

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0.1in Clad,
2½ x 3¾" **85p**
2½ x 5" **1.00**
3¾ x 3¾" **1.05**
3½ x 17" **3.25**
3¾ x 17" **4.10**
4¾ x 17¾" **4.95**
0.1in PLAIN.
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3¾ x 17" **2.70**
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Vero Strip **1.25**
Pkt. of 100 pins **50p**
Spot face cutter **1.48**
Pin insert tool **1.83**
Vero Wiring Peg + spool **4.50**

SERVICE AIDS

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Switch Cleaner **0.98**
Circuit Freezer **1.14**
Foam Cleanser **0.96**
Aero Klene **0.90**
Silicone Grease (Aerosol) **1.64**
Silicone Grease Tbe **1.60**
Antistat Spray **0.98**
Plastic Seal **1.08**
Excel Polish **0.92**
Fire Extin 640g **2.86**
Video Head Cleaner **0.86**
Super 40 Moisture Fepellant & Lub **1.62**

SOLDA MOP

Std. **0.72**
L/Gauge **0.72**
Industr. **2.90**
Additional P&P on above — 30p. each

RESISTORS — CARBON FILM 5%

¼W 1RO to 10M (E12 Range) **2p each. 15p/10. 75p/100**
½W 2R2 to 10M (E24 Range) **2p each. 15p/10. 75p/100**
1W 10R to 2M2 (E12 Range) **7p each. 65p/10. 6.00/100**
2W 10R to 2M2 (E6 Range) **8p each. 70p/10. 6.00/100**

RESISTOR KITS — each value individually packed

¼W pack 10 each value E12 — 10R to 1M 610 pieces **5.00**
¼W pack 5 each value E12 — 10R to 1M 305 pieces **3.00**
½W pack 10 each value E12 — 2R2 to 2M2 730 pieces **6.00**
½W pack 5 each value E12 — 2R2 to 1M 365 pieces **3.00**
1W pack 5 each value E12 — 2R2 to 1M 353 pieces **15.00**
2W pack 5 each value E6 — 10R to 2M2 317 pieces **18.00**

RESISTORS — WIREWOUND Generally 5%

2-5W 0·22 to 270R Available in preferred values **0.20**
4W 1R0 to 10K. Available in preferred values **0.21**
7W 0·47R to 22K. Available in preferred values **0.25**
11W 1R0 to 22K. Available in preferred values **0.29**
17W 1R0 to 22K. Available in preferred values **0.37**

FUSES

1¼in Quick Blow 100 150 **250mA £1.30** 1 1.25 1.5 2.5 3 10 15A
55p 1¼in Time Delay 100mA **£3.50** 150mA**£2.25** 250 300 500 600 750 850mA **£1.84** 1 1.25 1.5 1.6 2A **£1.84** 2.5A 3 15 3.5A **£2.82 20mm Quick Blow** 100 125 160 200 250 315 400 500 600 800mA 1 1.25 1.5 2 2.5 3.5 4 5 6.3A **40p 20mm Time Delay** 100 125 150 200mA **£1.80** 750 300 400 500 600 800mA **£1.00** 1 1.25 1.5 2 2.5 3A **85p 1in Mains** 2 3.5 7 10 13A **85p**
Manufacturers please note – we can offer very competitive production quantities of 20mm Quick Blow & Time Delay range – apply for quotation

NI-CAD

Universal Ni-Cad charger, charges PP3, AA, C.D Price **£5.00**

RECHARGEABLE BATTERIES

AA HP7	0.85	10/**0.75 each.**
C HP11	1.75	10/**1.65 each.**
D HP2	2.05	10/**1.95 each.**
PP3	3.80	10/**3.70 each.**

PLUGS & SOCKETS

Metal Co-ax Plug	**0.18**
Plastic Co-ax Plug	0.14
Single Junction Socket	0.80
Plastic Phono	0.10
F.M Plugs	0.20
PL259	0.38
Reducer	0.15
2.5mm Plug Meta	0.15
2.5mm Plug Metal	0.16
2.5mm Chassis Socket	0.10
3.5mm Chassis Socket	0.10
2 pin ¼in Mono Chassis Socket	0.14
4 pin ¼in Mono Chassis Socket	0.20
6 pin ¼in Mono Chassis Socket	0.30
4mm Banana Plug	0.15
4mm Banana Socket	0.15
PP3 Battery Connectors	0.08
PP9 Battery Connectors	0.16

Sockets

12mm Panel Mounting	0.28
20mm Chassis Mounting	0.06
¼in Panel Mounting	0.35
¼in Chassis Mounting	0.342
Carline ¼in Mounting	0.10

Terminal Blocks

2 amp 12 way	0.19
5 amp 12 way	0.20
15amp 12 way	0.48
32amp 12 way	0.92

Soldering Section

XS25 Watt Iron Kit/complete with stand & plug attached **7.20**
CS 18 Watt as above **7.00**
ANTEX 15W IRON **5.00**
ANTEX 18W IRON **5.00**
ANTEX 25W IRON **5.20**
ANTEX ELEMENTS **2.00**
ANTEX STANDS **0.95**
SOLDERSUCKER **4.50**
500gm SOLDER **6.80**
SOLDA MOP **0.70**
ANTEX SOLDERING STATION complete with Iron – 30W or 40W **49.95**
Spare nozzles for Soldersucker **0.45**

POTENTIOMETERS

Carbon Track Rotary 0.25W Log & Lin values. All ¼in Spindle. 20mi body dia, Sahft 2" long

4K7-2M2 Single Gang Log	.30	10/**3.00**
1K — 2M2 Single Gang Lin	.32	10/**3.00**
5K — 2M2 Single Gang DP Switch Log	.75	10/**7.00**
5K — 2M2 Double Gang Log & Lin	.86	10/**8.25**

MIN 'D' CONNECTORS

		9way	15way	25way	37way
PLUS	Solder	.52	.65	.88	1.45
	Lug	.89	1.34	1.98	3.48
	R Angle	.78	.98	1.33	2.48
SOCKETS	Solder	1.18	1.78	2.70	4.15
	Lug	.95	.95	.98	1.00
COVERS	R Angle				

4000	0.24	4076	0.68	4526	0.60
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4002	0.25	4078	0.25	4528	0.68
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4012	0.24	4085	0.58	4536	2.65
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4014	0.60	4089	1.25	4539	0.90
4015	0.60	4093	0.37	4541	0.90
4016	0.40	4094	0.95	4543	1.25
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4020	0.85	4097	2.65	4554	1.92
4021	0.58	4098	0.80	4555	0.35
4022	0.96	4099	1.05	4556	0.55
4023	0.35	4161	0.96		
4024	0.50	4162	0.96		
4025	0.24	4163	0.96		
4027	0.45	4174	0.96		
4028	0.45	4175	1.00		
4029	0.75	4194	0.99		
4030	0.35	4501	0.38		
4031	1.30	4502	0.38		
4033	1.25	4503	0.40		
4034	1.46	4507	0.48		
4035	0.70	4508	1.30		
4036A	2.75	4510	0.55		
4038	0.75	4511	0.55		
4039A	2.80	4512	0.55		
4040	0.60	4514	1.15		
4068	0.24	4515	1.15		
4069	0.24	4516	0.55		
4070	0.25	4517	2.70		
4071	0.24	4518	0.48		
4072	0.25	4020	0.53		
4073	0.25	4521	1.15		
4075	0.25	4522	1.25		

MICRO

2764-250n/s	5.80
Z80A-CPU	3.70
Z80A-CTC	3.30
Z80-ADNA	9.00
Z80-API0	3.40
Z80-AS10/0	8.75
Z80-AS10/2	8.99

IC SOCKETS Dil to Dil

8	pin	0.08
14	pin	0.10
16	pin	0.11
18	pin	0.14
22	pin	0.21
24	pin	0.25
28	pin	0.30
40	pin	0.34

BRIDGES

1½2A 50V	0.27
200V	0.32
600V	0.50
3A 100V	0.52
600V	0.67
6A 100V	0.66
600V	0.80
10A 50V	2.20
400V	2.50
25A 50V	2.05
400V	3.20

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Safety in the shack

Some of the constructional projects featured refer to additions or modifications to equipment; please note that such alterations may prevent the item from being used in its intended role, and also that its guarantee may be invalidated.

When building any constructional project, bear in mind that sometimes high voltages are involved. Avoid even the slightest risk – safety in the shack please, at all times.

Cover Photographs
Top – New software for the Trace Digiscope 8612 (p4)
Middle – Russian satellite reception hardware (p23)
Bottom – Spectrum Watch (p16)

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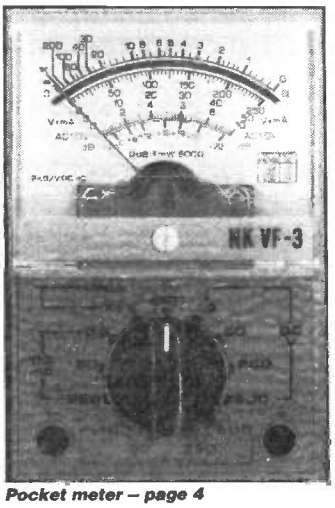
REGULARS

READER SERVICES

NEXT MONTH

☐ **Next Issue**
Cover date April 1985 on sale Thursday, 14 March

☐ **Publication Date**
Second Thursday of the month preceding cover date



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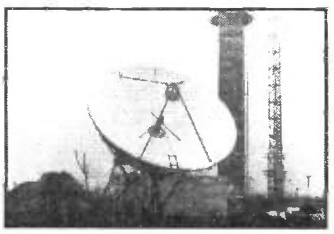

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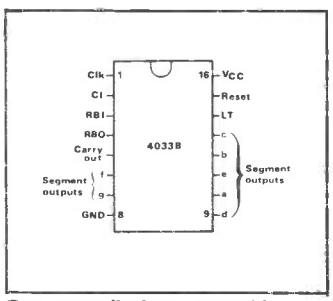

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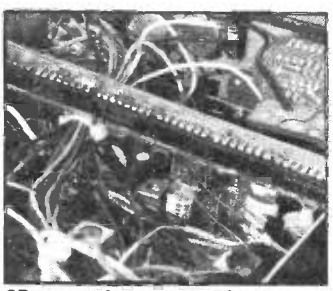


CB conversions – page 52

Buenas noches, Buenos Aires – page 62

PRODUCT NEWS

Featured on these pages are details of the latest products in communications, electronics and computers. Manufacturers, distributors and dealers are invited to supply information on new products for inclusion in Product News.
Readers, don't forget to mention ***Radio & Electronics World*** when making enquiries

SOFTWARE FROM MSS

Just announced by Microsystem Services (MSS) is a new software suite which allows the Trace Digiscope 8612 digitiser/storage oscilloscope to function as an FFT analyser.

Known as AMS II (advanced mathematics software), it is designed for studying continuous, changing or transient events in vibration, sound or electronics. Its use adds new and enhanced waveform processing capabilities – FFT, integration, differentiation, averaging and correlation – to the Digiscope 8612, enabling the instrument to cover both the time and frequency domains.

The FFT function in AMS II allows user-definable display modes which enhance the Digiscope's exclusive capability to show recorded, stored and computed waveforms in colour. With AMS II it is possible to select real or complex amplitude spectrum, and linear or logarithmic amplitude axes.

The user can also choose between several spectra such as phase, amplitude, sine, cosine and power – whichever is most suitable for the application.

Different weighting functions have been included in the software to allow better analysis for the frequency domain display; the user may select 'Flat' for no weighting, 'Hanning Window' or self-defined window.

The combination of AMS II with the unique digitiser/storage oscilloscope provides a powerful and extensive diagnostic system in a compact mainframe – able to cover virtually any requirement for laboratory, field service and production testing.

Full details of both the AMS II package and the Trace Digiscope Colour 8612 are available from the sole UK distributors MSS.

Microsystem Services,
PO Box 37,
Lincoln Road,
Cressex Industrial Estate,
High Wycombe,
Bucks, HP12 3XJ.
Tel: (0494) 41661.

ANALOGUE MULTIMETER

TMK Test Instruments have announced the VF3, a small pocket size analogue multimeter, featuring a full range of functions with a high sensitivity of 2000 ohms/volt on all dc and ac ranges, assuring accurate measurements without unnecessary loading of the circuit under test. Included in the 16 measurement ranges are dc and ac volts, dc current, ohms and decibels.

Rugged and reliable with a high impact resistant case, the VF3 is very easy to use. It has a single rotary switch giving analogue indication on a mirror arc scale to reduce parallax error and the meter movement is protected against accidental overload.

The VF3 comes complete with test leads and a long-lasting battery. It weighs approximately 90gms and its dimensions are 90 x 60 x 29mm. The retail price is £7.00.

TMK Test Instruments,
138 Grays Inn Road,
London WC1X 8AX.
Tel: (01) 837 7937.

MOBILE ANTENNA

About to be launched by ARM, the Multi-P6+ mobile antenna promises to be as versatile as a boy scout's pocket knife.

This all stainless steel British made aerial should satisfy all the needs of the discerning mobile operator. Designed primarily for 2m multi-mode working, the P6 is many aerials in one. It will operate vertical or horizontal, directional or omni-directional. It can be used as a DF loop or, by attaching the extra element, is easily converted to a directional horizontal collinear – ideal for hilltop DX working.

In addition to all this, its free space design allows these facilities to be used off the car, indoors or out. The tuning stub is continuously adjustable for higher frequencies, including 70cm. Performance in the vertical plane is equal to the popular ⅝ but not having to rely on the vehicle as a ground plane means that a better all round radiation pattern is claimed by the designer.

R Withers Communications,
584 Hagley Road West,
Oldbury,
Warley,
West Midlands.
Tel: (021) 421 8201/2.

RF POWER COMPUTER

Fieldtech Heathrow Limited has announced the availability of a new RF power computer. Manufactured by Coaxial Dynamics Inc, the model 83500 RF Power Computer provides complete system flexibility by means of the quick match line section which slips on and latches to The Expediter power computer, forming a single field unit.

Alternatively, the quick match cables can be slipped into the bench-mounted line

section for convenient out-of-the-way power computations.

The Expediter power computer may also be used for testing remote transmitters by simply connecting the matching cables into the permanently installed line section for the power computations. There is no need to keep breaking lines or installing meters at each site.

The Expediter power computer provides the following functions: two modes of operation, analogue for fast tuning and digital for accuracy; advance ¾ inch LCD display; programmable forward and reflected power ranges; compatibility with existing elements; up to three months life on a single battery charge; auto prompting and auto diagnosing for convenience; annunciators for all functions, modes, and conditions; 18 ranges from 100mW to 500KW.

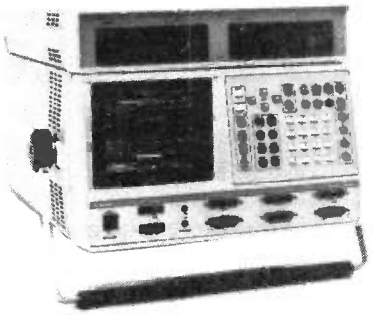
Fieldtech Heathrow Ltd,
Huntavia House,
420 Bath Road,
Longford,
Middlesex UB7 0LL.
Tel: (01) 897 6446.

LOGIC ANALYSER

Making its UK debut at the 1985 Microprocessor Development show was a new high-performance logic analyser, the K205, from Gould Design & Test Systems.

The K205 offers advanced circuit analysis capabilities and triggering power. Designed to solve at least 95 per cent of the toughest design problems, the K205 has 48 channels at 100MHz, thus making it ideal for high-speed bit-slice microprocessors, ECL devices, gate arrays, and discrete logic designs.

The logic analyser features 16 independent triggering decision levels, with four commands in each level. Four decisions can be made every 20 nanoseconds (nS), enabling designers to locate difficult logic problems by selectively triggering on a unique event. Trigger points can be chosen while running at full speed through logic sequences, without restrictions. This triggering method, known as *trace control,* is 150 per cent faster than any comparable scheme.



The K205's tolerance compare feature allows fast analysis of logic circuits by comparing timing sequences against stored references. This facility eliminates sampling error difference inherent in asynchronous analysis. Reference data can be stored automatically via an input/output port, by testing a known good circuit, or by testing a known bad circuit, and manually editing a correct pattern.

Other features include an auto save facility to allow automatic storage of multiple measurements on the K205's disk drives without user intervention, and a glitch mode, which displays transient noise on all channels.

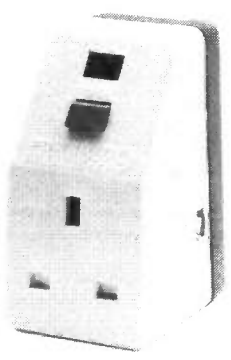
Gould Design & Test Systems also exhibited the 9508T, a stand-alone in-circuit emulator which supports all of the popular 8-bit microprocessors and microcomputers.

Gould Instruments Ltd,
Roebuck Road,
Hainault,
Ilford,
Essex.

POWERBREAKER

The PowerBreaker-20 electrical adaptor has been selected by the Design Council for the Design Centre. Manufactured in Britain by B&R Electrical Products Ltd, PowerBreaker-20 plugs into any standard 13A socket prior to plugging in an appliance and provides a high degree of protection against electrocution in the event of an accident. It also incorporates additional safety features.

Most electrical accidents result from cut or frayed cables, loose connections, exposure to dampness or humidity, contact with water, abuse or misuse of equipment. B&R point out that less than ¼ amp can kill, yet will not blow a fuse, and the only effective way to guard against such dangers is by using a residual current circuit breaker (RCCB). PowerBreaker-20 provides RCCB protection in a convenient, portable form. When danger threatens, it senses a tiny amount of electricity flowing to earth – through a human body, for example – and cuts off the current in a split second.



PowerBreaker-20 is built to the relevant requirements of BS1363 and BS4293. Its additional safety features include a 'power-on' indicator lamp, a test button and automatic current cut-off with illumination of a warning light if the adaptor should be plugged into an incorrectly wired socket (live and neutral reversed). Designed for 220/240V, 50Hz operation, PowerBreaker-20 incorporates a 13A fuse to BS1362 and is slim enough for two units to fit side by side into a double-socket outlet.

Selection for the Design Centre means that a product not only represents the best in British design, having satisfied the tough criteria set by the Design Council, but also, in the case of a product such as PowerBreaker-20, that it has been tested by an independent test house for conformity with the relevant published safety standards.

B&R Electrical Products Ltd,
Temple Fields,
Harlow,
Essex CM20 2BG.

VOLTAGE CONVERTER

In common with other leading semiconductor manufacturers GE Intersil Semiconductor has developed surface mounting package variants of its standard product line, and the first GE Intersil CMOS linear IC to appear in the SO 8 lead package, the ICL7660CBA, is now in full commercial production.

The ICL7660CBA is a CMOS voltage converter developed for applications in data acquisition and in microprocessor based systems where a positive supply is available.

It performs a complete supply voltage conversion from positive to negative over an input range of +1.5V to +10.0V. The conversion results in complementary voltages of −1.5V to −10.0V being available at the output and conversion is achieved with a typical power efficiency of 98% and a typical open circuit efficiency of 99.9%.

Volume quantities of other Intersil linear CMOS products housed in surface mounting packages will soon be available too.

GE Intersil Semiconductor Division,
Intersil Datel (UK) Ltd,
Belgrave House,
Basing View,
Basingstoke,
Hants RG21 2YS.
Tel: (0256) 57361.

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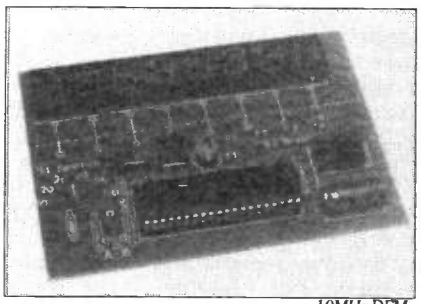
10MHz DFM

A DFM capable of operating at frequencies up to 10MHz. The kit can be configured in six different measurement modes including: frequency, period, elapsed time and unit counter. Applications can be extended using the CIRKIT prescaler and preamp.

SPECIFICATION: Input signal: 2.0V (min) TTL. Frequency range: 0 to 10MHz. Period measurement: 0.5 to 10 secs. Time measurements: up to 10 secs. Output: BCD multiplexed. Display: 8 digit 12mm LED. Supply: 6-9V DC at 100mA(nom).

41-01500 54.10



10MHz DFM

DFM PRE-AMPLIFIER

The rise time of some low frequency signals, even apparent square waves, is often too slow to give a constant readout from a DFM. The use of a pre-amp ensures that these signals are input to the DFM at the correct level and with the correct shape. This simple addition greatly increases the effectiveness of a DFM at low frequencies.

SPECIFICATION: Frequency range: 1Hz-5MHz. Sensitivity: 1Hz-3MHz:20mV, 3MHz-5MHz: 40mV. Max input voltage: 100V (220V instantaneous). Power supply: 5V 8mA. Input signal: Any. Output signal: TTL square wave.

41-01502 5.13

DFM PRESCALER

This prescaler is intended for use with the Cirkit 10MHz DFM, although it is compatible with other frequency counters. The function of the prescaler is to divide the incoming frequency by ten and to shape it into a waveform suitable for the digital input requirements of the DFM. This enables the frequency range of the DFM to be extended up to 50MHz.

SPECIFICATION: Supply voltage: 5V DC. Nominal current: 25mA. Frequency range: 10kHz-50MHz. Input sensitivity: 20mV(typical). Output: 5V TTL level. Dimensions: 80mm x 50mm.

41-01501 8.55

2m POWER AMP

A carefully designed 20W, 144MHz linear power amplifier, to boost the output of hand-held and transportable transceivers such as the TR2400 IC2E, FT208, FT290 etc. With 10dB gain to give a 20W output from a 2W input. Automatic changeover relay - switched from RF sense circuit. High power - output relay, robust construction with die-cast box, plus RX pre-amp.

SPECIFICATION: Bandwidth -3dB: 144-146MHz. Power gain: min 10dB. Output power; 1W input: 10W, 2W input: 20W. Supply voltage: 10-16V. Supply current (at 12V): <3amps-20W output. Input/Output impedance: 50Ω. Size (excluding sockets): 122 x 96 x 44mm. Pre-amp section spec as 2m Pre Amp Kit.

41-01404 32.87

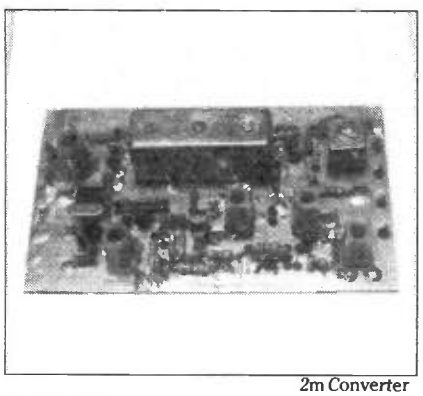
2m CONVERTER

Low noise 2m to 10m converter. This design uses low noise dual gate MOSFETs in the RF and mixer stages which, together with a TOKO pre-aligned helical filter and pre-wound coil, give a high specification and repeatable performance.

A reliable 116MHz overtone oscillator circuit is followed by a double tuned stage which gives a very clean output, this reduces spurii to a minimum. As the circuit is basically linear any mode - AM, FM or SSB - can be converted. The complete circuit is built onto a double-sided PCB.

SPECIFICATION: Noise figure: Less than 2dB. Gain: Min 22dB. 3dB Bandwidth: 144-146MHz. IF Output: 28-30MHz. Input/Output impedance: 50Ω. Supply voltage: 10-16V. Supply current (at 12V): 28mA. Size: 97 x 57 x 22mm.

41-01306 17.35



2m Converter

2m PRE-AMP

Very compact low-noise MOSFET 2m pre-amp. The overall PCB is sufficiently small to be installed inside receivers or transceivers.

SPECIFICATION: Noise figure: Better than 1.5dB. Gain: 18dB Min. Input/Output impedance: 50Ω. Size: 34 x 13 x 10mm.

KIT INCLUDES: Double-sided PCB - All resistors - All capacitors - MOSFET - Coils and cans.

41-01307 3.91

To: Cirkit Holdings PLC, Park Lane, Broxbourne, Hertfordshire. EN10 7NQ.
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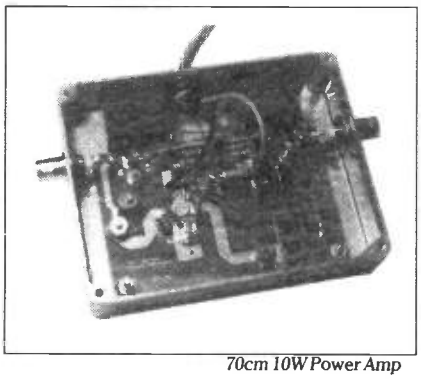
70cm CONVERTER

70cm to 144MHz low profile converter employing high level Schottky diode double balance mixer, pre-aligned helical filter and low noise transistors. The complete design gives a low noise figure and uses pre-aligned filters and pre-wound coils to give repeatable performance with minimum alignment.

SPECIFICATION: Bandwidth: 430-440MHz. RF Gain: 8dB min. Noise figure: <2.5dB. IF output: 144-146MHz. Supply voltage: 10V. Supply current: 30mA. Size: 97 x 57 x 15mm.

41-01405 21.50



70cm 10W Power Amp

70cm 10W POWER AMPLIFIER

The current generation of UHF handheld synthesised transceivers have almost all the facilities found in mobile/base transceivers, the only major limitation being their output power. For handheld operation 1 watt or so is adequate, but for mobile to mobile and for use wth higher power repeaters, the addition power provided by the CIRKIT amplifier increases the range considerably. This is especially noticeable, as is to be expected, at the limits of the service area.

The Cirkit 70cm Power Amp will boost the output power of hand held transceivers up to 12W. Automatic relay switching between TX and RX, is provided via the RF sense circuitry. The finished unit is mounted in a tough pre-drilled die-cast box, which provides sufficient heatsinking while providing a rugged low profile housing.

SPECIFICATION: Power gain (2W I/P): 7.2dB. Output power (13.8V) 2W input: 10W(min). Saturated power output: 14W. Supply voltage: 10-16V (13.8V nom). Input/Output impedance: 50R. Bandwidth: 430-440MHz. Supply current: 2 amps at 12W. Dimensions: 119 x 94 x 34mm.

41-01505 33.82

70cm PRE-AMPLIFIER

This high performance pre-amp offers increased receiver sensitivity and a corresponding extension of the useful communication range. The completed unit is sufficiently compact to be built into virtually any existing receiver and does not require the use of any test gear when setting up.

SPECIFICATION: 3dB bandwidth: 425-445MHz. Noise figure <2dB. Gain: 13dB(min). 1dB compression: -3dBm (0.5mW). Saturated output: -2dBm (0.7mW). Supply voltage: 8-12V (12V nom). Input/Output impedance: 50R. Dimensions 50 x 10 x 17mm.

41-01506 4.78

NOW AVAILABLE
exclusively from CIRKIT, TAU high quality ATU kits and accessories.

Full HF coverage, tunes from 1.5MHz continuously to 29.350MHz. Based on the reknowned SPC transmatch configuration, TAU innovated this composite module design with large air-spaced capacitors rated at 5kV, tested to 7kV. Roller inductor infinitely variable. Solid precision radio engineering. Heavy weight long life construction. Will tune any transmitter/aerial combination to optimum. A lifetime investment and should never need replacing. Power handling capabilities from a few milliwatts to above 3000 watts PEP. Undoubtedly the finest ATU module available today.

STU 5K ATU Kit 41-50500 130.00

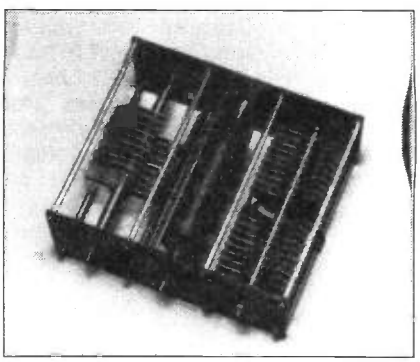
CABINET - custom-made for STU 5K ATU
41-50510 62.50

DIGITAL TURNS COUNTER
Multi-turn, vernier scale with digital indication, for use with roller coaster, with or without cabinet.
Turns counter 41-50520 27.94

BALUNS
To complete the ATU, we have the following Baluns:

Location		PEP	Ratio	Stock No.	Price
Outdoor	OB141	1kW	4:1	41-50141	27.35
Outdoor	OB111	1kW	1:1	41-50111	27.55
Indoor	IB241	200W	4:1	41-51241	17.25
Indoor	IB141	1kW	4:1	41-51141	22.35

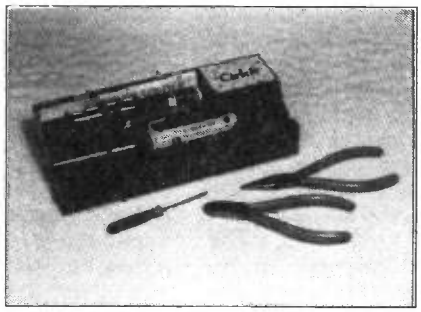
ROLLER COASTER
To complement existing equipment, covers 1-30MHz, 28uH inductance, tapered pitch for 10 and 15 meters.
Roller Coaster 41-50540 46.00



TAU ATU

AKC AERIAL KIT
Unique clip-on spacer system for open wire feeders. Patented design manufactured from an ultra-violet resistant poly-propylene the spacer can be configured to give a 75,300, 400 or 600 ohm system. Kit contains 20 spacers, 1 Tee piece and 2 Ceramic insulators.

AKC Aerial Kit 41-50530 12.70



CIRKIT ELECTRONICS TOOL KIT
Contains: 15W Soldering Iron, 2 spare bits, heat shunt, solder, pliers, cutters, and screwdriver.
41-00007 15.56

Selected Lines

PB2720	80dB Piezo Buzzer	43-27201	0.55
10M15A	10.7MHz Filter	20-10152	2.10
FC177	LCD Freq. Meter	39-17700	20.00
CM161	Min LCD Clock	40-80161	8.25
8 x 0.3"	IC socket	28-00800	0.12
14 x 0.3"	IC socket	28-14000	0.13
16 x 0.3"	IC socket	28-16000	0.13
CX120P	COAX relay (PCB)	46-90120	11.96
CX520D	COAX relay (N type)	46-90520	26.98
CX540D	COAX Relay (BNC)	46-90540	26.98
HC6010	10MΩ DMM	56-06010	33.00
HC7030	0.1% Acc DMM	56-07030	43.00
Meteor	100MHz DFM	56-00100	95.00
Meteor	600MHz DFM	56-00600	121.00
Meteor	1000MHz DFM	56-01000	165.00
CS240	Antex 17W Iron	54-22300	5.20
TCP3	Weller temp cont iron	54-20007	17.63
PU3D	Weller 24V PSU for TCP3	54-20026	30.74

Books

The Radio Amateurs: Q & A Reference Manual	02-02157	5.95
Oscilloscopes: How to use them, how they work	02-21300	4.35
The World's Radio Broadcasting Stations	02-11564	7.00
The ZX Spectrum	02-00100	5.95
Electronics Pocket Book	02-21309	7.50
Practical Design of Digital Circuits	02-11831	10.45
Projects in Amateur Radio	02-21304	3.80
Active Filter Cookbook	02-21168	12.70
Beginners Guide to Amateur Radio	02-11262	4.50
CMOS Cookbook	02-21398	11.85
Design of Active Filters	02-21539	10.15
Design of Op-Amp Circuits	02-21537	9.30
Design of Phase-Locked Loop Circuits	02-21545	9.30
Design of VMOS Circuits	02-21686	10.15
Effectively Using the Oscilloscope	02-21794	9.30
Foundations for Microstrip Circuit Design	02-79447	21.00
Handbook of Electronic Tables Formulas	02-21532	11.00
TTL Cookbook	02-10358	11.00
TV Antennas and Signal Distribution Systems	02-21584	10.15

PRODUCT NEWS

FARADAY PAIL UNIT

John Chubb Instrumentation has developed a Faraday pail unit for measuring charge on powders, granules and on small articles from below 10 pico-coulombs to 200 nano-coulombs. This instrument is particularly useful in studies on the charging behaviour and deposition of powders and for investigation of factors likely to cause damage in the handling of static sensitive semiconductor devices.

The pail for charge collection is 60mm in diameter and 40mm deep and may easily be removed for cleaning. The unit is an attachment for the JCI101 fieldmeter and the combination provides an auto-ranging charge measuring sensitivity from 200 pico-coulombs to 200 nano-coulombs fsd, with the reading and polarity displayed on a 3½ digit liquid crystal display.

On the most sensitive range charges of a few pico-coulombs can be measured. This sensitivity is usually quite adequate to observe charges induced on dual in-line integrated circuit packs as they slide out from carrier tubes – even 'anti-static' tubes.

All the normal facilities of the JCI101 electrostatic fieldmeter are available when used in combination with the Faraday pail – battery or direct mains operation and signal and range outputs for chart recording. The Faraday pail may also be used with the JCI101C fieldmeter, which has the integral RS423 communications interface so that it may be linked to computer equipment via a serial data port for analysis of observations and for comparison and logging of results.

John Chubb Instrumentation,
Unit 30,
Lansdown Industrial Estate,
Gloucester Road,
Cheltenham GL51 8PL.
Tel: (0242) 573347.

SWITCHING MODULE

Plessey Semiconductors has announced the versatile MS2002EXP digital switching module (DSM), suitable for all sizes of electronic digital telephone exchanges from a small PABX through to main exchanges. Sample quantities are now available.

Originally developed for System X, the MS2002EXP is a complex device with the simple function of providing digital switching for 256 channels in pulsed code modulation (PCM) systems. The n-channel MOS integrated circuit therefore consists of a 256 x 8 bit random access memory (RAM) and a 256 x 9 bit RAM plus control logic and interface circuits. The device is used in single units or in groups to re-arrange the order of PCM words within the transmission frame. Consequently, it is a non-blocking digital switch capable of connecting all 256 incoming channels to all outgoing channels in any desired order, although alternatively selected input channels may broadcast to any number of output channels. Input data can be either serial or parallel at a 2.048Mb/S rate.

The position of words can be changed, and therefore if any data can be divided into 8 bit words, their significance can also be changed, so the MS2002EXP becomes a simple protocol or format converter for computer systems or local area networks.

Features of the new DSM include a single 5V supply and TTL compatability. It interfaces directly with the European standard CCITT 32 channel 2.048Mb/S format.

The MS2002EXP is currently available in a 28 lead ceramic package, but plastic package and surface mounting units are planned.

Plessey Semiconductors Ltd,
Cheney Manor,
Swindon SN2 2QW.
Tel: (0793) 36251.

IF AMPLIFIER

A unique IF amplifier and detector circuit capable of meeting all cellular radio specifications is now available in volume from Plessey Semiconductors.

The SL6652 offers tremendous advantages in a single chip circuit, operating up to 100MHz with an integral crystal oscillator/mixer but with an extremely low current consumption (2mA max) from any supply voltage from 2.5V to 10V.

The sensitivity and signal to noise ratio are now 100% factory tested, and the conventional FM quadrature detector ensures that the circuit is easy to use in both development and production.

A special feature of the SL6652 is the RSSI output, which offers outstanding linearity and monotonicity irrespective of IF filter tones.

The SL6652 has already entered volume production and is available from stock at most Plessey distributors worldwide. A complete applications package is now available with printed circuit board layouts and test results.

Charles Barker Lyons Ltd,
30 Farringdon Street,
London EC4A 4EA.

BASE STATION

The BS250 range of radio telephone base stations incorporate state-of-the-art-technology. Full duplex continuously rated operation is offered on either AM or FM single or two aerial working. RF power is adjustable from 5 to 40 watts on AM and 5 to 150 watts on FM.

The BS250 is also Band III convertible in the event of changes in legislation. This means that today's user is safe in the knowledge that the base station can be amortised over its long working life without very costly changes to its circuitry.

The BS250 is also 'self-diagnostic' on the Tx front panel and able to measure the following: forward/reverse power, transmitter and receiver multipliers, modulation depth, and receiver AGC and sensitivity. There is also a dc probe facility.

6 channel operation is standard but provision is made for an FGU input for quasi-synchronous operation, or a synthesised input for multi-channel operation. Remote selection of up to 6 channels is standard for a 4 wire circuit using the linking unit.

Neve RadioTelephones Ltd,
32 Caxton Way,
Holywell Estate,
Watford,
Hertfordshire WD1 8UA.
Tel: (0923) 31034.

KEYBOARDS

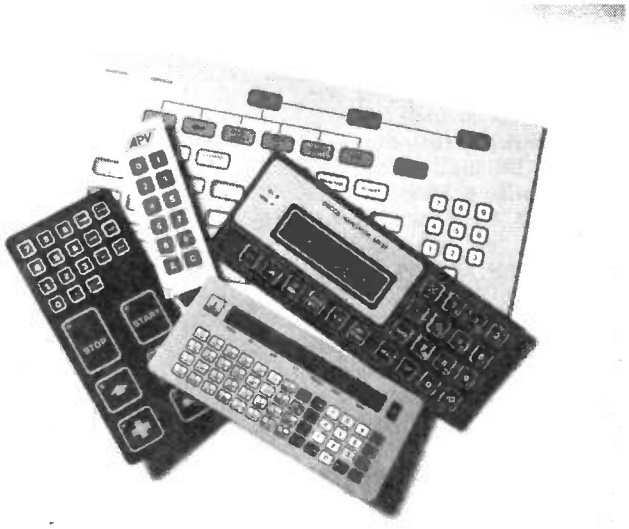
Quillertech Ltd, manufacturers of the Posi-Key range of custom-built, tactile feel keypanels, are now able to incorporate customised lighting within their designs.

This lighting is provided by an additional layer that is laminated into the keyboard construction directly below the top surface. A custom-designed inverter is provided allowing the light output to be altered by varying the dc voltage input about a predetermined nominal value (usually 5 or 12V dc). The inverter may be mounted either remotely or directly onto the keyboard, avoiding exposure of high voltage conductors.

It is possible to illuminate a number of areas of the same panel in different colours while other areas remain unlit.

In addition to the electroluminescent facility, the Posi-Key keyboards offer embossing, textured finish, 'dead front' legends, display windows etc and are suitable for a wide variety of applications including marine navigational equipment, aircraft and military equipment.

Quillertech Ltd,
85 Stanley Road,
Bournemouth BH1 4SD.
Tel: (0202) 303431.



CIRCUIT MAKER

Electrolube have introduced the CM100 Circuit Maker Kit which they claim is one of the first DIY kits on the market to offer a complete and easy-to-use system for producing printed circuit boards. It is ideal for the expert hobbyist or those wishing to try their hand at electronics.

This versatile kit enables hobbyists to produce layouts from magazines and other sources using an easy four-step system which is explained in a detailed set of step-by-step instructions. These steps include producing a film positive master of the chosen PCB design, etching of the board using photo-resist, removal of the photo-resist and finally drilling and component assembly.

Advantages of the CM100 kit include the photographic development system, which allows professional quality circuit boards to be produced without a darkroom, camera equipment or ultra violet lights, and the ease of use, which makes previous photographic experience unnecessary.

Electrolube now offers items from the CM100 Circuit Maker Kit separately, which will allow hobbyists to supplement their existing equipment and supplies. Included in this list of items is a specially designed universal assembly frame, which is useful for drilling and component assembly, developers, fixer and clearing solutions for the auto-positive film, photo-resist and developer, and double-sided copper clad boards.

A useful asset for electronics hobbyists, the CM100 Circuit Maker Kit is very adaptable and can be tailored to suit the needs and demands of various situations.

Electrolube Ltd,
Blakes Road,
Wargrave,
Berkshire RG10.
Tel: (073) 522 3014.

RESISTOR NETWORKS

Balzers has expanded its complete range of chip resistors and chip resistor networks.

Standard resistor arrays (SRA) are now available ex-stock, from the company and universal resistor arrays can be provided to customer specified values and tolerances.

In the SRA, chips with one resistor and four isolated resistors are available with 5K, 10K, 50K and 100K values, and the company has announced plans to add yet further values to the programme.

The SRA chip resistors have a guaranteed maximum TCR of 0 ±25ppm/K between −55°C and +125°C.

Maximum TCR tracking within one chip is 2ppm/K.

The guaranteed film stability unprotected in air for 1000 hours is better than 0.1 per cent for 125°C, while the absolute trim tolerance is ±0.25 per cent.

High frequency resistors (HFR) are also now available ex-stock for values of 100, 200 and 300 ohms with tolerances of ±15 per cent.

The HFR chip resistors have a TCR of −70ppm/K to −130ppm/K between −50°C and +150°C. Constructed on a 0.25mm thick MRC-B substrate, their dimensions are 1.27 x 1.27mm.

URA chip resistors and chip networks of up to 12 resistors are available in a range of 400 ohms to 200K ohms per resistor.

Balzers High Vacuum Ltd,
Northbridge Road,
Berkhamsted,
Herts HP4 1EN.
Tel: (04427) 2181.

UVIPROM PROGRAMMER

Available from Ground Control, to complement their Uvipac EPROM eraser, is a low cost EPROM programmer for the BBC microcomputer which will enable the experienced user to program 2764 and 27128 EPROMs. The software available enables an EPROM to be programmed from disc, sideways RAM (STL SWR compatible) or master EPROM.

The unit, called the Uviprom, is available in two versions initially. Uviprom 1 is the basic version consisting of an uncased PCB with a normal 28 pin IC socket. Uviprom 2 is also an uncased PCB but with a 28 pin Textool Econozip zero insertion force (ZIF) socket. The Uviprom 3 cased version with ZIF socket should be available soon.

Uviprom plugs into the user port on the BBC microcomputer using a 20 way ribbon cable and socket, taking its power directly from the computer. It has a switch mode power supply for Vpp (21 volts nominal) voltage generation. Two switches with LED indicators are provided, one for powering down Uviprom to insert an EPROM, and one for Vpp on/off.

The easy to use 1.0 Uviprom software is available on sideways ROM (EPROM) only and the following commands are available:

★ TEST – blank check;
★ READ (afsp) – read EPROM to disc;
★ BLOW (afsp) – blow EPROM with named file;
★ VIEW – look at contents of EPROM after read;
★ COMP (afsp) – compare contents of EPROM to source.

When using ★ BLOW, ★ VIEW and ★ COMP the screen displays the data in HEX and ASCII format, in full colour. EPROM data storage starts at &2000.

Retail prices are: Uviprom 1 – £20.95; Uviprom 2 – £25.95; Uviprom 3 – £29.95; Uviprom 1.0 ROM – £8.00. All prices are for the UK and include postage and VAT.

Ground Control,
Alfreda Avenue,
Hullbridge,
Hockley, Essex SS5 6LT.
Tel: (0702) 230324.

PRODUCT NEWS

DIRECT VIEW COLOUR TUBE

Mitsubishi Electric Corporation have recently developed a 35 inch (diagonal) colour picture tube, the world's largest for home use direct-view colour television sets, and a 35 inch colour TV set using this new picture tube.

Based on its computer simulation technology for glass bulb designing and experience in developing a colour picture tube for a 40 inch high definition TV set, Mitsubishi Electric succeeded in solving various problems involved in the development of huge screens. The 35 inch square picture tube brings the excitement of large screen pictures which has so far been available only on projection TVs.

Mitsubishi Electric optimised the distribution of glass thickness of the tube with computer simulation to reduce its weight and facilitate mass production. The adoption of a 110 degree deflection angle resulted in the compactness of the colour set despite the huge screen, which is 3.1 times as large as a 20 inch screen. The TV set is 58 centimetres (approximately 23 inches) deep and 91 centimetres (approximately 36 inches) wide. It has a new natural picture control circuit to ensure crisp, clean pictures.

Other features of the colour set include a multi-channel sound circuit, three systems of audio-visual input terminals for high quality videocassette and videodisc playing and satellite broadcasting, and an RGB (red, green and blue) terminal for teletext or a personal computer.

Mitsubishi Electric Corporation,
2-3 Marunouchi 2-chome,
Chiyoda-Ku,
Tokyo,
100 Japan.

TVRO SYSTEM

Salora (UK) Ltd is now offering an earth station package to receive satellite transmissions on the 4 and 12GHz bands.

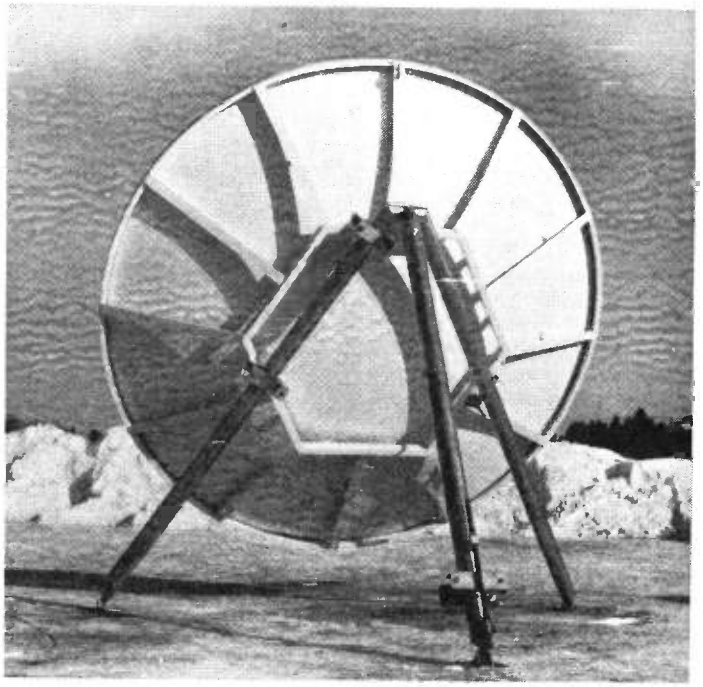
The system comprises a dish antenna of 1.8, 2.4, 3 or 5m diameter, a low noise converter, and a satellite video receiver. Also included is 30m of RF cable to connect the converter to the receiver.

The parabolic reflector surface is finished to resist atmospheric pollutants and salts, and is designed for maximum gain at 12GHz. It can, however, also be used at 4GHz.

The low noise converter employs GaAsFETs for optimum noise performance, and is precision manufactured in order to withstand all weather conditions.

The satellite video receiver accepts downconverted signals from 950 to 1750MHz. It employs threshold extension demodulation for excellent broadcast quality performance, with a 7.5dB carrier to noise threshold. The unit also has completely automatic frequency control and LED indication to facilitate spot-on tuning.

Salora have also launched their Digi-computer range of



TVs. These sets employ an 8 bit micro-computer which enables many operational modes, eg changing the vision IF, to be programmed from the front of the set by using a particular password and appropriate programming instructions.

The all-band tuner allows reception of 100 channels, including the special channels reserved for satellite via cable transmissions. For reception of direct broadcast satellite transmissions you can have a satellite tuner/decoder installed.

Salora (UK) Ltd,
Techno Trading Estate,
Swindon,
Wiltshire SN2 6EZ.
Tel: (0793) 46321.

VIDEO DATA SHEET

Acron Video has published a comprehensive data sheet on the 401P and 402P series of PAL synchronising pulse generators, which include many features normally found only in full broadcast equipment but are offered at significantly lower prices.

Both the 401P and the 402P are available with a choice of three grades of crystal reference oscillator, having stabilities to suit differing applications.

Both types deliver the full set of PAL synchronising pulses and continuous subcarrier as well as colour-black outputs with programmable white pulse on Line-7 Field-1. Model 401P series generators operate only in the free-run mode using the internal crystal reference oscillator. Model 402P is similar to model 401P but can also operate in a genlocked slave mode to a master SPG or with soft genlock to a VTR.

The type of reference oscillator fitted is denoted by a suffix letter to the model number. The 'A' version of either model is equipped with an oven-stabilised crystal oscillator, and meets the PAL I requirements over a wide range of ambient temperatures.

The 'B' version contains a lower stability ovenned crystal oscillator than the 'A' version and meets PAL I requirements over a limited range of temperatures. The 'C' version meets PAL I requirements in all respects except for subcarrier stability, but meets PAL B, G and H requirements in full over a limited temperature range.

The illustrated leaflet gives full technical specifications of all models, together with brief general descriptive information. It is available on request.

Acron Video,
Unit 3,
Lovelace Road,
Bracknell,
Berks RG12 4YT.
Tel: (0344) 55625.

OXLEY LEDs

The Oxley range of T1¾ LED indicators has received MOD approval to DEF STAN 59-61/80/018 and 028.

These wide viewing angle LED lamps are available in red, green and yellow in tinted and diffused epoxy encapsulation.

The LEDs offer to the military and professional user reliability and light output certified by release to DEF STAN specifications. They are 100% burnt-in prior to measurement of luminous intensity and have a minimum level light output guaranteed. In addition, LEDs to DEF STAN 59-61/80/028 are binned (categorised) according to luminous intensity for array applications.

Oxley Developments Co Ltd,
Priory Park,
Ulverston,
Cumbria LA12 9QG.
Tel: (0229) 52621.

ELMASET INSTRUMENT CASE
300x133x217mm deep ..... **£10.00 ea (£1.50)**

REGULATORS
LM317T Plastic T0220 variable **£1.00**
LM317 Metal **£2.20**
7812 Metal 12v 1A **£1.00**
7805/12/15/24 plastic **50p**
7905/12/15/24 plastic **50p**
CA3085 T099 Variable regulator **£1.00**

EPROMS/MEMORIES
27128-300nS **£15.00**
2764 INTEL/FUJITSU 300ns **£5**
2716, 2708, 1702 EX EQUIPMENT £2 ..... 10/**£17.00**
2732 EX EQPT **£2.50**
2114 EX EQPT 60p 4116 EX EQPT **70p**
4164-200nS EX EQPT **£2.50**
MC6810P **£1.00**

POWER TRANSISTORS
TIP141, 142, 147 £1 ea, TIP112, 125, 42B ..... 2/**£1.00**
TIP35B £1.30 TIP35C **£1.50**
SE9302 100V 10A DARL SIM TIP121 ..... 2/**£1.00**
2N3055 Ex eqpt tested ..... 4/**£1.00**
Plastic 3055 or 2955 equiv 50p ..... 100/**£30.00**
2N5302 NPN 30A 60V SIM 2N3771 ..... **80p**
2N3773 NPN 25A 160V £1.80 ..... 10/**£16.00**

DISPLAYS
Futaba 4 digit clock, fluorescent display 5-LT 16 ..... **£1.50**
Futaba 8 digit calculator, fluorescent display 9CT-01-3L **£1.50**
LCD Clock display 0.7" digits **£3.00**
Large LCD Clock display 1" digits **£3.00**
7 seg 0.3" display comm cathode ..... 2/**£1.00**

QUARTZ HALOGEN LAMPS
A1/216 24v 150w **£2.25**
H1 12v 55w (car spot) **£1.25**

MISCELLANEOUS
NEW BRITISH TELECOM PLUG+LEAD **£1.50**
1.25" Panel Fuseholders ..... 5/**£1.00**
5.25" floppy discs ..... box 10/**£15**
MAINS ROCKER SWITCHES 6A SPST ..... 5/**£1**
4700μF 63v ITT 10A RIPPLE **£1**
STAINLESS STEEL HINGES 14.5" BY 1" OPEN £1.00 each ..... 10/**£7.00**

MAINS TRANSIENT SUPPRESSORS 245v ..... 3/**£1.00**
TOK KEY SWITCH 2 POLE 3 KEYS – ideal for car/home alarms £3 £100+ **£2.00**
12v 1.2w small wire ended lamps fit AUDI/VW TR7 VOLVO SAAB ..... 10/**£1.00**
Heat shrink sleeving pack **£1.00**
PTFE sleeving pack asstd colours **£1.00**
250 mixed res diodes, zeners **£1.00**
Mixed electrolytic caps ..... 100/**£2.00**
Stereo cassete deck **£5.00** (£1.50)
Stereo cass R/P head **£2.50**
Mono head £1, Erase head **50p**
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Thermal fuse 121°C 240v 15A ..... 5/**£1.00**
Vero pins fit 0.1" Vero ..... 200/**£1.00**
Double sided PCB pins ..... 200/**£1.00**
TO220 Micas + bushes 10/50p ..... 100/**£2.00**
TO3 Micas + bushes ..... 20/**£1**
RELAYS 240v AC coil PCB mounting 2 pole changeover £1 3 pole c/o **£1.00**
Fig. 8 mains cassette leads ..... 3/**£1.00**
KYNAR wire wrapping wire 2oz reel **£1.00**
PTFE min. screened cable ..... 10m/**£1.00**
TOKIN MAINS RFI FILTER 250v 15A **£3.00**
IEC CHASSIS PLUG/RFI FILTER 10A **£3.00**
Epoxy potting compound 500g **£2.00**
Mercury tilt switch small **£1.00**
Min. rotary sw. 4p c/o 1/8" shaft ..... 2/**£1.00**
Thorn 9000 TV audio o/p stage ..... 2/**£1.00**
10m7 CERAMIC FILTER 50p ..... 100/**£20.00**
6m or 9m CERAMIC FITLER 50p ..... 100/**£25.00**
240v AC FAN 4.6" SQUARE NEW **£5.50** (£1.60)
240/115v AC FAN 4.6" SQ. NEW **£7.00** (£1.60)
KLIPPON terminal block EKS 12/4
12-way 20A term block ..... 3/**£1.00**
BELLING-LEE 12-way block L1469 ..... 4/**£1.00**
POTENTIOMETERS short spindle
2k5 10k 2m5 Lin ..... 5/**£1**
500k lin 500k log long spindle ..... 4/**£1**
40KHZ ULTRASONIC TRANSDUCERS EX-EQPT. NO DATA ..... PAIR/**£1.00**
STICK-ON CABINET FEET ..... 30/**£1.00**
T03 TRANSISTOR COVERS ..... 10/**£1.00**
TRANSISTOR MOUNTING PADS T05/T018 £3/1K
DIL REED RELAY 2 POLE N/O CONTACTS **£1.00**

RECTIFIERS
120v 35A stud **50p**
12FR400 12A 400v small stud ..... 4/**£1.50**
BY127 1200V 1.2A ..... 10/**£1.00**
BY254 800v 3A ..... 8/**£1.00**
BY255 1300v 3A ..... 6/**£1.00**
1A 800v bridge rectifier ..... 4/**£1.00**
6A 100v bridge **50p**
10A 600v bridge **£1.50**
15A 100v bridge **£1.50**
25A 200v bridge £2.00 ea ..... 10/**£18.00**
25A 400v bridge £2.50 ..... 10/**£22.00**

SCRs
MCR72-6 400v £1 BTX95 800V 15A **£1.50**
BTX95 800v 15A **£1.50**
35A 800v stud **£2.00**
70A 500v large stud **£3.00**
MCR106 equiv. 4A 400v **40p**
2N5061 800mA 60V T092 ..... 4/**£1.00**
TICV106D .8A 400v T092 3/£1 ..... 100/**£15.00**
MEU21 Prog. unijunction ..... 3/**£1.00**

TRIACS diacs 25p
TXAL225 8A 400V 5mA gate 2/£1.00 ..... 100/**£35.00**
TXAL228 8A 400v isol. tab 2/£1.00 ..... 100/**35.00**
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VHF conference

The International Telecommunication Union's regional administrative radio conference to plan the use of the VHF sound broadcasting band (87.5 – 108MHz) has now ended.

The background to the six week conference held in Geneva was that the major World Administrative Radio Conference in 1979 raised the upper limit of the band from 100MHz to 108MHz. This created considerable problems for the services at present occupying the band and, from the technical point of view, for co-ordination with the aviation services (instrument landing systems etc) which lie in the next adjacent band.

The conference involved about 100 countries in Western and Eastern Europe (including the whole of the USSR) plus Iran and Afghanistan, and the whole of Africa. It has now established a broadcasting plan for the entire area. In the course of its work, over 54000 individual broadcasting assignments were taken into account.

The final acts of the conference, which were signed at the end of last week, will come into force on 1 July 1987. Stations may be brought into use after that date, subject to any constraints identified in the plan which forms part of the agreement. There are, for example, other services still legitimately using the band on a temporary basis, so that it will not be for some years after July 1987 that all the frequencies will become available. The conference also created procedures to allow for modifications to the plan, and for the introduction by agreement of some assignments before the final acts come into force.

The United Kingdom's delegation was led by officials from the Department of Trade and Industry's Radio Regulatory Division, and included representatives from the Home Office Broadcasting Department, the BBC, the IBA and the Civil Aviation Authority.

The United Kingdom's objectives for the conference were:

a) to secure a further two national VHF networks, one to enable BBC Radio 1 and Radio 2 to have separate networks, and the other for the introduction of a new independent national radio service;

b) the provision of additional frequencies for the development of BBC and independent local radio;

c) the maintenance of the existing VHF networks and improvements to their coverage.

In the event, the plan which the United Kingdom took to the conference required only very minor modifications, with the result that the United Kingdom's aims have been fully met. In addition, the UK had to safeguard the position of land mobile services at present still operating in various parts of the band, and a Protocol of Agreement with our neighbours was negotiated.

The plan thus establishes the regulatory framework within which present and future VHF sound broadcasting in the United Kingdom can be developed.

Cellular portable telephone

The only portable cellular telephone in the UK to have passed the BABT test by early January was Motorola's 8000X, the top model in their cellular telephony family, which is both a portable and mobile unit. Motorola are awaiting written confirmation of approval.

Motorola is now the only company to have received the official thumbs-up for its complete range of cellular equipment designed specifically for the UK Cellnet system.

One of the world's most experienced single-source cellular communications specialists, Motorola have invested over $100 million and some 1,000 man years of engineering time to develop a totally integrated hand-held radio telephone system. A complete UK turn-key cellular project, worth in the first phase over £20 million, is already well under way. This will expand to include all of the infrastructure equipment installation for the TSCR Cellnet system.

Combining both a portable and mobile telephone in one compact package, the 8000 series represents the state-of-the-art in personal communications.

It is lightweight, takes up little room, and can be mounted as an in-car phone or simply popped into a briefcase for use anywhere covered by the cellular telephone system infrastructure and at any time.

User programmable functions provide features which can be uniquely controlled from the keypad. These include outward call restrictions which only allow specific types of call to be placed, security codes, automatic locking, silent ring and silent keypad functions.

For further information contact Motorola Ltd, Communications Group, Jays Close, Viables Industrial Estate, Basingstoke, Hampshire. Tel: (0256) 58211.

Another company to enter into the cellular radiophone market is Marconi Mobile Radio, a division of Marconi Communication Systems Limited of Chelmsford, which has launched its range of 'Marconiphone' products following the recent announcement of its acceptance as an accredited Cellnet retailer.

The new 'Marconiphone' cellular products include a choice of two vehicle mounted sets and a modern cordless personal radiophone with battery charging facilities.

The new equipment meets all the demands of modern cellular radiophones including a wide range of standard telephone facilities with ease of operation. An electronic memory stores 30 most often called numbers, provides a hand-free dialling function,

conferencing and a call redirect facility with further options to follow.

To meet the increasing cellular radiophone market, Marconi are further expanding their national Radiophone Sales and Service Centres, particularly in London where their new Wembley centre will be able to handle over 100 car installations a week.

BBC closes transmitters

A milestone in the history of British broadcasting was reached in January when all of the remaining BBC 405-line transmitters were switched off.

When the 405-line service started in 1936 it was described as 'the world's first regular public service of high-definition television programmes'. The number of viewers had been dwindling since the introduction of the duplicate 625-line ultra-high frequency (UHF) colour service in 1969.

The closure comes as the result of an announcement by the Home Secretary in 1983 that the frequencies used by the 405-line transmitters should be released by the broadcasters for mobile radio communication. The close-down of the last transmitter, at Melvaig in West Scotland, was carried out by Syd Garrioch, the local transmitter manager. In its hey-day, the 405-line network comprised one hundred and seven transmitters.

After the formal opening by the Postmaster General, Major G C Tryon, on 2nd November 1936, the service grew in popularity when the BBC screened the first major outside broadcast in May 1937, the Coronation of King George VI. Over 23,000 receivers were in use in September 1939 when the Alexandra Palace transmitter was closed for the war years. The service re-opened after the war in 1946, screening the Victory Parade on 8th June.

Television spread throughout the UK with stations at Sutton Coldfield serving Birmingham and the Midlands opening in 1949, Holme Moss serving Yorkshire and Lancashire in 1951, and Kirk O'Shotts and Wenvoe serving parts of Scotland and Wales in 1952. The London transmitter moved to Crystal Palace in 1956 to provide a better signal to London and the Home Counties.

Commenting on the closures, Bill Mitchell, the BBC's Assistant Chief Engineer, Transmitters, said, 'The end of the first chapter of television broadcasting is a sad day for us. However, the 405-line service has been duplicated on 625-lines for many years now, so it is appropriate that these old transmitters should be switched off.'

British Telecom Shop

The first new-style British Telecom shop opened in Southend High Street on 3 January.

It sells a wide range of telephones, business equipment and telephone accessories. Customers will also be able to pay their telephone bills at the shop and make general enquiries about British Telecom's services.

The new shop represents a major extension of British Telecom's retailing activities. It forms part of a trial of competitive retail outlets in high street sites.

Two more British Telecom shops will be opening in the spring – in Newcastle and Plymouth – and if the shops prove popular British Telecom will be looking for further sites around the country.

Compared to these new shops, British Telecom's chain of 53 'Phoneshops' are limited operations, mostly sited within department stores or telephone area offices.

The range of phones available for sale are not restricted to the British Telecom 'Inphone' range. British Telecom are also selling phones from several independent suppliers. Customers can try out equipment before they buy.

Overwhelming response

The launch of Grand Metropolitan's £1 million Innovation Development Centre at Surrey Research Park (see *News Desk*, December 1984) has brought hundreds of enquiries from innovators all over Britain, underlining the company's belief that the creation of a technology transfer unit with a strong commercial orientation would fill a very clear gap in the existing innovation development market.

Applications already received for the sixteen units at the Innovation Development Centre, which will be ready for occupation in March 1985, cover a wide range of technologies, notably in the field of physics and electronics, fuel conservation, computer software and data retrieval systems, plastics, energy, security and even catering.

Dr George Christies, Managing Director of Grand Metropolitan Biotechnology Ltd, describes the response as 'overwhelming'.

'The most encouraging part of the response is not just the quantity of the enquiries, but the very high overall standard of the innovations which have been submitted,' he says.

New Chairman

Mr PA McDonald of Thorn EMI Electronics has been elected chairman of the Wideband Cable Systems Committee of the Electronic Engineering Association. This influential new committee has been set up to ensure that UK industry plays an active role in determining the technical specifications for the new generation of interactive cable networks.

Manager of the London office of the company's Wells-based Communications Division, Mr McDonald has been actively associated with cable TV and associated systems for some 15 years. He has been closely involved in determining the technical specifications for the relay by satellite of the Thorn EMI Music Box channel to cable networks throughout Europe. Within Thorn EMI Electronics, he spearheaded the company's move into the satellite earth station market as a systems supplier and helped negotiate the collaborative agreement between Thorn EMI Electronics and Satellite Transmission Systems Inc, who have constructed or integrated over 100 major earth terminals throughout the world.

House of Instruments

Advance Power Supplies Ltd, a leading UK power-supply manufacturer, has purchased instrument distributor House of Instruments.

Advance, which sees the move as a major step forward in its expansion and diversification plans, is moving the existing House of Instruments operation from Saffron Walden to its Bishop's Stortford headquarters. Advance is committed to providing continuity for existing House of Instruments customers, and the sales staff are remaining with the company.

For the future, Advance intends to invest considerably in House of Instruments, both in terms of higher stocking levels to ensure speedier service and in completely new product lines and services.

Commenting on the move, Tony Jannece, Chairman of Advance, said: 'We are very pleased to be able to acquire an entrepreneurial firm like House of Instruments in an area which complements our existing manufacturing operations. We fully intend to make House of Instruments into a successful and profitable part of our organisation, and we will expand both the product offering and the overall scale of the operation'.

Ant Products' shop

Ant Products, manufacturers of the Silver 70 and Tiger range of amateur radio antennae, have announced the opening of their trade counter and factory shop.

Besides being manufacturers of antennae and other specialist equipment, the company also carries products from many other manufacturers embracing a wide range from plugs and cables to complete transceivers, from nuts and bolts to aluminium tubing.

The shop is located on All Saints Industrial Estate, Baghill Lane, near Pontefract town centre and within 1½ miles of both the A1 and M62 motorway. The premises offer ample free parking.

Opening times are Tuesday to Friday 10.00am to 5.00pm and Saturday 10.00am to 12 noon. NEW

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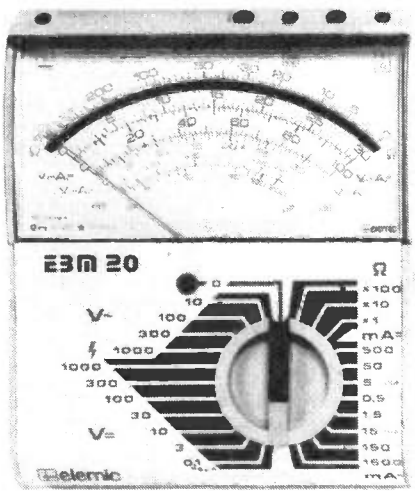

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SPECTRUM WATCH

NIGEL CAWTHORNE G3TXF

The radio frequency spectrum is a natural resource. It has been there since the beginning of time, but it is only in the last 100 years or so that man has been making use of it. Ever wondered what the short wave or amateur bands must have sounded like at the time of the battle of Hastings? Apart from the odd burst of solar noise, pretty quiet I would have thought!

Spectrum Watch takes a look at what is currently happening in different parts of the radio spectrum, from the lowest frequencies to the highest.

VLF

The lowest commonly used part of the radio spectrum is the VLF band, which runs upwards from around 15KHz and where there are a number of standard frequency and time signal stations. One of the most famous VLF stations is GBR at Rugby, transmitting on 16KHz with a transmitter power of 750KW and a radiated power of about 60KW. Antennae at these low frequencies are very inefficient. The wavelength corresponding to 16KHz is 18.75Km (11.7 miles)!

At 60KHz and with 50KW there is the UK's National Physical Laboratory time signal service, which gives time of day and calendar information in BCD. At 66.66KHz there is a Russian standard frequency station, RBU.

Between the very low end of the usable radio spectrum and the bottom end of the long wave broadcast band at 150KHz there are several stations designed for worldwide communications with submarines. It is only these low frequency signals that can penetrate sea water to any depth at all.

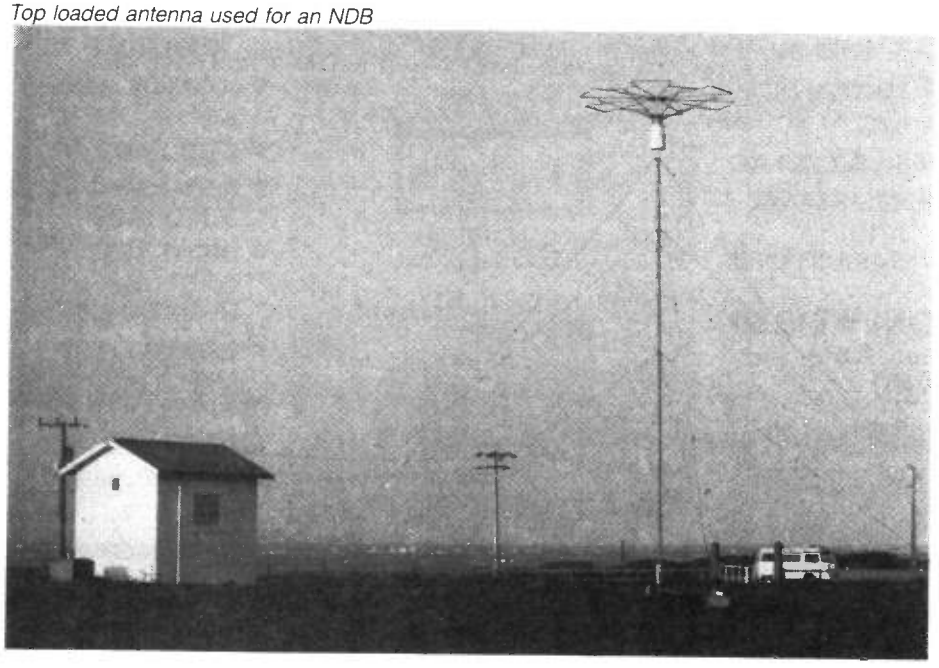
LW and MW

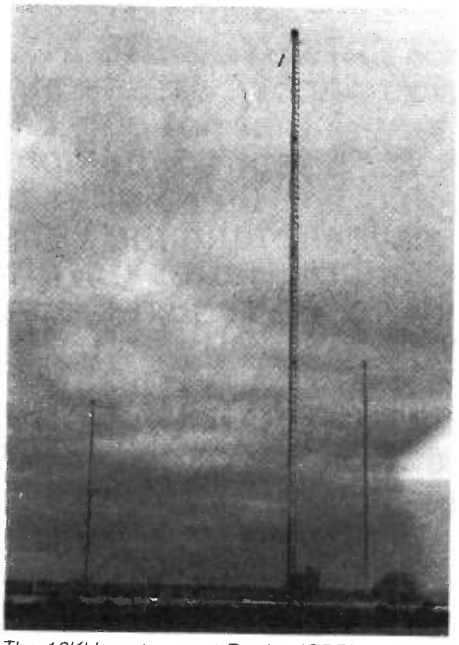
The frequencies that lie between the long wave and medium wave broadcast bands are used for many different purposes, including aircraft beacons (NDBs: non-directional beacons) and coastal navigation beacons as well as the LF marine CW band (400-512KHz).

Navigational beacons at these frequencies consist of a small transmitter which is automatically keyed to send its callsign in a regular sequence. The marine radio beacon at Cap Gris Nez, for example, sends the letters 'GN' on a frequency of 310.3KHz.

In the Channel area there are several networks of radio beacons operating in synchronism on the same frequency. Each beacon transmits for just one minute. The next beacon at a different location will automatically transmit during the following minute, and so on right through the network. The network of which the Cap Gris Nez beacon forms a part consists of six beacons. Because they all operate in synchronism on the same frequency, yachtsmen and other navigators can take several radio fixes on their position by monitoring just one frequency.

Top loaded antenna used for an NDB





The 16KHz antenna at Rugby (GBR)

Short waves

The 1979 WARC, as well as opening the door to three new HF bands for radio amateurs, also set the ground for some changes in the short wave broadcast bands. A new 22 metre band is to be opened at 13600-13800KHz (just below the 20m amateur band) and most of the existing SW broadcast bands (31m, 25m, 19m, 16m and 13m) were expanded. The highest frequency SW broadcast band at 11m was slightly trimmed by 70KHz from 25600-26100KHz to 25670-26100KHz.

Although the 22m broadcast band is not due to come into service for some years, several major international broadcasters have been reported using frequencies in the new band. Radio Moscow on 13660KHz, Radio Korea on 13665KHz and Iran on 13745KHz have all been monitored already.

A future ITU conference on HF broadcasting is now in preparation. At this conference numerous short wave broadcast allocations will be reviewed and discussed by delegates from international broadcasting authorities.

VHF and UHF

In the UK it is the VHF and UHF ranges that are currently undergoing the greatest changes. As reported in detail in the November '84 issue of ***R&EW***, two new mobile radio services are due to come into operation in early 1985.

Up at 900MHz the two new cellular radio services have just come into operation. Cellnet, one of the two competing consortia, switched on some

of their London area cells on January 9th. Racal-Vodafone pipped their competition at the post by switching on their first cells in the early hours of January 1st, 1985.

A stipulation of the government-issued operating licence is that they are each operational by March 1985 and that they must provide a 90% coverage of the population by the end of the decade.

Although initially operating around the capital, the two cellular radio services will spread rapidly to cover most of the populated areas of the country in the next two years. Both consortia will also be covering the main interconnecting motorways.

The frequencies used for the two new cellular services are high in the UHF band. Mobiles will be transmitting in the range 890-915MHz and base stations in the range 935-960MHz. The frequencies are considerably higher than others that have been in common use for mobile radio services in the UK.

Optimistic market predictions have been made to show that there could be up to 500000 cellular radio users by the end of the decade. Even if only half this figure is achieved it would still represent a very significant increase in the number of land mobile radio service users in the UK. But it is not only up at the top end of the UHF band that land mobile services are looking for large market growth. Back down at VHF there are important spectral changes taking place as well.

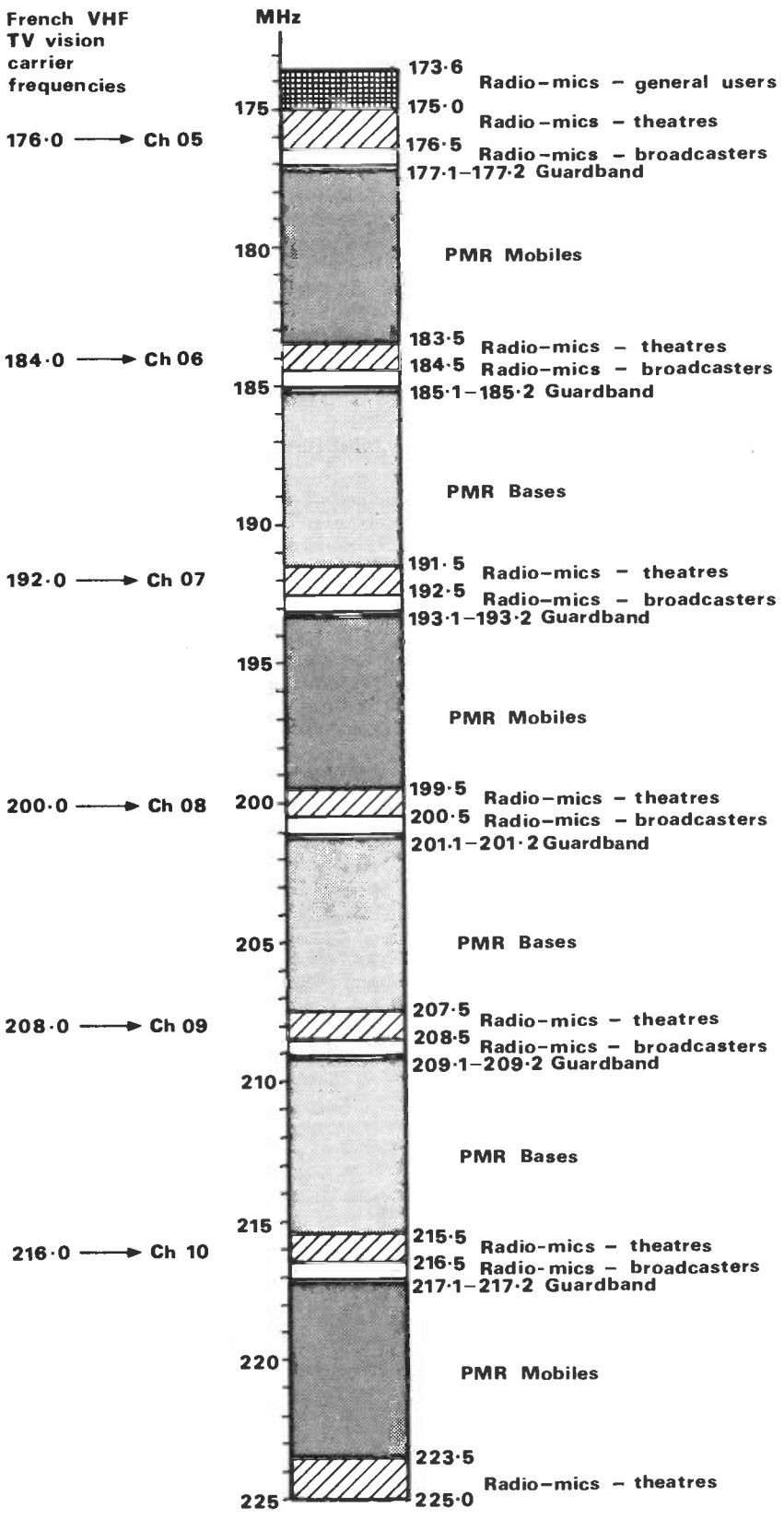
VHF: all change!

The most significant spectral change in the UK for many years has been the recent closedown of the VHF Bands I and III TV transmitters. This has liberated over 70MHz of prime spectrum for civil users. The land mobile radio services will be getting the lion's share of these newly found frequencies.

TV Band I covered 41-68MHz, and Band III 174-225MHz. In broad terms, all of Band III will be used for new VHF mobile radio services. Final decisions on the use of Band I have not yet been made known, but radio amateurs are hopeful for the rebirth of the six metre band in the range 50-54MHz.

The November ***R&EW*** article explained how it was proposed to split Band III into three sets of paired mobile/base station bands and to use the intervening frequencies for other services. Not all the frequencies within Band III in the UK can be used for mobile radio services because of the interference that will be caused by overseas TV transmitters. Continental TV transmitters will continue to operate in Band III for many years to come.

In particular in southern England it is the transmitters of France's newly opened Canal Plus TV (as described in January's ***R&EW***) that are likely to cause the most interference to mobile radio



Suggested allocations for radio-microphones within Band III

services in Band III. The proposed band-planning for the re-use of Band III has therefore avoided the vision carrier frequencies of Canal Plus. These frequencies will be allocated to services that would not be so susceptible to interference from overseas TV transmitters.

Ancillaries uncovered!

Although the BBC and IBA are probably pleased at no longer having to maintain ageing Band I and Band III transmitters in service, the closedown of these TV transmitters has presented the broadcasters with another type of frequency problem.

As well as needing frequencies for transmitting high power signals from TV transmitter stations, broadcasters also need to have frequencies available for a whole range of equally important but much less obvious uses. These are called broadcast ancillary services, and include radio-microphones in studios and on location, radio links from OB vans to control centres, radio talk-back facilities in studios and on sites, and reverse programme feeds that allow people on location or in studios to monitor the transmitted signal.

As well as all these, broadcasters also need frequencies on which they can relay programme quality sound and vision for feeding from a remote location into a control room and hence into the transmitter network.

Quiet frequencies

For many years broadcasters have been able to hide many of these ancillaries in amongst the TV transmitter frequencies themselves. By carefully selecting 'quiet' TV transmitter frequencies in one part of the country, broadcasters were able to have access to an adequate number of 'discreet' frequencies for their own uses.

Now that the VHF Band I and III transmitters have been closed down, and since these frequencies are to be re-allocated to other services, the broadcasters have lost their 'cover' at VHF! They will still be able to use the same techniques in amongst the UHF TV channels, but since Channel 4 has now spread to most of the UK there are less and less 'quiet' frequencies to be found there too.

So the broadcasters, having just given up a very large and important piece of radio spectrum to other services, are now having to fight to obtain sufficient frequency allocations for their own ancillary service needs!

Joint study

In order to find a solution to the impending problems that UK broadcasters would have in locating their ancillary services after the closedown of the Bands I and III TV transmitters, a joint study group made up of representatives of the DTI, the BBC and the IBA was set up to look into the whole question of broadcast ancillary services in the frequency range 30-960MHz. An interim report of the study group was published late in 1984, and makes firm proposals for frequency allocations for broadcast ancillary services.

The report recommends that 4MHz in Band I and 4.2MHz in Band III be set aside for broadcaster's radio-microphones. The report also recommends that the present radio-microphone band at 173.6-175MHz becomes a general user radio-microphone band and that the broadcasters should vacate it. The 4MHz of bandwidth in Band I that is being proposed by the broadcasters is the range 60-64MHz.

The study group had been looking into the specific needs of broadcasters, but broadcasters are not the only users of radio-microphones. Radio-microphones are now used more and more frequently in theatres.

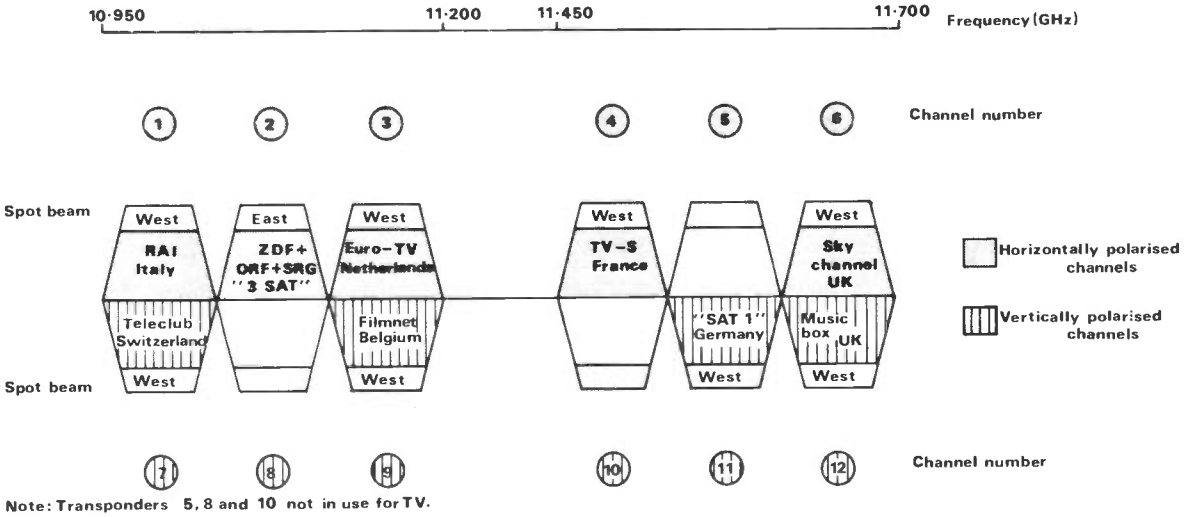
Radio-mic : QRM!

Theatres have radio-microphone problems too! This was dramatically illustrated by the well publicised fiasco on the opening night of the show 'Starlight Express', which relies heavily on the use of radio-microphones. Although the twenty or so radio-microphone channels could be made to work with each other, the real problem started when an OB unit drew up outside the theatre and set up its radio links. Several of the radio-microphone channels were made totally useless by 'breakthrough' from the OB channels.

Following this embarrassing incident the Association of British Theatre Technicians (ABTT) has put a set of proposals of its own to the DTI, suggesting that fixed location low power radio-microphone users such as theatres be given their own exclusive frequency allocations. The 8MHz of bandwidth that the ABTT proposes is made up of 7 segments within Band III. Each segment corresponds to one of the guard-bands that have been put around the vision carrier frequencies of the French TV transmitters.

Both the broadcasters and the theatres are proposing the use for radio-microphones of frequencies within Band III which would otherwise be unusable for mobile radio services. However, many other suggestions have been made to the DTI for these otherwise 'crumby'

The nine TV channels carried by ECS-1



frequencies, and it seems unlikely that both proposals for exclusive radio-microphone allocations would be accepted in their entirety. Alternative accommodation may have to be found elsewhere in the spectrum for radio-microphone users.

VHF FM Band II

While Bands I and III are being closed down for TV broadcasting, the FM broadcast Band II at 87.5-104MHz is due to be extended up to 108MHz. In the UK, the other services that are currently located in Band II such as the Police, and services which are currently at the edge of Band II such as the nationalised industries (coal, gas and electricity), will all have to be 'rehoused' elsewhere within the spectrum. This will leave Band II in the UK as an exclusive sound broadcast allocation.

An important part of the planning of the newly expanded Band II on an international level has been the ITU regional administrative radio conference, which was held in Geneva over six weeks at the end of 1984.

At that conference over 54000 individual broadcasting assignments were taken into account. The UK's objectives at the conference included securing a further two national VHF FM broadcast networks. One is to enable Radios 1 and 2 to have separate networks, and the other is for the introduction of a new independent radio service.

The Final Acts of the RARC will come into force on July 1st 1987. Not all frequencies will become immediately available at that date, as other services will still be in the process of transferring to other allocations.

Satellites galore!

Up on the satellite frequencies there is plenty of activity too! Two new television channels have recently come on the air through satellites.

The new 3SAT channel, which is a German language co-operative venture between the broadcasting authorities in Germany, Switzerland and Austria, came on the air in December. It is working through the East Spot beam on the ECS-1 satellite.

Another German language TV channel with a confusingly similar name, SAT 1, has also started transmissions through the West Spot beam on the same satellite.

Since both these TV channels are carried through communications satellites (rather than through the yet to be launched Direct Broadcast Satellites, which will be more powerful), they can only be received by installations with a relatively large dish antenna.

Largest antenna ever?

The Electronics Group News of the IEE reports a claim for what must be electrically the largest radio antenna ever built. It is a 15 metre diameter Cassegrain designed for operation at frequencies up to 750GHz (yes, GHz not MHz!). The electrical diameter of the antenna is 37500 wavelengths! Scaled down to the 2m amateur band this would be an antenna with a diameter of over 78Km (48 miles)!

This 750GHz antenna is part of a radio-telescope that has been designed by the Rutherford Appleton Laboratory with the help of British and Dutch university groups. The radio-telescope will be located on the 14000ft Mauna Kea mountain in Hawaii, where a number of other radio-telescopes are already operating.

Reference

Interim Report of the study of the requirements for a revised broadcast ancillary radio frequency allocation plan: DTI/RRD July 1984.

HAVE YOU THOUGHT OF BECOMING AN AUTHOR?

We are always interested in receiving articles to be considered for publication and are particularly keen to hear from anyone who has something to say related to the amateur radio field. As mentioned before, projects for fellow readers to build are most welcome.

You don't need to be an expert writer. If you can get your ideas down on paper, preferably typed, with drawings that we can follow and photographs where relevant, we will sort out the style, grammar, spelling etc.

If you have an idea for an article, or have designed and built a project that you think others would be interested in, but still have doubts about becoming an author, why not write (giving brief details and your *telephone number*) or telephone the editorial dept..and of course you will be paid for your effort.

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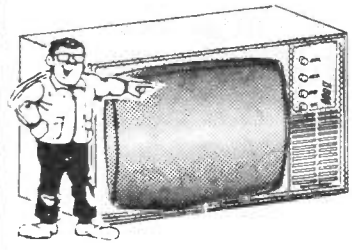

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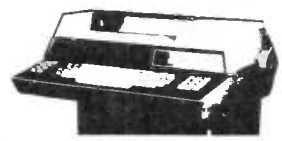

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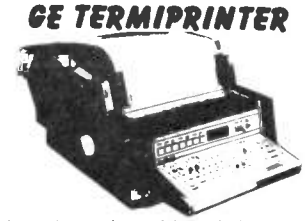

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Pro S100 system with dual 5" floppy drives, software, manuals etc.
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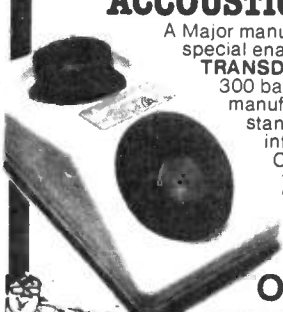

A Major manufacturer's over production and a bulk buy special enables us to offer this **BRAND NEW TRANSDATA 307A** ultra compact, **BT APPROVED**, 300 baud full duplex accoustic modem at a fraction of manufacturer's list price. The unit operates on the standard **CCITT V21** frequencies with **RS232** interface via 25 way 'D' skt.
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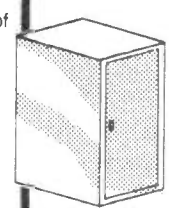
PROFESSIONAL 6 FOOT 19" RACK CABINETS



LARGE 19" equipment cabinet. Totally enclosed with locking front and rear doors. An internal sub fram 63" high is pre drilled for standard 19" equipment etc. Other features include internal 12" cooling fan, two-tone blue and grey finish with alloy trims. Mounted on 4 heavy duty castors, mains panel etc. And at a current cost from **IMHOFS** of over **£500** A snip at **ONLY £125**. Supplied in **NEW** or little used condition. Carriage £22.00.
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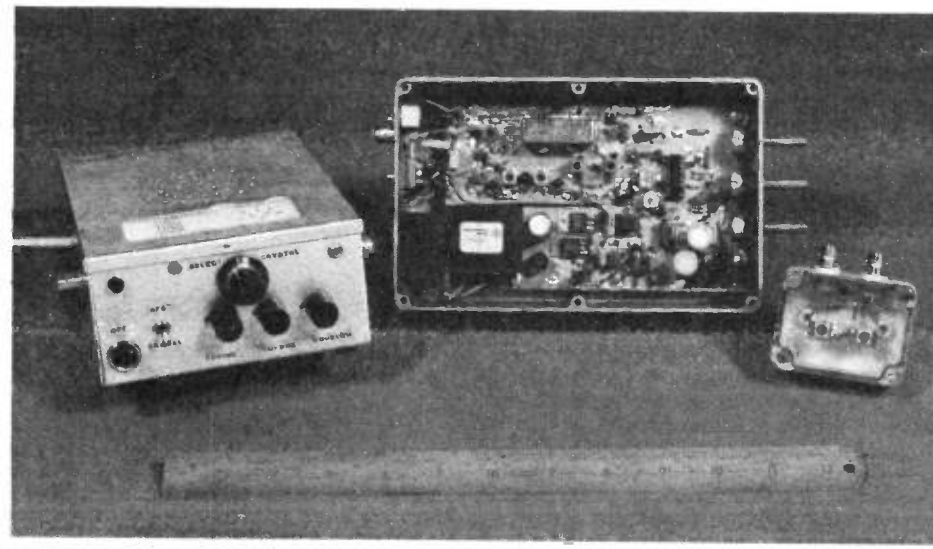
RUSSIAN ☆ SATELLITES

A guide to the reception and decoding of VHF signals from the USSR's navigation satellites: PART THREE: The computing of the received data transmissions



by P Daly, D Bell, M Leybourne
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and
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University of Leeds

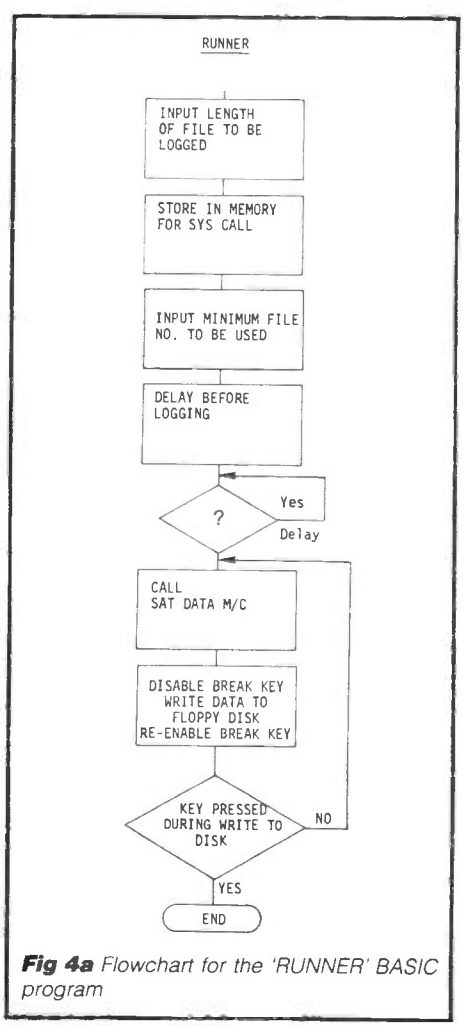

Fig 4a *Flowchart for the 'RUNNER' BASIC program*

5. COMPUTER OPERATIONS

5.1 General

For all computer operations involved in processing satellite data, the necessary hardware consists of a minicomputer with VDU display, a dual disk drive and printer. All software for the various processing operations is written in either BASIC or machine code (when the high level language cannot provide sufficient speed).

5.2 Data logging

Two separate programs in data logging of the serial data stream from the signal conditioner are employed.

The first, 'RUNNER' (in BASIC), requests inputs from the user concerning the logging format, and also directs the data onto the floppy disk drive unit.

The second, 'SATDATA', is a machine code program called by RUNNER, and performs the serial to parallel conversion and storage in memory of the incoming data.

5.2.1 The RUNNER program

The reader is referred to *Figure 4(a)* for a flow chart of the RUNNER program.

This program first displays a message Pto the user as a reminder to load the program SATDATA into memory, and also ensures that the top of the memory pointers are set to free memory space for data storage. Three pieces of information are requested of the user:

(1) the length (in bytes) of files to be logged;

(2) the minimum file number for disk storage;

(3) the delay time required before logging commences.

The default option for length is the maximum (1791 bytes). The program proceeds to call the machine code routine which logs data until the memory is full. Program control returns to RUNNER which transfers stored data to disk and returns to collect more data unless instructed otherwise.

5.2.2 The SATDATA program

The flow chart for the SATDATA routine – see *Figure 4(b)* – breaks down into two main streams:

(1) false sync/start sync detect

(2) data logging and storage

The peripheral interface adaptor (PIA), memory pointers and program scratch working areas are initialised each time SATDATA is called as a sub-routine.

Initially, the sync is sampled to ensure that no sync pulse is present which might cause a false start to the logging process. The sync line continues to be sampled until the start of a valid sync pulse occurs. A delay of 10mS is then executed so as to bring the sampling point to the exact centre of the next bit.

If, then, the sync pulse is still present, the data is assumed to be valid and further sampling at 20mS intervals takes place until the end of the particular word. Otherwise, the program loops until a valid sync pulse occurs.

Throughout the data logging (serial to parallel conversion), the two 8-bit registers, X and Y, of the 6502 microprocessor are used as follows:

(1) X register: the number of bytes to

log counter;

(2) Y register: the number of bits per byte counter.

The time of reception in hours, minutes and seconds occupies three 6-bit bytes, while the data takes up four 8-bit bytes.

The data is logged and then stored on a byte-to-byte basis using the sub-routine store-in-memory.

This sub-routine stores the byte in the allocated memory space and checks for the last byte in the current second. If the check is positive a variable character is displayed on the screen to indicate 'logging in process'.

The memory pointers are updated and an end-of-file check made, which is followed by a return to the main program if the answer is 'yes'. Otherwise, logging continues.

After each second of data, a null byte is stored to enable the logged data to be examined in hexadecimal format within the system memory.

An example of such a display is given in *Figure 4(c)* commencing at time 01:28:00 and ending at 01:28:59. The interested reader can confirm that the satellite identification sequence is 5, 6, 7 and 8.

5.3 Processing stored data

Data stored on the floppy disk drive can be processed in binary (intermediate) or decimal format.

5.3.1 Binary listing

A BASIC program, 'BINARY LIST', allows the inspection of logged data files in binary format – see *Figure 1(a)* – before conversion. Display can be directed to screen and/or line printer and the user only has to specify certain options available to him.

5.3.2 Processed output

Two programs, 'PROCESS' and 'FORMAT', load the stored data file into computer memory and convert the binary data into decimal quantities according to the format description already given under section 2.

The result of the conversion of the binary data shown in *Figure 1(a)* is given in *Figure 1(b)*.

In the case of incorrect decoding of the time, particularly the second count, the computer is instructed to print a dummy character and also to maintain its own internal timing reference.

This is extremely important since it often arises that data is spoiled by sudden bursts of interference which would otherwise cause incorrect decoding of a complete sequence of data.

5.4 System test routines

Two test routines have been developed to provide a means of testing both the hardware and software used in the complete receiving system. Their purpose is to simulate a satellite transmission, to be used in one of two ways:

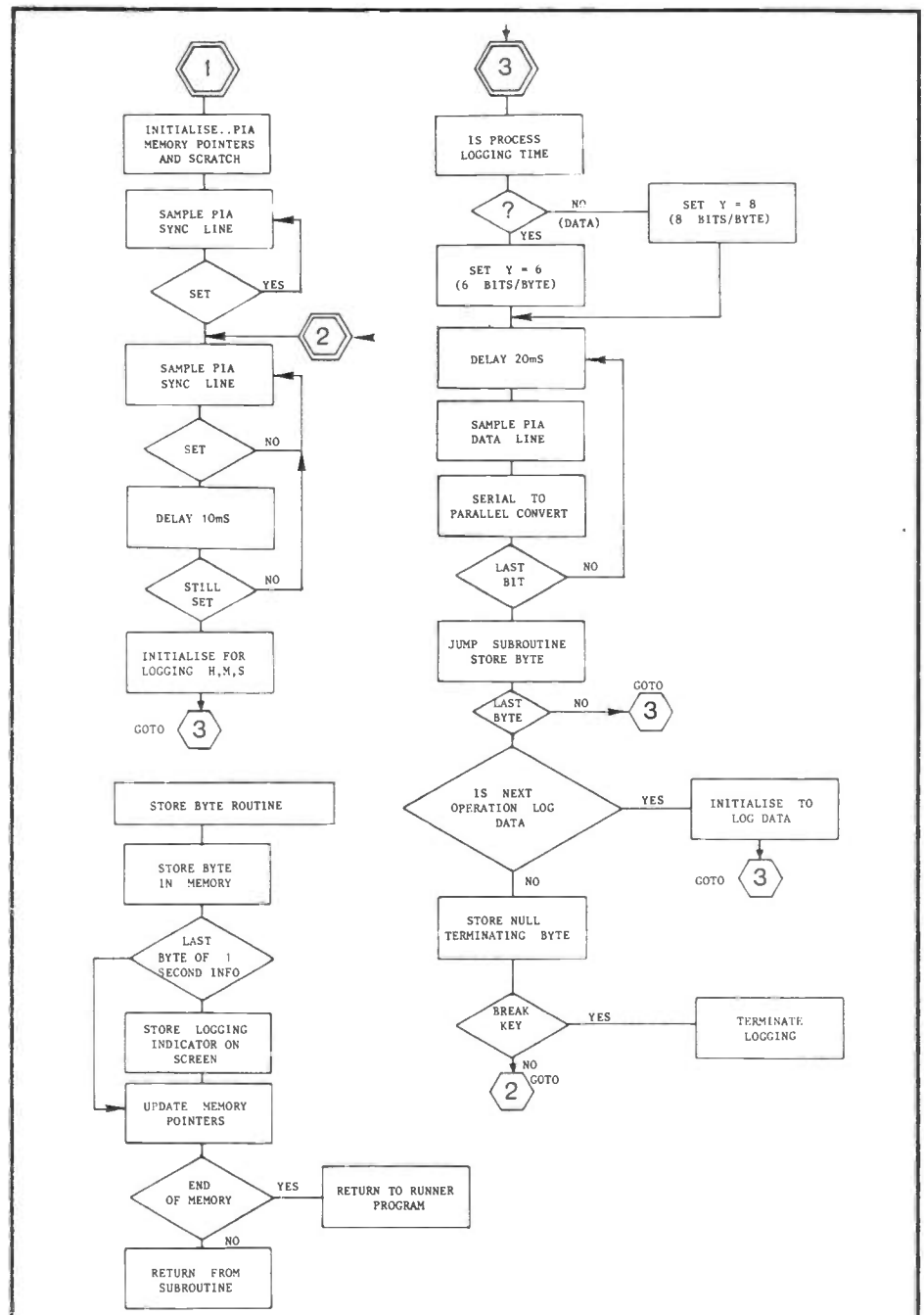

Fig 4b *Flowchart for the 'SATDATA' machine-code logging program*

(1) to create a magnetic tape of the test transmission for playback through the system;

(2) to interface the test signal with the sync/decoder input and thereby test the receive chain from the point onwards.

5.4.1 Test tape BASIC

This program initialises the versatile interface adaptor (VIA) and memory allocated to data for transmission.

Following a start time request data is added to the memory as hexadecimal AA or 55 for alternate seconds. The first and last two seconds of the frame are set to zero to conform to the real data pattern.

The flow chart for this program is shown in *Figure 4(d)*.

5.4.2 Test tape m/c

The machine code test program is called as a sub-routine from the test tape BASIC program, and performs the actual parallel to serial tone conversion of the test data – see *Figure 4(e)* for the flow chart.

The scratch working areas and memory pointers are initialised each time the routine is called, and the VIA is set to produce a 7KHz tone output.

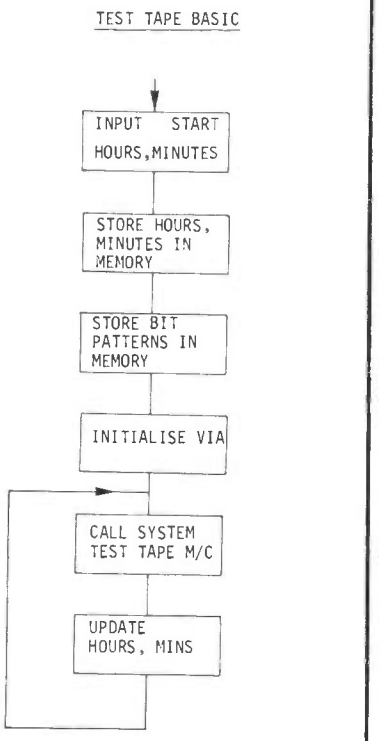

Fig 4d *Flowchart for 'Test Tape BASIC'*

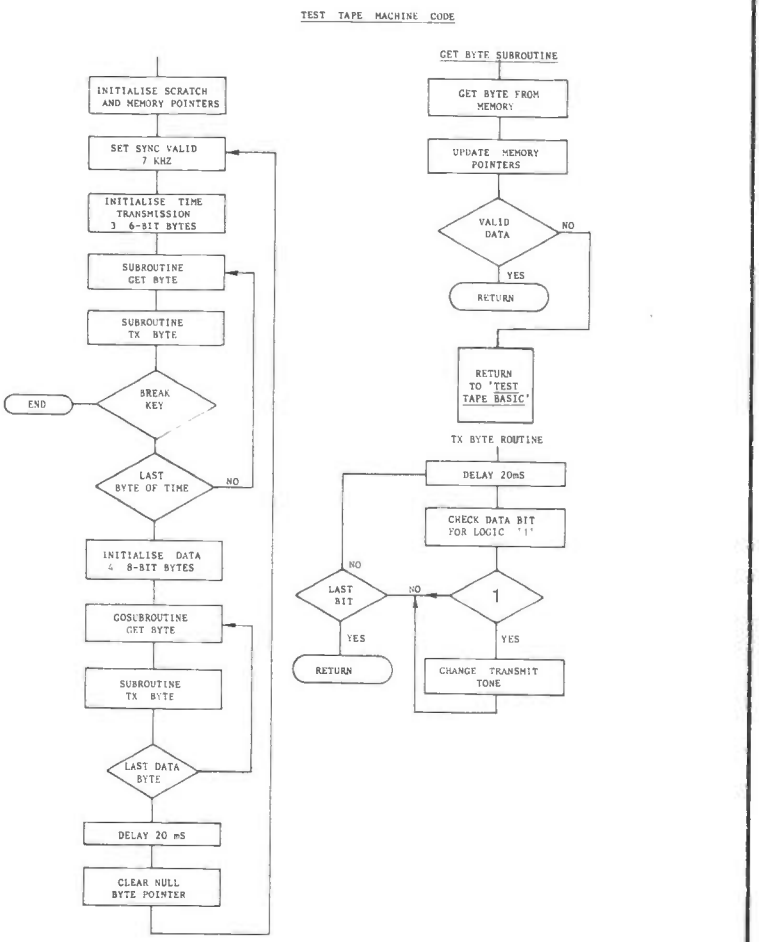

Fig 4e *Flowcharts for sub-routines 'TXBYTE' and 'GETBYTE'*

The program now transmits the time as three 6-bit bytes and two sub-routines, called 'GETBYTE' and 'TXBYTE' as described in the next sub-section.

If no break is detected, the program will begin to command the transmission of data as four 8-bit bytes. Again the two sub-routines GETBYTE and TXBYTE are called and the program loops to the next second of data.

5.4.3 Sub-routines in test programs

The GETBYTE sub-routine fetches bytes of data from memory and updates the memory pointers. Checks are also made for valid data, and 60 words (one minute) of data are transferred before control is passed back to test tape BASIC.

The TXBYTE sub-routine performs the actual changing of the data tone frequency. Each time the routine is called, a delay of 20mS is executed. The logic is such that the tone is only changed if the binary information changes. The sub-routine terminates after the last bit in the byte has been transmitted.

The flow chart for both the above sub-routines is given in *Figure 4(e)*.

6. ORBIT PREDICTION

Future orbit prediction is very important in enabling the observer to plan reception and measurement over longer intervals of time. The essential data needed to predict equator crossing

3100	01 1C 00 00 00 00 00 00	31F0	01 1C 1E 17 F9 F3 23 00
3108	01 1C 01 00 00 00 00 00	31F8	01 1C 1F 0E E5 3F 43 00
3110	01 1C 02 6A 4B 9F A0 00	3200	01 1C 20 2F 99 82 22 00
3118	01 1C 03 5B 3C 5B 3C 00	3208	01 1C 21 4A 49 5B 96 00
3120	01 1C 04 6A A5 22 F8 00	3210	01 1C 22 46 A0 FA 23 00
3128	01 1C 05 1E AF 6C 65 00	3218	01 1C 23 3B 47 5F C6 00
3130	01 1C 06 07 7A 11 CE 00	3220	01 1C 24 37 58 EE E5 00
3138	01 1C 07 1A 6E CA 0E 00	3228	01 1C 25 0F E3 57 75 00
3140	01 1C 08 11 06 04 FF 00	3230	01 1C 26 0E E5 77 A8 00
3148	01 1C 09 63 93 7B 2C 00	3238	01 1C 27 33 99 2F DA 00
3150	01 1C 0A 5A E7 E9 25 00	3240	01 1C 28 4F CA A0 81 00
3158	01 1C 0B 6B 07 13 A8 00	3248	01 1C 29 C2 5B 33 BF 00
3160	01 1C 0C 9F 12 C0 21 00	3250	01 1C 2A 3B 46 E9 A9 00
3168	01 1C 0D 07 FF 05 2A 00	3258	01 1C 2B 37 6C 93 BE 00
3170	01 1C 0E 13 D0 FA B8 00	3260	01 1C 2C 1E 35 C2 B1 00
3178	01 1C 0F 47 06 7D DF 00	3268	01 1C 2D 0E E5 3D 99 00
3180	01 1C 10 6A 4B 9F A0 00	3270	01 1C 2E 3B 9A 0F 6A 00
3188	01 1C 11 5B 3C 5B 3C 00	3278	01 1C 2F CF C9 87 E7 00
3190	01 1C 12 6A A5 22 F8 00	3280	01 1C 30 57 77 DC 38 00
3198	01 1C 13 1E AF 6C 65 00	3288	01 1C 31 3B 48 1F 3E 00
31A0	01 1C 14 07 7A 11 CE 00	3290	01 1C 32 B7 4D A8 FA 00
31A8	01 1C 15 1A 6E CA 0E 00	3298	01 1C 33 0B E8 82 E2 00
31B0	01 1C 16 11 06 04 FF 00	32A0	01 1C 34 0E E5 41 8F 00
31B8	01 1C 17 63 93 7B 2C 00	32A8	01 1C 35 47 99 B6 3A 00
31C0	01 1C 18 5A E7 E9 25 00	32B0	01 1C 36 C2 45 B9 1E 00
31C8	01 1C 19 6B 07 13 A8 00	32B8	01 1C 37 C2 31 82 7F 00
31D0	01 1C 1A 1F 12 80 21 00	32C0	01 1C 38 3B 47 A2 2F 00
31D8	01 1C 1B 07 FF 05 2A 00	32C8	01 1C 39 B7 68 9E 6D 00
31E0	01 1C 1C 13 D0 FA B8 00	32D0	01 1C 3A 00 00 80 00 00
31E8	01 1C 1D 47 06 7D DF 00	32D8	01 1C 3B 00 00 80 00 00

Fig 4c *Data storage in system memory (hexadecimal)*

Table 3

Orbital parameters of the USSR Cosmos navigation satellites using the VHF frequency band for data transmission

ID	W long (°)	incl (°)	sma Kms	period min	date	asc.node GMT	ecc(e)	$\dot{\omega}$ (°/day)	Cosmos no.
01	101.22	82.96	7367.11	104.8148	Aug 17	20:37:15.9	0.0018	−0.7364	1448 83-23A
02	109.70	82.97	7365.29	104.7765	Aug 17	23:15:02.3	0.0027	−0.7364	1386 82-69A
03	77.72	82.92	7363.67	104.7395	Aug 17	23:01:58.1	0.0046	−0.7425	1428 83-01A
04	101.31	82.98	7365.24	104.7721	Aug 17	02:48:34.5	0.0059	−0.7357	1459 83-42A
05	71.56	82.95	7372.15	104.9210	Aug 17	02:52:16.5	0.0042	−0.7362	1464 83-48A
06	73.00	82.98	7369.37	104.8645	Aug 17	05:03:22.6	0.0035	−0.7344	1417 82-102A
07*	145.44	82.95	7376.46	105.0153	Jul 06	08:39:34.0	0.0020	−0.7348	1333 82-03A
08*	298.35	82.95	7373.62	104.9544	Aug 17	18:03:54.3	0.0033	−0.7356	1181 80-39A
11	87.98	82.94	7392.38	105.3560	Aug 24	08:21:17.0	0.0026	−0.7302	1383 82-66A
12	78.39	82.94	7327.77	103.9750	Aug 24	09:47:13.2	0.0058	−0.7527	1304 81-87A
13	108.34	82.95	7370.23	104.8822	Aug 24	15:28:35.8	0.0027	−0.7369	1447 83-21A
14	2.06	82.91	7368.72	104.8509	Aug 24	11:14:06.8	0.0039	−0.7419	1339 82-12A

The asterisk * indicates that this satellite is not always referred to in the outputs of others in the group and also that its own data is not updated as regularly as the others. Note the figures given refer to 1983.

times and longitudes is contained in the parameter block.

6.1 Equator crossing time

The time of equator crossing for any number of orbits after a reference orbit is simply obtained by adding the appropriate multiple of the orbital period to the time of the ascending node.

6.2 Equator crossing longitude

As with equator crossing time, a multiple of the change in longitude per orbital period is to be added to the current value of equator crossing longitude (ascending or descending node).

However, the situation is more complicated because the rate of change of longitude with time is made up of three contributions:

(i) the rotation of the earth on its axis;

(ii) the rotation of the earth around the sun;

(iii) the rotation of the plane of the satellite orbit owing to the fact that the earth is an oblate spheroid rather than a perfect sphere.

The sum of the three contributions, $\dot{\Omega}$, amounts to:

$$\dot{\Omega} = 360.9856 + \dot{\omega} \text{ (°/day)}$$

where ω is the contribution from (iii) and depends on the orbital inclination, eccentricity and semi-major axis. It is tabulated in *Table 3* with the most important parameters of the Keplerian orbit of the Cosmos navigation satellites.

6.3 Accuracy of prediction

Figures obtained at intervals of two months indicate that predictions based on the above calculations remain accurate to within seconds (equator crossing time) and fractions of a degree (equator crossing longitude). It is certainly possible to use one set of figures to prepare look-alert data usable over periods of several months or longer.

7. TRANSMISSION FREQUENCIES

As one of the navigation satellites passes the observer, the maximum Doppler shift on the transmitted centre frequency reaches approximately 3.5 KHz as the satellite appears on the horizon on an overhead pass.

Obviously Doppler frequency changes depend on satellite elevation as seen from the observer, and are zero at the time of closest approach (TCA).

Measurements of received frequency at regular intervals (30 seconds) during a pass result in frequency plots as shown in *Figure 5*, which are symmetrical about a point of inflexion where the Doppler frequency is zero. The received frequency at this point is identical to the transmit frequency.

Results indicate that the satellites use transmit frequency spacings of 30KHz around 150000KHz as shown in *Table 4*.

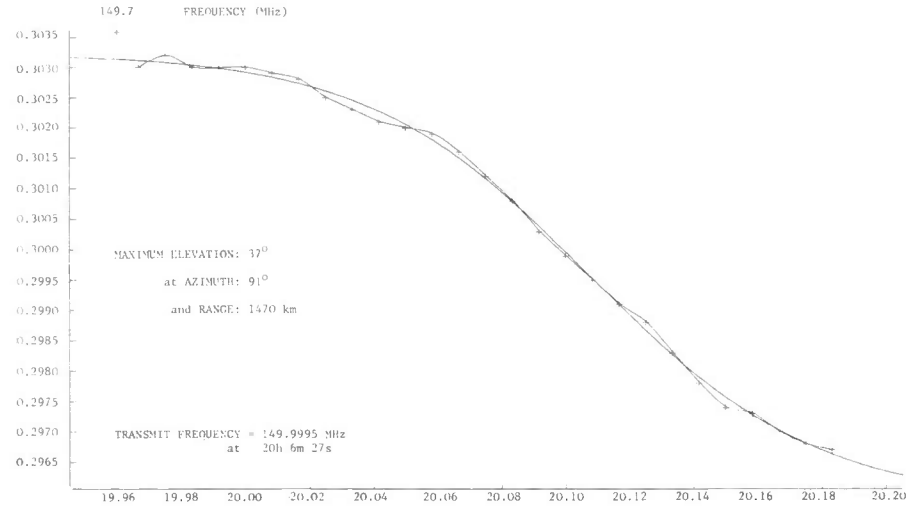

Fig 5 *Doppler frequency plot for cosmos navigation satellite*

Table 4

Transmit frequency (KHz)	Identification number
149910	2
149940	3 6 7
149970	1 4
150000	11 12 13 14
150030	5

The satellite with identification number 8 is (March '84) inactive

References

1 Wood C D, Perry G; *The Russian satellite navigation system,* Phil. Trans. R.Soc.Lond. A 294,307-315 (1980)

2 Stansell T A; *The Transit navigation satellite system,* Magnavox Advanced Products Division, Torrance CA, USA.

AMATEUR RADIO WORLD

Compiled by Arthur C Gee G2UK

One is inclined to forget these days that amateur radio, with its 'black boxes' and 'chatter' on the bands, has contributed very greatly in the past – and still does, though perhaps in a lesser degree – to what one can call 'community service'. This was very well illustrated by the work done during the last war in the various specialities of radio communication, which are only now coming to light.

Quite apart from the large number of radio amateurs who were drafted into the services at the outbreak of hostilities, thus providing a ready trained core of radio technicians and operators upon which the great increase in service radio communications was rapidly built up, there were numbers who went into highly specialised and at the time very secret radio activities.

Secret warfare

A most interesting account of some of these activities has recently been produced in this country by the translation of *'Secret Warfare'*, first produced in French, which describes in detail how the French Resistance maintained contact with intelligence in England.

Written by Pierre Lorain F2WI and translated into English by David Kahn, the first part of the book describes in detail the procedures taken to avoid detection of the radio systems used and the painstaking processes followed by German operators to locate a clandestine transmitter. The various codes and ciphers used, such as Delastelle and Playfair, are described and the difficulties they set for code-breakers are outlined. The second part of the book deals with how the French Resistance was supplied with equipment and personnel by Britain's Special Operations Executive and makes fascinating reading.

The book solved a mystery for your scribe which had been puzzling him for years. Just after the end of the war it was said that there had been a small *steam* driven electric generator, which was used for charging radio batteries in 'out of the way places'. This was even said to be available on the war-surplus market, but your scribe never saw one or heard of anyone who had ever seen one.

However, in this book mention is made of this generator. Under the heading *'Battery Chargers'* appears a description of one described as a 'steam recharger'. To quote:

'This was the most amazing of all. It consisted of a boiler suspended over a brazier and attached by a flexible tube to a small 2 cylinder steam engine. The engine was coupled to a generator. The total weight did not exceed 70 pounds. With steam pressure at 70 pounds per square inch, an hourly consumption of 2 quarts of water and 10 to 20 pounds of wood, a 6 volt battery could be charged to 4 amps.

This recharger was used frequently in the Indo-Chinese and Burmese jungles in 1945 by Force 136. In this way a group of saboteurs could remain isolated from all civilization for several months, but still maintain a permanent radio link as long as they had some dry wood'.

Coincidence

Now, would you believe it, recently a pile of old magazines came the way of your scribe. Amongst them were several copies of a magazine called *'Mechanics'*. It appeared weekly in the 1940s – price 4 'old' pence! The copies which came into your scribe's hands were for the year 1947 and in the copy for 30 May there appeared a description of a 'Steam driven electric generator', used for clandestine radio operations during the war. There was even an advertisement for them, war-surplus from 'Marble Arch Motor Supplies'!

It appeared to be a somewhat improved model from the battery charger mentioned above, and it was described as being 'for dropping by parachute to troops stationed in forests during the war'. It consisted of a twin cylinder steam engine directly coupled to a 'standard wireless service dynamo rated at 6 to 8 volts, 4 amps.'

The advert photo showed an engine which resembles the present day 'Sirius' engine made by Stuart Turner Ltd of Henley-on-Thames, being a twin cylinder high speed type with sump lubrication. The boiler was a simple pot type mounted in a casing which served the purpose of a furnace. Filling the boiler with water was accomplished by removing a flanged lid and one filling was sufficient for 2½ hours running, the water consumption being about 1 gallon per hour. Working pressure was 45psi. Heat was provided by wood or any other fuel available. The whole unit was housed in a strong box and weighed 30lbs.

Your scribe would be very interested indeed to hear from any reader who may have used one of these units or possessed one of the war-surplus ones.

RTTY from the computer problems

Those readers who use RTTY will be aware that there has been a noticeable deterioration in the signal characteristics to be heard from many stations using this mode. This problem is referred to by Ian Wade G5NRW in the leader article in the August 1984 issue of BARTG's journal *Datacom*.

He writes: 'One of the most important articles in this issue is the one describing an AFSK filter, by Alan Hobbs G8GOJ. It is important because of the ever-increasing number of bad signals heard on the bands these days, arising very often from computers generating audio tones connected directly into the transmitter without any form of filtering.

'To produce a clean RTTY signal with AFSK tones it is essential that the transmitter is modulated with pure sine waves. The only way to check this is to monitor the modulating stage in your transmitter (at the end of the microphone amplifying chain) with an oscilloscope. This means borrowing a scope if you haven't got one. It means taking the lid off your black box and identifying the right place to monitor. It means making sure that you are not overdriving the audio amplifier into

compression. Simply relying on the deviation limiting circuitry in your FM black box is not sufficient.

'It means making sure that you are not overdriving the amplifier into flat-topping. Many people drive the transmitter with tones generated by their computer. There is nothing wrong with this, provided that you filter the output from the computer to make sure that harmonics of the audio tones are removed. Alan's article describes just such a filter and is a must to remove dirty audio'.

We recommend it to all our readers who are interested in RTTY.

Amateur radio from RRS Discovery

The research vessel *RRS Discovery* will have amateur radio aboard for part of its voyage to the Antarctic, using the call GB4DIS/MM. She was due to leave Gibraltar on 7 December last and should be in Montevideo by 12 April. Three amateur radio operators will be aboard and SSB, CW and perhaps RTTY will be used in the 20 metre and 15 metre bands, daily between 1800 and 2000 hours GMT for QSOs with the UK.

FAX endorsement for WAC certificate

The popular Worked All Continents certificate issued by the International Amateur Radio Union can now be awarded for two-way facsimile QSOs. A3C, F3C or J3C communication with all six continents will entitle the operator to claim this award and contacts of any date, past or future, are valid.

The High Speed Club

This club, which was founded in 1951, is for those who can use Morse code at a speed of twenty-five words per minute or more. Members must be able to send and read this speed perfectly. Application for membership is made by arranging several CW contacts with other club members and if you appear to qualify getting one of them to recommend you for HSC membership. Two-way CW QSOs lasting at least thirty minutes must be made for the test QSOs.

When you have obtained five such recommendations you forward them to the secretary of the club with your application, which must state that you did not use a keyboard, decoder or computer during the test QSOs. The membership fee is 5DM or 8IRCs. The club station, DL0HSC, transmits an 'HSC-Bulletin' on the first Saturday of each month on 7025KHz at 1500 hours GMT. It gives information about club activities, new members and so on.

This club is not to be confused with another 'High Speed Club' known as 'HSC eV'. This society was founded and registered as a club in 1979 and persists in calling itself 'HSC'. It apparently tried to enforce its claim to this title by taking several lawsuits against members of the original 'HSC'. Judgement in these lawsuits, however, went against them in favour of the earlier club.

Further details can be obtained from the secretary, Ernst Manske DL1PM, at *Anagarstr, 14 D2105, Seevetal 11, West Germany.*

Radio amateurs' examination

'How to Pass the Radio Amateurs' Examination' is now available from the RSGB HQ. It is a new publication written by George Benlow G3HB, who is the author of the *'Radio Amateur's Examination Manual'*. It is a must for anyone taking the RAE.

Shuttle mission 51-F

Latest news is that two radio amateurs will be on board the shuttle mission 51-F, due to be launched on 17 April 1985. Dr Tony England W0ORE will be one, the other being John-David F Bartol W4NYZ. Listen to RSGB news bulletins for the latest information on this mission. REW

AA117	9p	BD682	48p	OC35	100p	3N.128	55p	ECL80	57p	4520	51p	74LS148	120p	MB3712	150p	AY3-1015	290p
AA119	9p	BDX32	100p	OC36	120p	3N.143	58p	ECL82	59p	4521	108p	74LS151	48p	MB3730	280p	AY5-3600	570p
AAY32	9p	BDX65	80p	OC45	50p	DIODES		ECL84	57p	4522	80p	74LS153	80p	MB3756	280p	SPO256AL2	580p
AC107	28p	BDY92	100p	OC71	30p	AA119	8p	ECL85	57p	4526	57p	74LS154	160p	MC1327	70p	Z80ACPU	250p
AC126	17p	BF180	16p	OC72	50p	BY100	40p	ECL86	48p	4527	57p	74LS155	58p	NE555	20p	Z80BCPU	500p
AC127	15p	BF181	18p	OC200	180p	BY103	32p	EF80	31p	4528	57p	74LS156	65p	NE556	40p	Z80ADMA	850p
AC128	15p	BF183	20p	R2008B	100p	BY126	6p	EF85	34p	4529	100p	74LS157	35p	SAS560	110p	Z80AP10	220p
AC128K	23p	BF184	20p	R2010B	100p	BY127	8p	EF89	43p	4532	62p	74LS158	50p	SAS570	110p	Z80BP10	300p
AC141K	30p	BF185	20p	TAG4443	76p	BY133	6p	EF183	48p	4551	98p	74LS160	65p	SN76003N	140p	Z80ACTC	220p
AC142K	30p	BF194	8p	TAG4444	76p	BY164	40p	EF184	53p	4553	230p	74LS161	58p	SN76013N	140p	Z80BCTC	600p
AC153K	23p	BF195	8p	TIP29	15p	BY176	55p	EL34	190p	4555	30p	74LS162	58p	SN76023N	140p	Z80AS10	680p
AC176	18p	BF196	8p	TIP29A	22p	BY179	35p	EL36	80p	4556	47p	74LS163	60p	SN76033N	160p	Z80AS10/1	700p
AC176K	20p	BF197	7p	TIP29C	25p	BY182	32p	EL84	50p	4557	230p	74LS164	68p	SN76110N	70p	Z80AS10/2	700p
AC187	15p	BF198	7p	TIP30	28p	BY184	32p	EL95	50p	4583	65p	74LS165	98p	SN76115	70p	Z80ADART	680
AC187K	20p	BF199	6p	TIP30C	30p	BY187	32p	EL500	80p	4584	42p	74LS166	120p	T2800D	52p		
AC188	17p	BF200	16p	TIP31A	24p	BY196	20p	EL504	100p	4585	58p	74LS168	120p	TA-7120	65p	LED	
AC188K	23p	BF240	16p	TIP31C	30p	BY206	11p	EY86	31p			74LS169	80p	TA-7137P	83p	LED 3mm RED	5p
ACY18	48p	BF241	10p	TIP32	24p	BY207	11p	EY87	31p	74 SERIES		74LS170	120p	TA-7146P	400p	LED 3mm YEL	10p
ACY19	48p	BF255	12p	TIP32A	24p	BY208	15p	EY88	42p	7400	22p	74LS174	58p	TA-7193P	400p	LED 3mm GRN	10p
AD142	80p	BF256	18p	TIP32C	28p	BY210	22p	EZ35	45p	7401	16p	74LS175	58p	TA-7200	200p	LED 5mm RED	8p
AD149	45p	BF257	18p	TIP33	50p	BY223	72p	EZ80	50p	7402	18p	74LS190	70p	TA-7201	200p	LED 5mm YEL	10p
AD161	22p	BF258	18p	TIP34	50p	BY225	120p	EZ81	55p	7403	22p	74LS191	58p	TA-7203	180p	LED 5mm GRN	10p
AD162	22p	BF259	15p	TIP41A	22p	BY226	18p	GZ34	180p	7404	40p	74LS192	50p	TA-7204	110p		
AF124	25p	BF262	25p	TIP41C	25p	BY227	19p	PC97	100p	7405	10p	74LS193	73p	TA-7205	80p	OPTO ELECTRONICS	
AF125	25p	BF263	25p	TIP42A	22p	BY228	32p	PCC85	42p	7406	40p	74LS194	58p	TA-7210	200p		
AF126	25p	BF270	18p	TIP42C	25p	BY296	20p	PCF80	58p	7407	40p	74LS195	60p	TA-7222AP	120p	2N.5777	40p
AF127	25p	BF273	16p	TIP47	40p	BY296	26p	PCF200	135p	7408	25p	74LS196	72p	TA-7310P	100p	OCP71	100p
AF139	22p	BF311	21p	TIP48	40p	BY299	28p	PCF801	110p	7409	20p	74LS197	52p	TA-7609	270p	ORP12	65p
AF239	22p	BF324	25p	TIP50	60p	BY476	90p	PCF802	87p	7413	38p	74LS221	75p	TAA550	18p	ORP60	100p
AL112	70p	BF336	20p	TIP51	120p	BYX10	15p	PCF806	115p	7414	45p	74LS240	80p	TBA120S	48p	ORP61	100p
AL113	80p	BF337	20p	TIP52	120p	BYX55/350	30p	PCH200	100p	7417	32p	74LS241	72p	TBA395	80p		
ASZ15	100p	BF338	20p	TIP53	120p	BYX55/600	30p	PCL81	54p	7420	22p	74LS242	78p	TBA396	80p	DISPLAYS	
ASZ17	100p	BF355	28p	TIP54	140p	BYX55/800	32p	PCL82	53p	7421	25p	74LS243	78p	TBA520	100p	MAN.72	118p
AU110	110p	BF362	30p	TIP105	85p	BYX70/300	29p	PCL84	50p	7425	15p	74LS244	80p	TBA530	100p	MAN.74	118p
AY102	180p	BF367	13p	TIP106	85p	BYX70/500	32p	PCL85	55p	7430	25p	74LS245	90p	TBA540	100p	MAN.4640	180p
AY106	180p	BF371	17p	TIP107	65p	BYX70/800	36p	PCL86	55p	7437	28p	74LS247	90p	TBA560	100p	MAN.8910	230p
BA145	10p	BF414	18p	TIP110	47p	BYX71/600	80p	PCL805	55p	7442	45p	74LS248	50p	TBA750	100p	DL.747	180p
BA148	10p	BF420	16p	TIP111	50p	OA47	6p	PFL200	85p	7447	60p	74LS249	98p	TBA800	35p		
BA154	6p	BF421	18p	TIP112	40p	OA90	4p	PL36	80p	7450	22p	74LS251	30p	TBA810S	90p	TRIACS PLASTIC	
BA157	12p	BF422	21p	TIP115	45p	OA91	4p	PL82	45p	7451	10p	74LS253	65p	TBA820	75p	TIC206D-4A/400V	60p
BB101	13p	BF423	15p	TIP116	45p	OA200	7p	PL83	32p	7454	25p	74LS256	85p	TBA920	100p	TIC225D-6A/400V	80p
BB103	16p	BF440	16p	TIP117	50p	OA202	7p	PL84	50p	7470	30p	74LS257	60p	TBA950	100p	TIC226D-8A/400V	88p
BB105B	18p	BF451	17p	TIP120	43p	IN.914	2p	PL95	140p	7473	30p	74LS258	60p	TBA990	100p	TIC236D-12A/400V	85p
BB205B	24p	BF455	14p	TIP121	46p	IN.4001	4p	PL500	110p	7474	40p	74LS259	90p	TCA270	40p	TIC246D-16A/400V	90p
BC107	7p	BF458	18p	TIP122	47p	IN.4002	4p	PL504	95p	7475	25p	74LS260	68p	TCA800	200p	TIC253D-20A/400V	190p
BC108	7p	BF459	19p	TIP125	47p	IN.4003	4p	PL508	170p	7481	90p	74LS266	28p	TCA940	100p	TIC263D-25A/400V	208p
BC109	7p	BF461	60p	TIP126	56p	IN.4004	4p	PL519	450p	7482	70p	74LS273	80p	TDA1170	100p		
BC115	10p	BF462	62p	TIP127	56p	IN.4005	4p	PY81	70p	7485	45p	74LS279	55p	TDA1412	80p	T2800D	52p
BC118	11p	BF469	30p	TIP141	90p	IN.4006	4p	PY88	45p	7486	28p	74LS280	180p	TDA2002	80p		
BC140	19p	BF470	28p	TIP142	90p	IN.4007	5p	PY500A	160p	7489	100p	74LS290	30p	TDA2003	160p	THYRISTORS	
BC141	19p	BF471	28p	TIP145	65p	IN.4148	2p			7490	38p	74LS293	30p	TDA2020	140p	2N.5061-0.8A/60V	20p
BC142	19p	BF479	30p	TIP146	90p	IN.5400	9p	CMOS		7492	45p	74LS365	44p	TDA2030	140p	2N.5062-0.8A/100V	28p
BC143	19p	BF493	18p	TIP147	100p	IN.5401	10p	4000	26p	7493	38p	74LS366	44p	TDA2522	90p	2N.5064-0.8A/200V	29p
BC147	6p	BF494	16p	TIP2955	42p	IN.5402	10p	4001	20p	7495	48p	74LS367	47p	TDA2530	100p	C106D 4A/400V	23p
BC148	6p	BF595	16p	TIP3054	45p	IN.5403	11p	4002	20p	7497	80p	74LS368	43p	TDA2532	100p	TIC116C 8A/300V	58p
BC149	6p	BF595	16p	TIP3055	42p	IN.5404	11p	4006	65p	74107	30p	74LS373	68p	TDA2540	100p	TIC116D 8A/400V	70p
BC157	6p	BF597	10p	TIS43	45p	IN.5405	12p	4007	23p	74111	52p	74LS374	68p	TDA2560	100p	TIC116M 8A/600V	79p
BC159	6p	BF615	30p	TIS44	40p	IN.5406	13p	4008	52p	74116	85p	74LS375	70p	TDA2593	100p	TIC126D 12A/400V	75p
BC182	6p	BF758	41p	TIS61	15p	IN.5407	13p	4009	40p	74119	85p	74LS399	85p	TDA2690	100p	TIC126M 12A/600V	90p
BC182L	6p	BF869	22p	TIS88A	45p	IN.5408	13p	4010	50p	74122	40p	74LS670	130p	UPC-555H	60p		
BC183	6p	BF870	22p	TIS90	15p			4011	20p	74123	20p			UPC-556H	80p	2N.4444	75p
BC183L	6p	BF872	23p	TIS91	18p	ZENERS		4012	23p	74125	40p	LINEAR IC'S		UPC-575C2	100p	BT106	90p
BC184	6p	BF960	38p	TIS93	20p	400MW		4013	30p	74126	45p	AN-214P	200p	UPC-577H	64p	BT116	80p
BC184L	6p	BF963	40p	VK1010	88p	BZY88 Range		4014	50p	74132	42p	AN-240P	160p	UPC-592H2	95p	BT119	100p
BC212	6p	BF964	38p	VN.10KM	60p	2V7 to 39V	6p	4015	42p	74136	95p	AN-360	120p	UPC-1001H	220p	BT120	100p
BC212L	6p	BF966	40p	VN.46AF	88p	1.3W Zeners		4016	30p	74145	70p	AN-7110	140p	UPC-1025H	230p	TIC44	22p
BC213	6p	BFR40	25p	VN.66AF	100p	BZX61 Range		4017	43p	74153	45p	AN-7114	160p	UPC-1026C	106p	TIC45	27p
BC213L	6p	BFR51	21p	VN.88AF	115p	2V7 to 39V	12a	4018	48p	74155	45p	AN-7115	160p	UPC-1028H	90p	TIC47	32p
BC214	6p	BFR62	21p	VN.89AF	110p	JAPANESE		4019	50p	74157	45p	AN-7120	140p	UPC-1031H2	180p		
BC214L	6p	BFR79	25p	ZTX107	11p	TRANSISTORS		4020	72p	74160	50p	AY3-1270	680p	UPC-1032H	70p		
BC237	7p	BFR90	52p	ZTX108	11p	2SB324	58p	4021	52p	74164	50p	AY3-1350	300p	UPC-1155H	200p	BRIDGE RECTIFIERS	
BC238	7p	BFR91	99p	ZTX109	12p	2SB507	68p	4022	52p	74167	35p	AY3-8910	360p	UPC-1156H	140p		
BC300	16p	BFX29	20p	ZTX212	27p	2SB754	80p	4023	24p	74173	50p	AY3-8912	400p	UPC-1181H	115p	W005 1A/50V	16p
BC301	18p	BFX84	20p	ZTX300	13p	2SC495	60p	4024	38p	74174	70p	AY5-3600	570p	UPC-1182H	150p	W01 1A/100V	16p
BC302	16p	BFX85	20p	ZTX301	16p	2SC1060	99p	4025	22p	74175	65p	CA270	40p	UPC-1185H2	250p	W02 1A/200V	19p
BC303	16p	BFX87	15p	ZTX302	16p	2SC1061	200p	4026	75p	74176	45p	CA3046	60p	UPC-1350C	150p	W04 1A/400V	21p
BC327	6p	BFX88	15p	ZTX303	24p	2SC1096	78p	4027	38p	74180	50p	CA3048	190p			W06 1A/600V	23p
BC328	6p	BFX89	60p	ZTX304	17p	2SC1161	110p	4028	40p	74182	45p	CA3060	280p	COMPUTER ICS		W08 1A/800V	28p
BC337	6p	BFY17	30p	ZTX320	29p	2SC1172	150p	4029	58p	74192	40p	CA3080E	70p	2114	200p	BR81D 2A/100V	35p
BC338	6p	BFY18	40p	ZTX326	29p	2SC1306	90p	4030	30p	74196	40p	CA3086	68p	2516	200p	BR82D 2A/200V	36p
BC557	6p	BFY41	28p	ZTX500	13p	2SC1307	100p	4031	120p	74197	45p	CA3089E	160p	2532	370p	BR84D 2A/400V	42p
BCY32	150p	BFY50	14p	ZTX501	13p	2SC1678	120p	4032	64p	74393	70p	CA3090AQ	300p	2716	300p	BR86D 2A/600V	54p
BCY33	150p	BFY51	14p	ZTX502	18p	2SC1969	130p	4033	115p			CA3130E	80p	2732	400p	BR88D 2A/800V	58p
BCY34	160p	BFY52	14p	ZTX503	18p	2SC2028	78p	4034	140p	74LS SERIES		CA3130S	100p	2764	425p	BR32 3A/200V	66p
BCY42	20p	BFY56	20p	ZTX504	25p	2SC2029	120p	4035	80p	74LS00	24p	CA3140E	38p	27128	900p	BR34 3A/400V	65p
BCY56	16p	BFY57	25p	ZTX550	24p	2SC2078	120p	4036	220p	74LS01	24p	CA3189E	220p	4116	75p	BR36 3A/600V	78p
BCY70	16p	BFY64	25p	2N.696	26p			4037	100p	74LS02	24p	CA3240E	90p	4164	300p	BR62 6A/200V	100p
BCY71	16p	BFY90	45p	2N.697	22p	LOW PROFILE		4038	65p	74LS03	24p	HA-1156W	110p	6116	400p	BR64 6A/400V	60p
BCY72	16p	BLY48	85p	2N.698	40p	SOCKETS		4039	220p	74S04	24p	HA-1197	150p	6264-15	2000p	BR251 25A/100V	160p
BD115	28p	BLY49	85p	2N.699	45p	8 pin	6p	4040	52p	74LS05	23p	HA-1306W	170p	6502	320p	BY164	40p
BD124P	50p	BR100	14p	2N.706A	22p	14 pin	8p	4041	40p	74LS08	24p	HA-1319	250p	6802	220p	BY179	35p
BD124	110p	BR101	43p	2N.708	22p	16 pin	9p	4042	47p	74LS09	25p	HA-1339	17p	6809	600p		
BD128	35p	BR103	37p	2N.914	28p	18 pin	12p	4043	42p	74S10	25p	HA-1342	170p	6821	150p		
BD131	25p	BSX20	15p	2N.918	36p	20 pin	14p	4044	48p	74S11	25p	HA-1366WR	160p	6840	320p		
BD132	25p	BSX26	18p	2N.930	18p	22 pin	16p	4045	98p	74LS12	25p	HA-1368	160p	6850	130p		
BD135	20p	BSX29	19p	2N.1131	28p	24 pin	18p	4046	65p	74LS13	30p	HA-1377	220p	8080A	400p		
BD136	20p	BT106	90p	2N.1132	28p	28 pin	20p	4047	58p	74S14	40p	HA-1389	140p	8085A	530p		
BD137	20p	BT109	90p	2N.1613	24p	40 pin	25p	4048	48p	74LS15	24p	HA-1392	230p	8155	470p		
BD138	20p	BT116	80p	2N.1711	24p			4049	33p	74LS20	24p	HA-1397	250p	8156	380p		
BD139	20p	BT119	100p	2N.2102	50p	VOLTAGE		4050	30p	74LS21	24p	HA-1398	240p	8250	880p		
BD140	20p	BT120	100p	2N.2160	300p	REGULATORS		4051	57p	74LS22	24p	LA-1201	85p	8251	470p		
BD144	90p	BT138/600	60p	2N.2218A	24p	7805	38p	4052	58p	74LS24	47p	LA-1352	120p	8253	580p		
BD150	30p	BT146/750	99p	2N.2219	24p	7812	38p	4053	54p	74LS26	24p	LA-1365	140p	8255	600p		
BD157	36p	BT151/650	58p	2N.2221	23p	7815	38p	4054	74p	74LS27	24p	LA-3301	120p	8288	1000p		
BD158	38p	BT151/800	58p	2N.2222	23p	7818	38p	4055	75p	74LS28	24p	LA-3350	120p				
BD166	30p	BTY79/500	140p	2N.2369	15p	7824	38p	4056	75p	74LS30	24p	LA-3361	115p				
BD175	30p	BU100A	110p	2N.2484	20p	7905	38p	4060	60p	74LS32	24p	LA-4030	200p				
BD177	30p	BU104	100p	2N.2646	40p	7912	40p	4063	78p	73LS33	26p	LA-4031	140p				
BD179	32p	BU105	80p	2N.2904	20p	7915	40p	4066	38p	74LS37	24p	LA-4032	140p				
BD181	45p	BU108	100p	2N.2905	20p	7918	40p	4067	220p	74LS38	24p	LA-4050	130p				
BD182	60p	BU110	110p	2N.2906	18p	7924	40p	4068	24p	74LS40	24p	LA-4051	160p				
BD183	60p	BU111	140p	2N.2907	18p	78L05	28p	4069	24p	74LS42	48p	LA-4100	120p				
BD201	33p	BU124	60p	2N.2926	8p	78L12	28p	4070	23p	74LS47	78p	LA-4101	100p				
BD202	38p	BU126	70p	2N.3019	28p	78L15	28p	4071	23p	74LS48	78p	LA-4102SK	140p				
BD203	42p	BU204	75p	2N.3053	18p	78L18	28p	4072	23p	74LS51	24p	LA-4112	260p				
BD204	42p	BU205	70p	2N.3054	35p	78L24	28p	4073	23p	74LS54	24p	LA-4125	210p				
BD222	31p	BU208	75p	2N.3055	35p	78L24	28p	4075	23p	74LS55	24p	LA-4140	70p				
BD225	31p	BU208A	80p	2N.3055H	50p	79L05	40p	4076	80p	74LS73	28p	LA-4201	120p				
BD232	31p	BU208D	100p	2N.3440	58p	79L12	40p	4077	24p	74LS74	33p	LA-4220	120p				
BD234	32p	BU325	55p	2N.3442	85p	79L15	40p	4078	24p	74LS75	36p	LA-4400	190p				
BD235	28p	BU326	85p	2N.3702	9p	LM309K	100p	4081	24p	74LS76	28p	LA-4420	140p				
BD236	30p	BU406	85p	2N.3703	9p	LM317K	220p	4082	24p	74LS78	35p	LA-4422	130p				
BD237	21p	BU406D	95p	2N.3704	9p	LM317T	180p	4085	58p	74LS83	68p	LA-4430	130p				
BD238	24p	BU407	75p	2N.3705	9p	LM323K	420p	4086	50p	74LS85	75p	LA-4460	170p				
BD244	50p	BU407D	95p	2N.3706	9p	LM723	32p	4089	110p	74LS86	32p	LA-4461	180p				
BD245	50p	BU408	85p	2N.3707	9p	78HGKC	570p	4093	32p	74LS90	45p	LA-5112	120p				
BD433	28p	BU408D	95p	2N.3708	9p	78HO5KC	520p	4094	65p	74LS91	68p	LM301	26p				
BD434	30p	BU409	95p	2N.3771	85p	78GU1C	190p	4095	85p	74LS92	50p	LM311	38p				
BD435	31p	BU426	120p	2N.3772	90p	79GU1C	215p	4098	70p	74LS93	48p	LM324	38p				
BD437	28p	BU500	110p	2N.3773	100p	79HGKC	670p	4099	70p	74LS95	60p	LM325	45p				
BD438	36p	BU526	80p	2N.3819	29p			4501	34p	74LS96	80p	LM339	40p				
BD439	40p	BU801	98p	2N.3866	68p	VALVES		4502	50p	74LS107	39p	LM348	60p				
BD440	40p	BU806	120p	2N.3903	11p	DAF96	80p	4503	36p	74LS109	39p	LM380	100p				
BD441	40p	BU807	95p	2N.3904	11p	DF96	50p	4504	72p	74LS112	40p	LM381	150p				
BD442	40p	C106D	23p	2N.3905	11p	DL92	47p	4505	340p	74LS113	32p	LM382	130p				
BD533	50p	MJ2500	100p	2N.3906	11p	DY86	50p	4506	80p	74LS114	42p	LM387	100p				
BD534	38p	MJ2501	110p	2N.4031	25p	DY87	50p	4507	34p	74LS122	65p	LM709 DIL	90p				
BD535	38p	MJ2955	85p	2N.4036	25p	DY802	45p	4508	110p	74LS123	70p	LM723	40p				
BD536	38p	MJ3000	115p	2N.4037	25p	EABC80	50p	4510	52p	74LS124	95p	LM741 DIL	18p				
BD537	40p	MJ3001	118p	2N.4058	13p	EB91	44p	4511	45p	74LS125	38p	LM741 MET	45p				
BD538	40p	MJE29A	30p	2N.4443	76p	EBF80	45p	4512	52p	74LS126	42p	LM747	58p				
BD675	40p	MJE30A	30p	2N.4444	76p	EBF89	50p	4513	120p	74LS132	53p	LM748	35p				
BD676	40p	MJE340	25p	2N.5061	20p	ECC82	40p	4514	100p	74LS133	48p	LM1458	33p				
BD677	38p	MJE350	80p	2N.5294	30p	ECC83	43p	4515	100p	74LS136	35p	LM3900	30p				
BD678	40p	MJE520	30p	2N.5296	30p	ECC84	40p	4516	53p	74LS138	47p	M-51513L	180p				
BD680	40p	MJE2955K	90p	2N.6106	40p	ECC85	40p	4517	208p	74LS139	45p	M-51515BL	270p				
BD679	40p	OC28	100p	2N.6107	40p	ECH81	48p	4518	45p	74LS145	90p	M-51516	280p				
BD681	45p	OC29	80p	2N.6109	40p	ECH84	52p	4519	32p	74LS147	130p	M-51517L	280p				

ELECTROLYTIC CAPACITORS

4700UF-16V CAN	60p
4700UF-40V CAN	60p
*4700UF-40V CAN	92p
*6500UF-50V CAN	100p
6800UF-40V CAN	85p
10000UF-16V CAN	83p
10000UF-25V CAN	87p
*15000UF-10V CAN	88p
33000UF-16V CAN	88p
47000UF-6.3V CAN	85p
2000+2K/35V CAN	88p
2200UF-40V CAN	35p
2350+2350-63V CAN	125p
*2800UF-100V CAN	92p

*Computer Grade Types
Computer grade types have screw terminals.
Other types are tag terminal.

SONY THYRISTORS

SG613	600p
SG264	480p

CRYSTALS

FREQ IN MHZ	
1.0	200p
2.00	200p
2.45760(L)	180p
2.45760	180p
2.5	200p
2.662	200p
3.276	115p
3.5795	95p
4.0	110p
4.194	130p
4.43	95p
4.608	150p
4.9152	160p
5.0	130p
6.0	116p
7.0	125p
8.0	126p
8.867	126p
10.0	140p
10.50	200p
10.70	160p
11.0	250p
12.0	120p
14.0	125p
14.138	120p
14.756	200p
15.0	160p
16.0	130p
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24.0	250p
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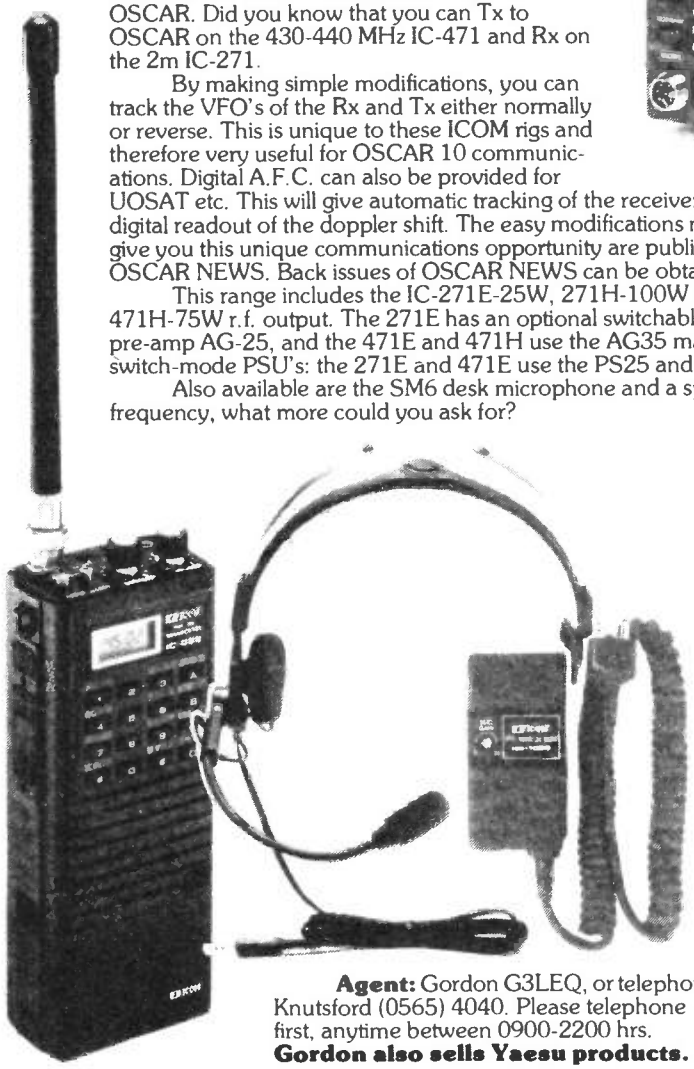
This range includes the IC-271E-25W, 271H-100W and the 70cm versions IC-471E-25W and 471H-75W r.f. output. The 271E has an optional switchable front-end pre-amp. The 271H has a mast-head pre-amp AG-25, and the 471E and 471H use the AG35 mast-head pre-amp. Other options include internal switch-mode PSU's: the 271E and 471E use the PS25 and the 271H and 471H use the PS35.

Also available are the SM6 desk microphone and a speech synthesizer that announces the displayed frequency, what more could you ask for?



IC-02E, IC-04E

The direct entry microprocessor controlled IC-02E is a 2 meter handheld features include: scanning, 10 memories, duplex offset storage in memory and odd offsets also stored in memory. Internal Lithium battery backup and repeater tone are included. Keyboard entry is made through the 16 button pad allowing easy access to frequencies, duplex, memories, memory scan and priority.

The IC-02E has an LCD readout indicating frequency, memory channel, signal strength, transmitter output and scanning functions. New HS-10 Headset, with earphone and boom microphone, which operates with either of the following:- HS 10-SB Switch box with pre-amplifier giving biased toggle on, off and continuous transmit. HS 10-SA Voice operated switch box, with pre-amplifier, mic gain, vox gain and delay. The IC-2E and 4E continue to be available.

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A COMPREHENSIVE VARIABLE FREQUENCY RAMP GENERATOR

DESIGNED BY

IJ DILWORTH

The requirement for the system described in this article arose during the design of a swept frequency source to be used to align and test bandpass filters. A feature of the system is that the amplitude of the ramp voltage may be selected via computer control. The purpose of this, in the original design, was to automatically pre-set the swept frequency range for each bandpass filter to be tested.

A block diagram of the overall system is shown in *Figure 1*. The basic system is a mixer type where a master voltage controlled oscillator (VCO) is mixed with fixed quartz crystal oscillators. In this article the ramp system will be described.

The circuit diagram of the ramp system is shown in *Figure 2*. In order to allow various sweep bandwidths to be displayed, and to accommodate different screen phosphor persistences, the ramp system was designed to be of variable frequency. However, to minimise flyback (and screen blanking) time the repetition rate of the ramp should not change the screen blanking time. This has been accomplished by generating re-set (and flyback) using pre-set voltage level detection.

Circuit description

Operational amplifier IC1 acts as an integrator. The time constant for the voltage ramp is governed by RV1 and C1. The desired output waveform, illustrated in *Figure 3*, is such that the start and end of the ramp voltage should be adjustable.

On the application of power to the circuit the voltage output of IC1 starts to increase linearly due to the negative voltage present at this time from the output of IC3. The output of IC1 is applied to the non-inverting input of IC4. The inverting input of IC4 is connected to a positive reference voltage which effectively sets the maximum voltage the ramp reaches (RV3).

When the ramp voltage slightly exceeds the reference voltage the output of IC4 changes from the negative rail value to the positive supply rail value. After removing the unwanted negative output, using R4 and D1, this 'pulse' is applied to a logic 'latch' implemented using a CMOS quad NAND package (IC6).

In order for the system to operate, two of the four NAND gates are used as inverters on the input to the latching arrangement.

The output at pin 4 of the latch goes from a logic zero to logic one when the output of IC4 changes at the pre-settable top of the ramp.

The output at pin 4 is applied to a CMOS 'relay', which consists of a DG308 IC (four in a package), which is used to short circuit the integrator capacitor on IC1. Hence the ramp is collapsed.

At the same time IC3 samples a voltage between the maximum positive rail and ground. The inverting input of IC3 is connected to the output of IC1. Thus as the ramp collapses to zero the output of IC3 changes from the positive rail to the negative when the inverting input drops to a smaller voltage than the non-inverting input. This voltage sets the lower voltage level of the ramp, and is adjustable using RV2.

The negative pulse from IC3 is clamped with R6 and D2, and used to re-set the IC6 latch. This same negative voltage is present on the inverting input of IC1 and the integrator starts charging until the cycle is repeated. The charging rate, and hence the period of the ramp, is controlled by RV1.

Advantage

The advantage of the circuit is that although the period of the ramp may be changed, the re-set period is independent of the ramp period. Within the response time of the circuitry re-set occurs at pre-set voltage levels.

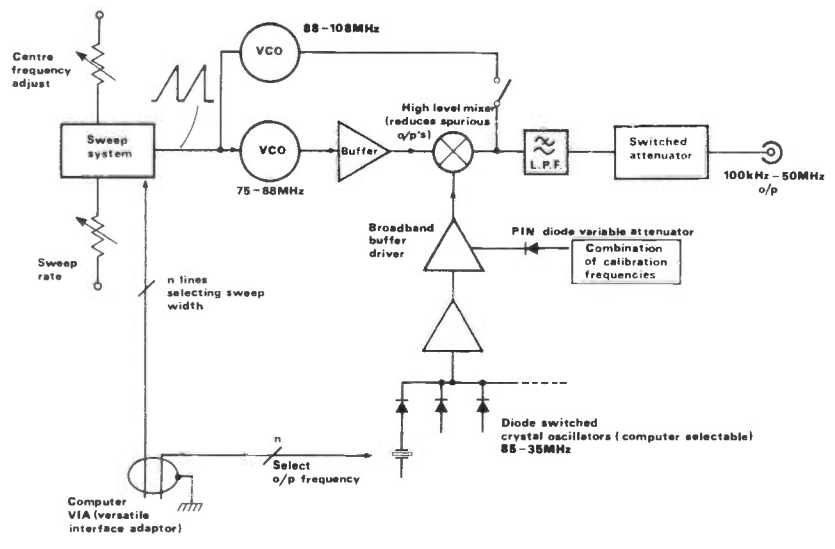


Fig 1 *The block diagram*

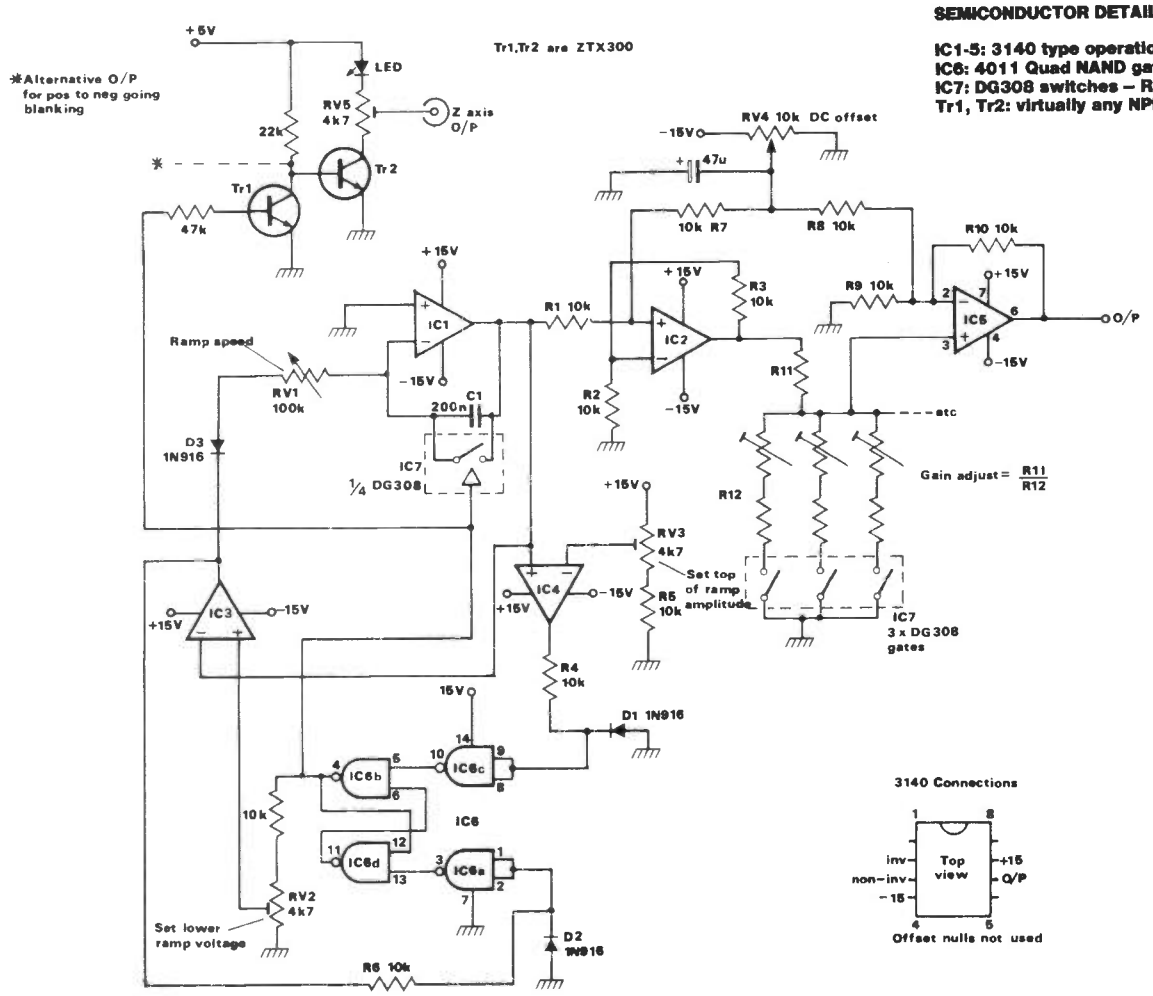


Fig 2 *The circuit diagram*

For Z-axis blanking two transistors, Tr1 and Tr2, provide a buffered drive which may be adjusted with RV5.

The circuitry associated with IC2 and IC5 allows the amplitude of the ramp output to be adjusted remotely, via computer control for example. The dc centre voltage of the ramp may be manually adjusted using RV4. This allows the trace to be centred when using the ramp generator with a voltage controlled oscillator.

IC2 is a unity gain non-inverting amplifier and the output is potentiometrically divided as shown in the circuit diagram. In order to remotely switch in the required voltage gain, DG308 'electronic relays' are used. Note that only three pre-set selectable levels are illustrated, but any number may be added to divide the amplitude in conjunction with R11. The DG308s require a positive supply rail to 'drive' the switch contacts.

So that the voltage ramp may be symmetrically varied in amplitude, the non-inverting input of IC2 is biased negatively so that the ramp produces equal voltage excursions about zero volts. However, in the author's application it was desired to use the ramp to drive varactor diodes with a positive reverse bias. Thus IC5 is employed to act as a non-inverting buffer to the ramp voltage and a unity gain inverting buffer to the dc offset voltage (simultaneously applied to IC2) via RV4. In this way the original ramp voltage swing is restored and symmetrical voltage excursions are preserved.

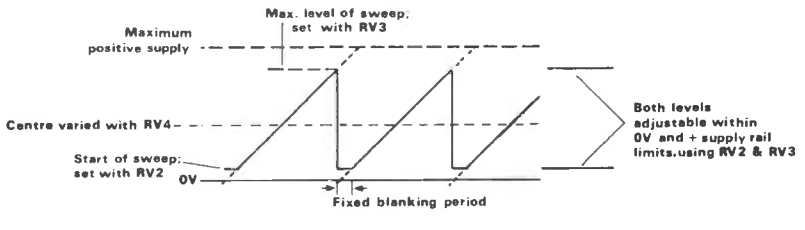


Fig 3 *The output waveform*

Beneficial

In the prototype + and −15 volt rails were used. However, in this circuit a negative rail of −5 volts is adequate for correct operation. This is beneficial when using the circuit to drive varactor diodes, since the positive supply rail may then be increased and the total available capacitance swing from the varactor be used, ie so that the maximum total supply rail for the operational amplifiers is not exceeded (30 volts for the CA3140).

ELECTRONIC LOCK CIRCUIT

construct this keypad-entry security device designed by AP Dean

Although slightly more complex in design than circuits using the LS7225 keyless lock IC, the electronic lock shown below is more versatile and considerably cheaper to build. The lock is intended for use with a 'data entry' type keypad which has 12 keys and one common terminal, ie not a matrix type. These keypads are readily available and quite inexpensive.

Circuit description

The circuit diagram of the electronic lock is shown in *Figure 1*. When the first digit is pressed the pulse from IC1 pin 3 charges C2 via D1. R6 discharges C2 slowly, providing a time period in which the next 3 digits must be entered.

The high level on C2 releases bistable IC2a, IC2b and when the second digit in the sequence is pressed the bistable changes state, causing a low on IC2 pin 4. This low is inverted by IC1c, thus releasing bistable IC2c, IC2d.

The third digit of the sequence puts a low on IC2 pin 11 which similarly releases bistable IC3a, IC3b via IC1d.

Pressing the fourth digit sets bistable IC3a, IC3b in much the same way, which in turn sets the output bistable IC3c, IC3d.

If a wrong digit is entered anywhere in the sequence the whole entry is cleared by discharging C2 via Tr1. If more than one key is pressed at one time the whole entry is again cleared. This is achieved by monitoring the keyboard current. With one key pressed insufficient voltage is developed across R8 to turn on Tr2; two or more keys pressed turn Tr2 on, thus discharging C2 via Tr1. Components R11 and C3 prevent operation of the lock during the time taken to discharge C2.

When the 'lock' key is pressed, the low on IC3 pin 13 causes the output bistable to change to its reset state.

It may seem at first glance that IC1c and IC1d can be omitted by using the complementary outputs of the bistables, but this is not so. If the full truth table for the bistables *(Figure 2)* is examined it can be seen that a high will appear on the Q output when the corresponding input is made low, irrespective of the state of the other input.

In our case this would mean the circuit would operate when just the last digit is entered.

Construction

All components (except the keypad) can be mounted on Veroboard or a purpose made PCB. IC1, 2, 3 are CMOS and the usual handling precautions against static should be taken. If preferred, IC holders can be used.

The circuit requires a 12V supply, although other supplies can be used with the appropriate change in R8, eg for 5V operation R8=1K. The current required is about 1mA so battery operation is possible if desired.

The complementary outputs are capable of sinking or sourcing up to 10mA and so will drive LEDs directly. However for most applications some buffering may be necessary.

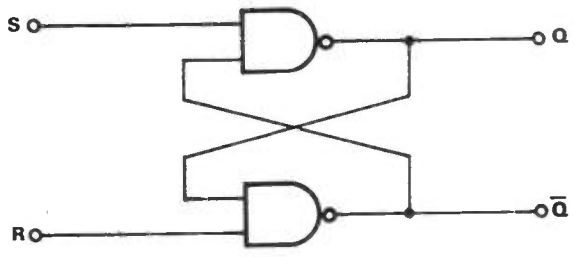
Selecting a code

The 4 digit code required is preset simply by connecting to the appropriate key connections on the keypad.

Note: the 4 digit code must not contain the same digit used consecutively, eg 1224, since the circuit will accept one key-press as two entries. The same number may be used twice elsewhere, eg 1242, but this is not advisable.

If more than 4 digits are required for the unlock sequence, this can be done simply by increasing the number of bistables (each with its own inverter on the 'R' input), the limiting factor being the number of keys on the keypad. REW

Fig 2 *Bistable configuration and truth table*



S	R	Q	$\overline{Q}$	
0	1	1	0	- Q is set by S going low
1	1	1	0	- previous state held
1	0	0	1	- Q is reset by R going low
0	0	1	1	- unstable state

NOTE: Q output is high whenever S is taken low, *irrespective* of state of R input

PARTS LIST

ICs
IC1, 2, 3 — 4011

Resistors
R1 — 12K
R2, 3, 4, 9, 12, 13 — 10K
R5, 10 — 100K
R6 — 680K
R7 — 220R
R8 — 390R
R11 — 1K

Transistors
Tr1, 2 — BC109

Diodes
D1 — 1N4148

Capacitors
C1, 3 — 1μF
C2 — 4.7μF
C4 — 0.1μF

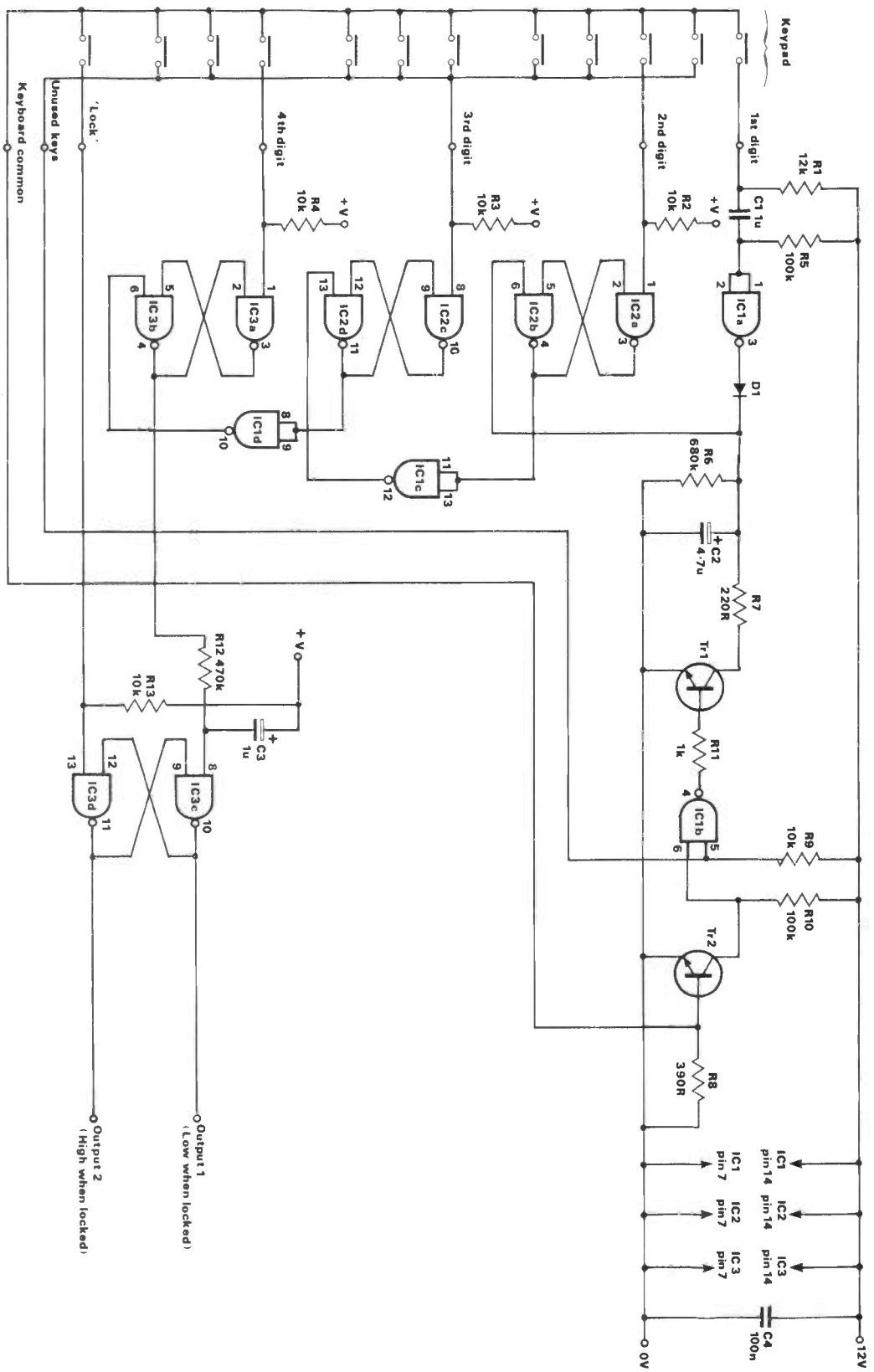


Fig 1 *Circuit diagram*

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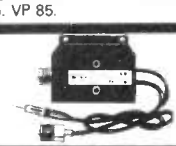

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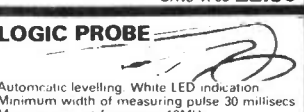

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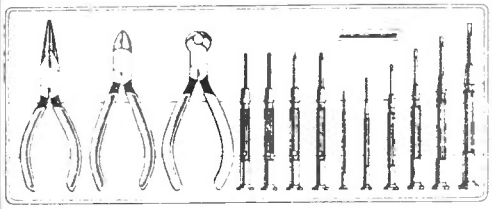

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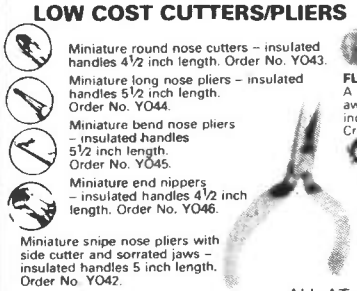

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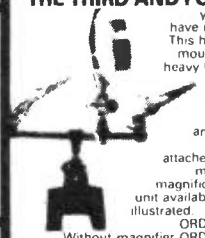

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DATA FILE . . .

Ray Marston takes an in-depth look at 7-segment driver techniques and circuits

In last month's edition of *Data File* we took a detailed look at the theory and practical applications of the LM3914-series of LED bar-graph driver ICs, and concluded by taking a brief look at 7-segment display systems.

In this edition of 'The File' we take a more detailed look at 7-segment display driving techniques and at practical 'driver' devices and circuitry.

Display latching

Last month we gave a brief introduction to 7-segment displays and to simple BCD-to-7-segment decoder/driver ICs that can be used to activate such displays. *Figure 1* shows how three sets of these ICs/displays can be used in conjunction with a trio of decade counters to make a simple digital-readout 'frequency' meter.

Here, the amplified external 'frequency' signal is fed to the input of the series-connected counters via one terminal of a 2-input AND gate, which has its other ('gate') input waveform derived from a built-in 'timebase' generator. The operating sequence of the circuit is as follows.

When the timebase 'gate' input signal is low, the AND gate is closed and no input signals reach the counters. At the moment that the timebase gate signal switches high, a brief 'reset' pulse is fed to all three counters, setting them all to zero count. Simultaneously, the input gate opens and remains open for a period of precisely one second, during which time the input-frequency pulses are summed by the counters. At the end of the one second period, the gate closes as the timebase gate signal goes low again, thus ending the count and enabling the displays to give a steady reading of the total pulse count, and hence frequency. The whole process then repeats one second later, when the timebase gate signal again goes high.

The simple system described above suffers from a major defect, in that the display becomes a 'blur' during the actual counting period, becoming stable and readable only when each count is complete and the input gate is closed. This 'blur-and-read' type of display is very annoying to watch.

Figure 2 shows an improved frequency meter circuit that does not suffer from this defect. Here, a 4-bit data latch is wired between the output of each counter and the input of its decoder/driver IC. This circuit operates as follows.

At the moment that the timebase gate signal goes high a reset pulse is fed to all counters, setting them to zero. Simultaneously, the input gate is opened and the counters then start to sum the input signal pulses. This count continues for precisely one second, and during this period the 4-bit latches prevent the counter output signals from reaching the display drivers. The display thus remains stable during this period. At the end of the one second count period, however, a brief 'latch enable' pulse is fed to all latches, and the instantaneous BCD outputs of each counter are latched into 'memory' and thence fed to the display via the decoder/driver ICs. This causes the display to give a steady reading of the total pulse count, and thus the input signal frequency. A few moments later the sequence repeats again, with the counters resetting and then counting the input frequency pulses for one second, and so on.

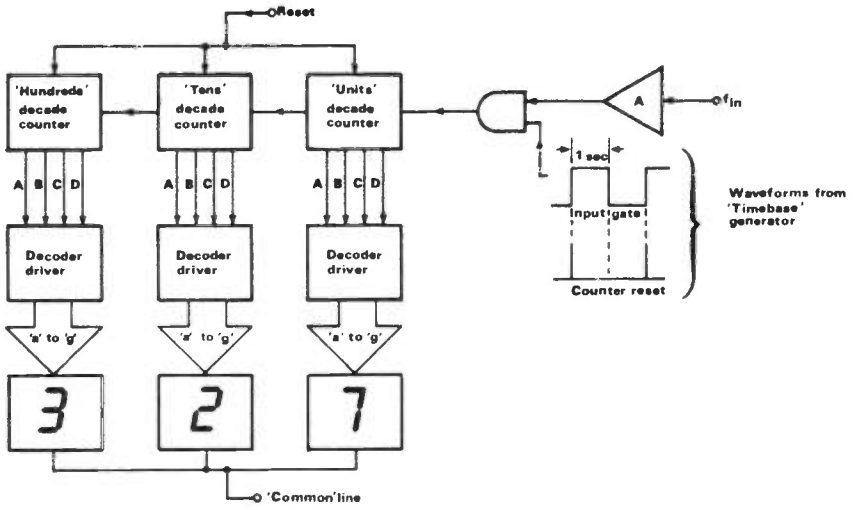

Fig 1 *Simple digital 'frequency' meter circuit*

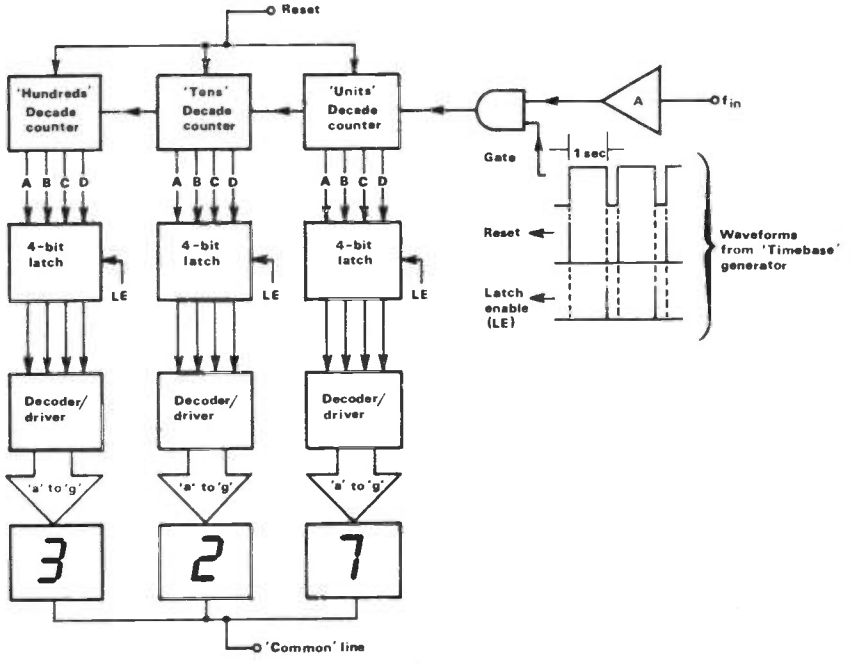

Fig 2 *Improved digital 'frequency' meter circuit*

The *Figure 2* circuit thus generates a stable display that is updated once per second. In practice, the actual count period of this and the *Figure 1* circuit can be made any decade multiple or submultiple of one second, provided that the output display is suitably scaled. Note that in practice a number of decoder/driver ICs are available with built-in 4-bit data latches.

Multiplexing

Note from the *Figure 1* & *2* circuits that a total of at least 21 connections must be made between the IC circuitry and the 7-

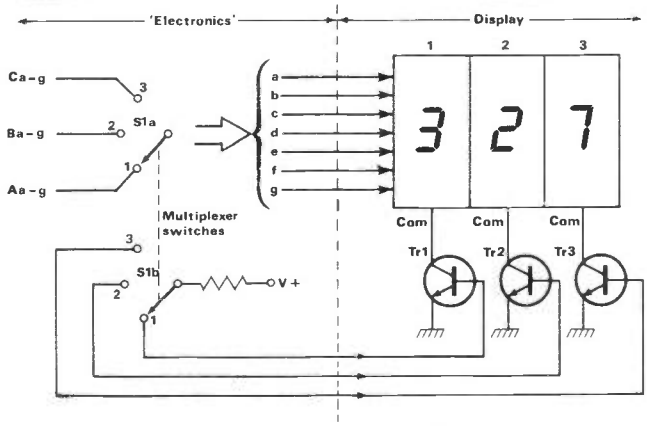

Fig 3 *Method of multiplexing a 3-digit common-cathode LED display*

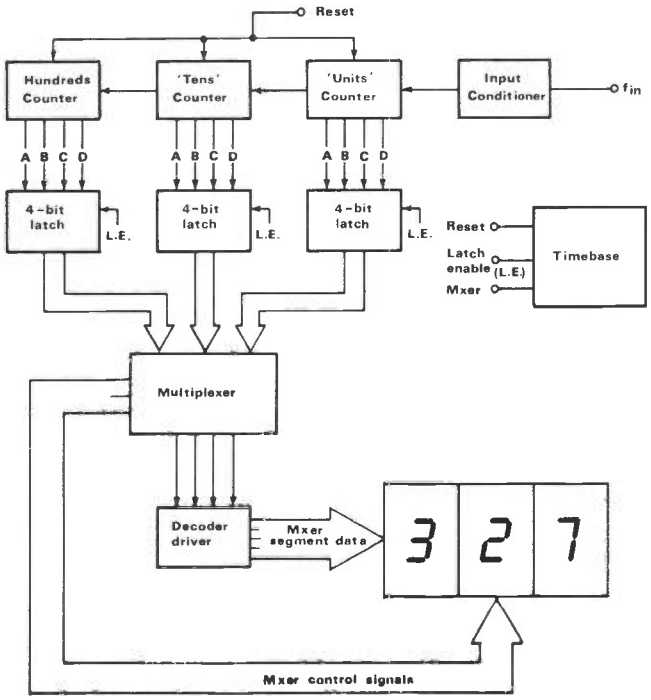

Fig 4 *Realistic implementation of the multiplexing technique in a 3-digit frequency meter*

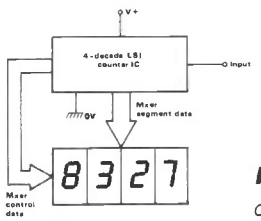

Fig 5 *4-digit counter circuit*

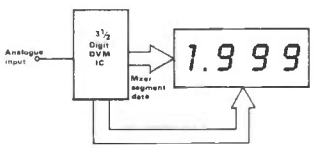

Fig 6 *3½-digit DVM*

segment displays of a 3-digit readout unit. A total of at least 70 connections are needed if a 10-digit display is used. In practice, the number of IC-to-display connections can be greatly reduced by using a technique known as 'multiplexing'. This technique can be understood with the aid of *Figures 3* and *4*.

Figure 3 shows how each digit of a 3-digit common-cathode LED display can be individually activated, using a total of only 10 external connections: the circuitry to the left of the dotted line should be regarded as 'electronic', and to the right of the line as 'display' circuitry.

In the display, all 'a' segments are connected together, as are all the other ('b' to 'g') sets of segments, so that a total of only seven external 'a' to 'g' connections are made to the display, irrespective of the number of 'digits' used. Note, however, that none of the 7-segment displays are influenced by signals on these 'segment' wires unless the display is enabled by tying its 'common' terminal to ground. In *Figure 3* this is achieved by activating switching transistors Tr1 to Tr3 via suitable external signals, which require the use of one additional connecting wire per display digit.

Note in *Figure 3* that three different sets of 'segment' data can be selected via switch S1a, and that any one of the three display digits can be selected via S1b and Tr1-Tr3. These switches are ganged together and provide the actual 'multiplexer' action, and should be regarded as fast-acting electronic switches that repeatedly switch through positions '1', '2' and '3'. The operating sequence of the circuit is as follows.

Assume initially that the switch is in position '1'. Under this condition S1a selects segment data 'A_{a-g}', and S1b activates display 1 via Tr1, so that display 1 shows the number '3'. A few moments later, the switch jumps to position '2', selecting segment data 'B_{a-g}' and activating display 2 via Tr2, so that display 2 shows the number '2'. A few moments later, the switch jumps to position '3', causing display 3 to show the number '7'. After this the whole process starts to repeat again, and so on ad infinitum.

In practice dozens of such sequences occur each second, so the eye does not see the displays as being turned on and off, but sees each of them as a steady display with the trio apparently showing the steady number '327', or whatever other number is dictated by the segment data.

Figure 4 shows a more realistic implementation of the 'multiplexing' (MUX) technique, as applied to a 3-digit frequency meter. Note in this case that the multiplexer is interposed between the outputs of the three BCD 'data' latches and the input of a display-driving BCD-to-7-segment decoder/driver IC.

This technique has two major advantages. First, it calls for the use of only a single decoder/driver IC, irrespective of the number of readout digits used. Second, it calls for the use of a multiplexer incorporating only five ganged 3-way sequencing switches (one for the 'control' data, four for the BCD-segment data), rather than the eight ganged 3-way switches called for in the earlier *(Figure 3)* system.

In practice, all of the counting, latching, multiplexing, decoding, timing and display-driving circuitry of *Figure 4* (and a great deal more) can easily be incorporated in a single LSI (large scale integration) chip which needs only 20 or so pins to make all necessary connections to the power supply, displays, inputs, etc.

Thus, a complete 4-digit counter can be implemented using a dedicated IC in a circuit such as that shown in *Figure 5*, or a '3½-digit' DVM (digital voltmeter) can be implemented using a circuit such as that shown in *Figure 6*.

Ripple blanking

If the basic 4-digit circuit of *Figure 5* is used to measure a count of '27', it will actually give a reading of '0027', unless steps are taken to provide automatic

suppression of the two (unwanted) leading zeros. Similarly, if the 3½-digit circuit of *Figure 6* is used to measure '0.1' volts, it will actually give a display of '0.100' volts, unless steps are taken to provide automatic suppression of the two (unwanted) trailing zeros.

Practice

In practice, automatic blanking of leading and/or trailing zeros can be obtained by using a 'ripple blanking' technique, as illustrated in *Figures 7* and *8*. In these diagrams, each decoder/driver IC has a BCD input and a 7-segment output, and is provided with 'ripple blanking' input (RBI) and output (RBO) terminals. If we assume that these terminals are 'active high' they have the following characteristics.

If the RBI terminal is held low (at logic 0), the 7-segment outputs of the IC are enabled, but the RBO terminal is disabled (held low). If the RBI terminal is biased high (logic 1), the 7-segment outputs become disabled in the presence of a BCD '0000' input (= decimal zero), and the RBO output goes high under the same condition. Thus, the RBO terminal is normally low, and goes high only if a BCD '0000' input is present at the same time as the RBI terminal is high. With these characteristics in mind, refer now to *Figures 7* and *8*.

Figure 7 shows the ripple blanking technique used to provide leading-zero suppression in a 4-digit display that is reading a count of '207'. Here, the RBI input of the 'thousands' or most significant digit (MSD) decoder/driver is tied high, so this display is automatically blanked in the presence of a 'zero', under which condition the RBO terminal is high. Consequently, the RBI terminal of the 'hundreds' IC is high, the digit reads '2', and the RBO terminal is low. The RBI input of the 'tens' unit is low, so this digit reads '0' and its RBO output is low. The least significant digit is that of the 'units' readout, and this does not require zero suppression; consequently, its RBI terminal is grounded and it reads '7'. The display thus gives a total reading of '207'.

Note in the *Figure 7* 'leading zero suppression' circuit that ripple blanking feedback is applied 'backwards', from the MSD to the LSD.

Figure 8 shows how trailing zero suppression can be obtained by reversing the direction of feedback, from the LSD to the MSD. Thus, when an input of '1.1' volts is fed to this circuit the LSD is blanked, since its BCD input is '0000' and its RBI input is high: its RBO terminal is high under this condition, so the '100ths' digit is also blanked in the presence of a '0000' BCD input.

Practical decoder/driver ICs are often (but not always) provided with ripple blanking input and output terminals. Often, these terminals are 'active low'. If a decoder/driver IC does not incorporate integral ripple blanking logic, it can usually be obtained by adding external logic circuitry similar to that shown in *Figure 9*, with the RBO terminal connected to the 'blanking' input pin of the decoder/driver IC.

In *Figure 9* (an 'active high' circuit), the output of the 4-input NOR gate goes high only in the presence of a '0000' BCD input, and the RBO output goes high only if the 'decimal zero' input is present at the same time as RBI is biased high.

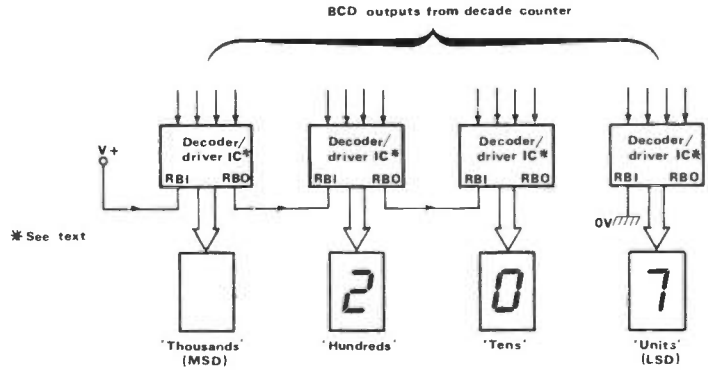

Fig 7 *Leading zero suppression in a 4-digit counter*

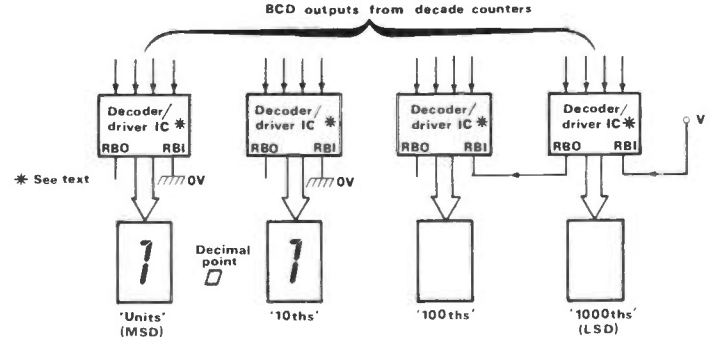

Fig 8 *Trailing zero suppression in a 3½-digit DVM readout*

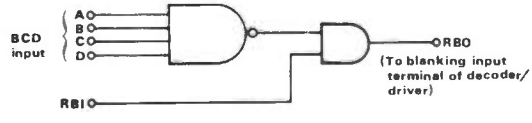

Fig 9 *DIY 'ripple blanking' logic (active high type)*

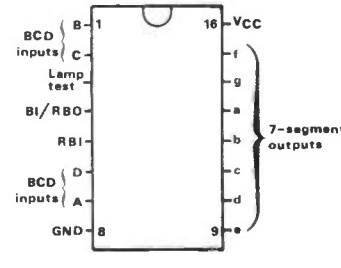

Fig 10 *Pin designations of the 7447 series ICs*

Practical decoder/driver ICs

Practical decoder/driver ICs are available in both TTL and CMOS forms. Some of these devices have integral ripple blanking facilities, others have built-in data latches, and a few even have built-in decade counter stages, etc.

Let's look at a few of the most popular of these devices.

The 7447A and 7448

These 7-segment decoder/driver ICs are members of the standard TTL family. They are also available in 'LS' form under the designations 74LS47 and 74LS48 respectively. All of these ICs have integral ripple blanking facilities, but do

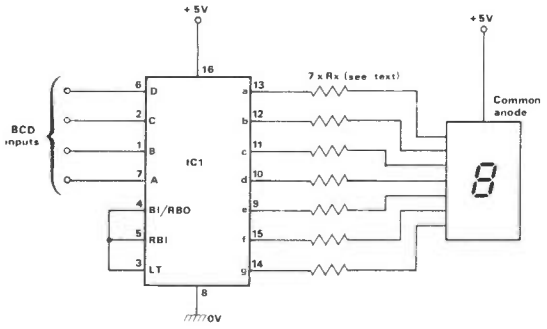

Fig 11 *Using the 7447A/74LS47 to drive a common-anode display*

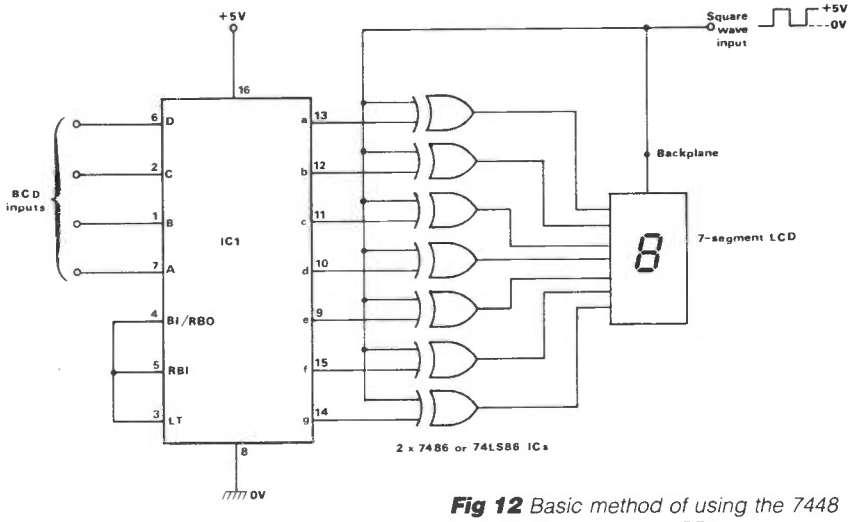

Fig 12 *Basic method of using the 7448 or 74LS48 to drive an LCD*

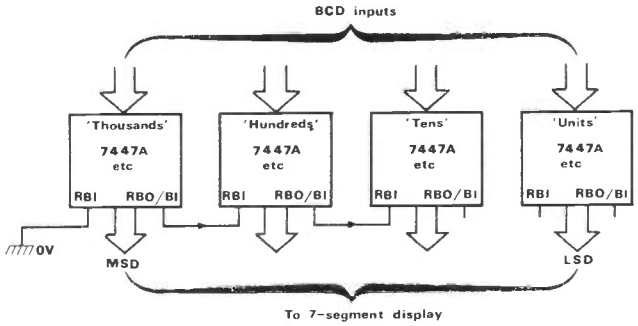

Fig 13 *Method of applying leading-zero suppression to the first three digits of a 4-digit display, using the '7447A' family of ICs*

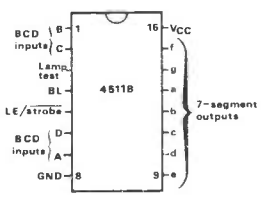

Fig 14 *Pin designation of the 4511B*

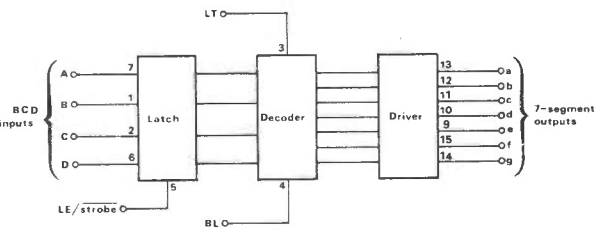

Fig 15 *Functional diagram of 4511B*

not incorporate data latches. *Figure 10* shows the outline and pin designations that are common to these devices, each of which is housed in a 16-pin DIL package.

The 7447A/74LS47 has an active-low output designed for driving a common-anode LED display via external current-limiting resistors (R*x*), as shown in *Figure 11*.

The 7448/74LS48 has an active-high output designed for driving a common-cathode LED display in a manner similar to that of *Figure 11*, but with the 'common' terminal of the display taken to ground. In all cases, the R*x* current-limiting resistors should be chosen to limit the segment currents below the following absolute limits: 7447A = 40mA; 74LS47 = 24mA; 7448 and 74LS48 = 6mA.

Figure 12 shows how a 7448/74LS48 can be used to drive a liquid-crystal display (LCD), using a pair of 7486 or 74LS86 quad 2-input EX-OR gate ICs and an external 50Hz squarewave to apply the necessary 'phase' signals to the display, as described last month.

Note from *Figure 10* that each of these ICs has three input 'control' terminals, these being designated LAMP TEST, BI/RBO, and RBI. The LAMP TEST terminal drives all display segments on when the terminal is driven to logic low with the RBO terminal open or at logic high. When the BI/RBO terminal is pulled low, all outputs are blanked. The BI/RBO terminal also functions as a ripple blanking output terminal. *Figure 13* shows how to connect the ripple blanking terminals to give leading zero suppression on the first three digits of a 4-digit display.

The 4511B

This BCD-to-7-segment decoder IC has an integral 4-bit data latch, but has no built-in facility for ripple blanking. It is constructed with CMOS logic, but features NPN bipolar output transistor stages that are capable of sourcing output currents of up to 25mA.

Figure 14 shows the outline and pin notations of the device, and *Figure 15* shows the functional diagram of the IC, which can be used with any power supply in the 5V to 18V range.

The 4511B has three 'control' input terminals, these being designated LAMP TEST (LT), BL (blanking), and LE (latch enable)/STROBE. The LT and BL inputs are active-low, and the LE input is active-high. In normal operation, LT and BL are made high and LE is held low.

When the LE terminal is low, BCD input signals are decoded and fed directly to the 7-segment output terminals. If LE goes high, the BCD input signals that are present at the moment of transition are latched into 'memory' and fed (in decoded form) to the 7-segment outputs while LE remains high.

If the LT input is grounded, all output segments are activated, irrespective of the BCD inputs. If the BL input is grounded (while LT is positive), all output segments are blanked.

The 4511B can be used to drive most popular types of 7-segment display.

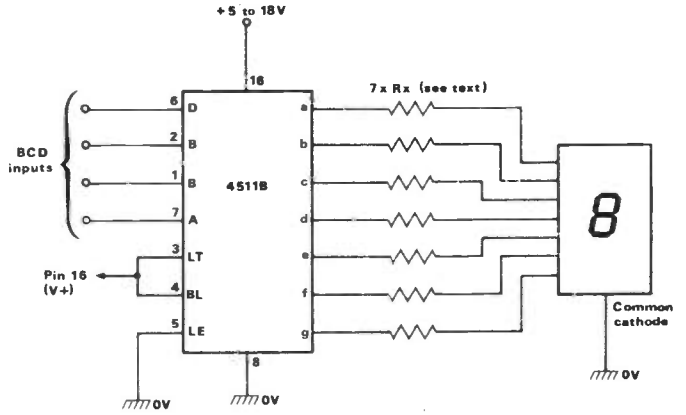

Fig 16 *Using the 4511B to drive a common-cathode display*

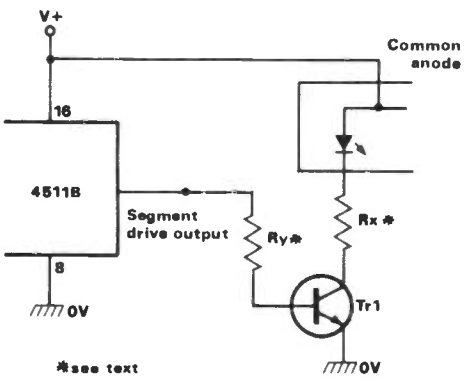

Fig 17 *Driving a common-anode display*

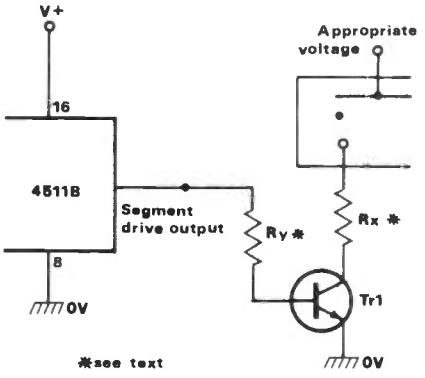

Fig 18 *Driving a gas discharge readout*

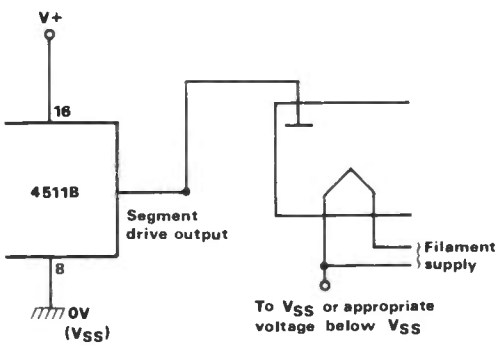

Fig 19 *Driving a low brightness flourescent readout*

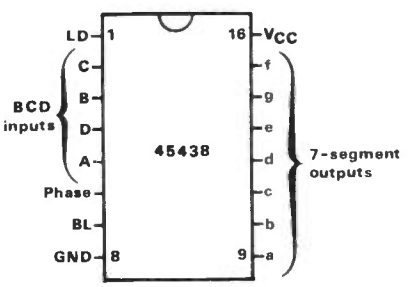

Fig 20 *Pin designations of the 4543B IC*

Figure 16 shows the basic connections for driving a common-cathode LED display.

A current-limiting resistor (R*x*) must be wired in series with each display segment, and must have its value chosen to limit the segment current below 25mA. Note that the 'segment' outputs of the 4511B are not internally current-limited, and the device thus has no output-overload protection.

Figures 17, 18 and *19* show how to modify the above circuit to drive LED common-anode displays, gas discharge displays, and low-brightness fluorescent displays respectively. Note in the cases of *Figures 17* and *18* that an NPN buffer transistor must be interposed between each output-drive segment and the input segment of the display: in each case, R*x* determines the operating segment current of the display, and R*y* determines the base current of the transistor.

The 4511B can also be used to drive 7-segment liquid-crystal displays by using an external squarewave 'phase' signal and a set of EX-OR gates in a configuration similar to that of *Figure 12*. In practice, however, it is far better to use a 4543B IC for this particular application.

The 4543B

This 7-segment decoder/driver IC is a CMOS device with integral 4-bit data latch. It is specifically designed for driving liquid-crystal displays, but can also drive most other types of 7-segment display. *Figure 20* shows the outline and pin designations of the device, which can be used with any power supply in the 3V to 18V range.

The 4543B has three input 'control' terminals, these being designated LD (latch disable), PHASE, and BL (blank). In normal use, the LD terminal is biased high and the BL terminal is tied low. The

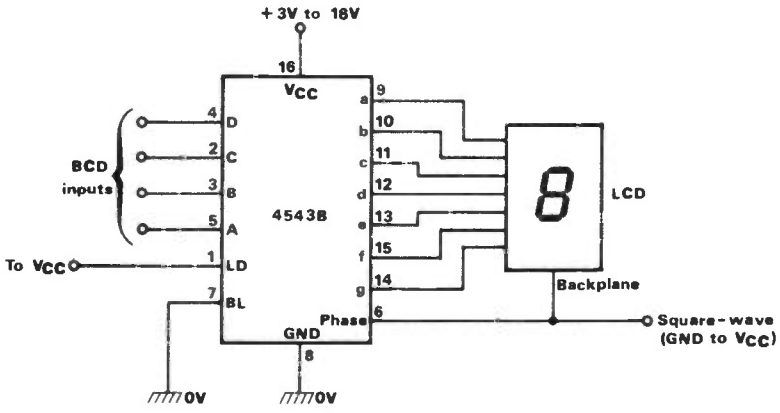

Fig 21 *Using the 4543B to drive a LCD*

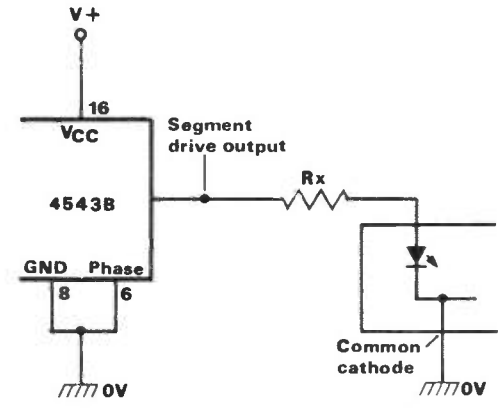

Fig 22 *Driving a common-cathode LED display with a 4543B*

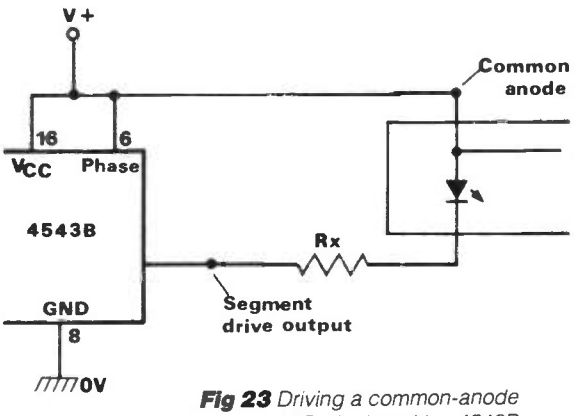

Fig 23 *Driving a common-anode LED display with a 4543B*

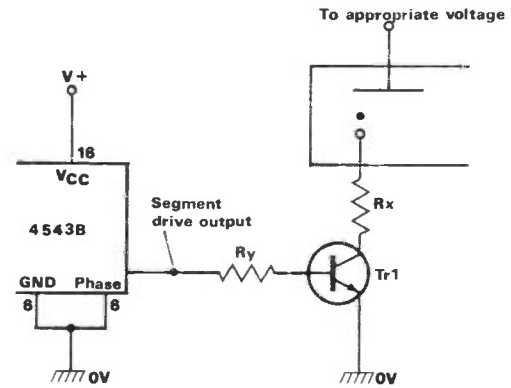

Fig 24 *Driving a gas-discharge readout with a 4543B*

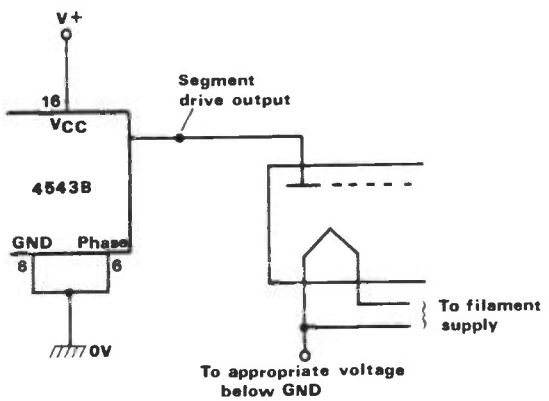

Fig 25 *Driving a flourescent readout with a 4543B*

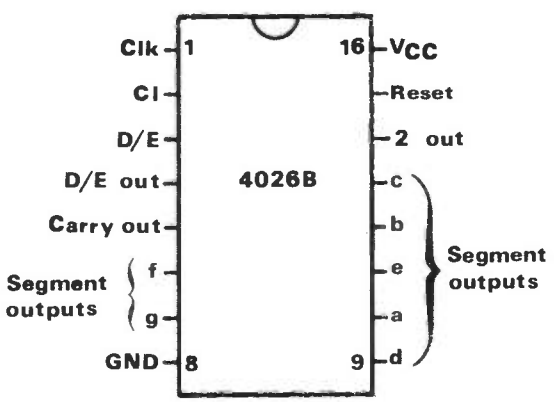

Fig 26 *Outline and pin designations of the 4026B*

state of the PHASE terminal depends on the type of display that is being driven. For driving liquid-crystal readouts, a squarewave (roughly 50Hz, swinging fully between the GND and Vcc values) must be applied to the PHASE terminal. For driving common-cathode LED displays, PHASE must be grounded. For driving common-anode displays, PHASE must be tied to logic 'high'.

The display can be blanked at any time by simply driving the BL terminal to the logic-high state. When the LD terminal is in its normal 'high' state, BCD inputs are decoded and fed directly to the 7-segment output terminals of the IC. When the LD terminal is pulled low, the BCD input signals that are present at the moment of transition are latched into 'memory' and fed (in decoded form) to the 7-segment outputs while LD is low.

Figure 21 shows the basic method of using the 4543B to drive a liquid-crystal display, and *Figures 22* to *25* show how this circuit can be modified to drive other types of 7-segment display. Note in the cases of *Figures 22* and *23* that the values of Rx must be chosen to limit the output 'drive' currents to below 10mA per segment.

The 4026B

This device is a complete decade counter with integral decoder/driver circuitry that can directly drive a 7-segment common-cathode LED display. The 'segment' output currents are internally limited (to about 5mA at 10V supply, 10mA at 15V supply), so the display can be connected directly to the output of the IC, without the use of external current-limiting resistors. The device does not incorporate a data latch and has no facility for ripple blanking. *Figure 26* shows its outline and pin designations.

The 4026B has four input 'control'

terminals, and three auxiliary output terminals. The input terminals are designated CLK (clock), CI (clock inhibit), RESET, and D/E (display enable). The IC incorporates a Schmitt trigger on its clock input line, and clock signals do not have to be pre-shaped. The counter is reset to zero by driving the RESET terminal high.

The CI terminal must be grounded to allow normal counting operation: when CI is high, the counters are inhibited. The display is blanked when the D/E terminal is grounded: the D/E terminal must be high for normal operation. Thus, in normal operation, the RESET and CI terminals are grounded and the D/E terminal is held positive, as shown in *Figure 27*.

The three auxiliary output terminals of the 4026B are designated D/E OUT, CARRY OUT, and 2 OUT. The D/E OUT signal is a slightly delayed copy of the D/E input signal. The CARRY OUT signal is a symmetrical squarewave at one tenth of the clock input frequency, and is useful when cascading 4026B counters. The 2 OUT terminal goes low only on a count of '2'. *Figure 27* shows the basic circuit connections to be used when cascading stages.

The 4033B

This device (see *Figure 28*) can be regarded as a modified version of the 4026B, with the D/E and D/E OUT terminals eliminated and replaced by ripple blanking input (RBI) and output (RBO) terminals, and with the 2 OUT terminal replaced with an LT (lamp test) terminal which activates all output segments when biased high. In normal use, the RESET, CI and LT terminals are all grounded, and the RBI terminal is made positive, as shown in *Figure 29*: this configuration does not provide blanking of unwanted leading and/or trailing zeros.

If cascaded 4033B ICs are required to give automatic leading-zero suppression, the basic *Figure 29* circuit must be modified as shown in *Figure 30*, to provide ripple blanking operation. Here, the RBI terminal of the most significant digit (MSD) is grounded, and its RBO terminal is connected to the RBI terminal of the next least significant stage.

This procedure is repeated on all except the LSD, which does not require zero suppression. If trailing-zero suppression is required, the direction of ripple blanking feedback must be reversed, with the RBI terminal of the LSD grounded and its RBO terminal wired to the RBI terminal of the next least significant stage, and so on.

Next month

In next month's edition of *Data File*, we'll continue the 'opto-electronics' theme by looking at a variety of light-sensitive circuits. REW

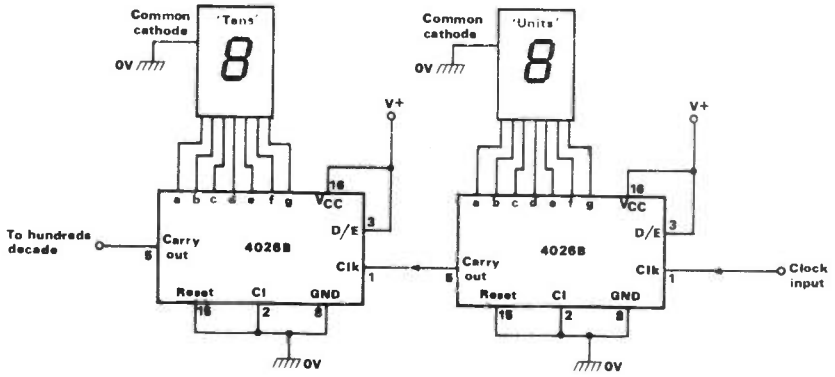

Fig 27 *Basic method of cascading 4026B ICs*

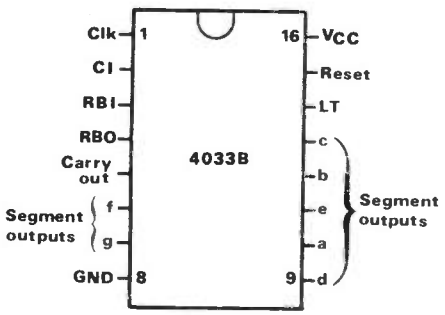

Fig 28 *Pin designations of the 4033B decade counter with 7-segment outputs and ripple blanking*

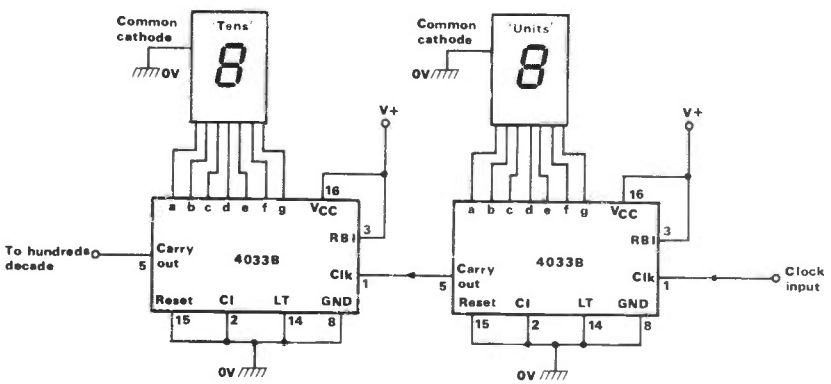

Fig 29 *Basic method of cascading 4033B ICs (without zero suppression)*

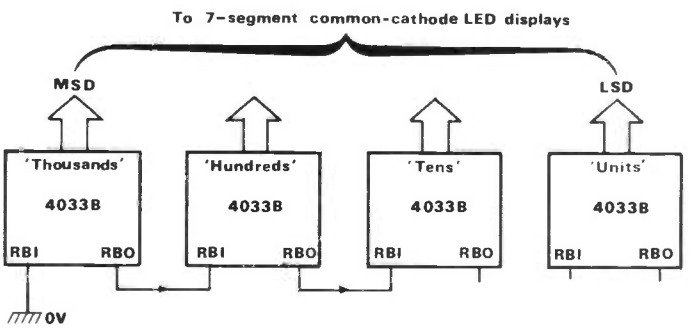

Fig 30 *Method of modifying the Figure 29 circuit to give automatic leading-zero suppression*

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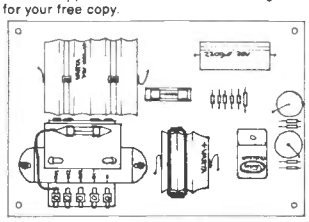

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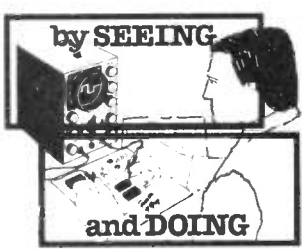

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COMPUTING

TUNED CIRCUIT TRACKING

BRIAN KENDAL G3GDU and
JEFF HOWELL G4BXZ

In a superheterodyne receiver, the local oscillator must operate at a frequency which is displaced from that being received by an amount equal to the first intermediate frequency. Should this difference not be maintained, the received frequency will be controlled by the local oscillator but the sensitivity of the receiver will be degraded due to the signal frequency stages being de-tuned. The action of making the oscillator and signal circuits tune with a fixed frequency difference is called 'tracking'.

The accomplishment of this in wide frequency coverage receivers has always presented considerable problems to the home constructor, and as a consequence for the past half century commercially manufactured coils have almost invariably been used for this purpose.

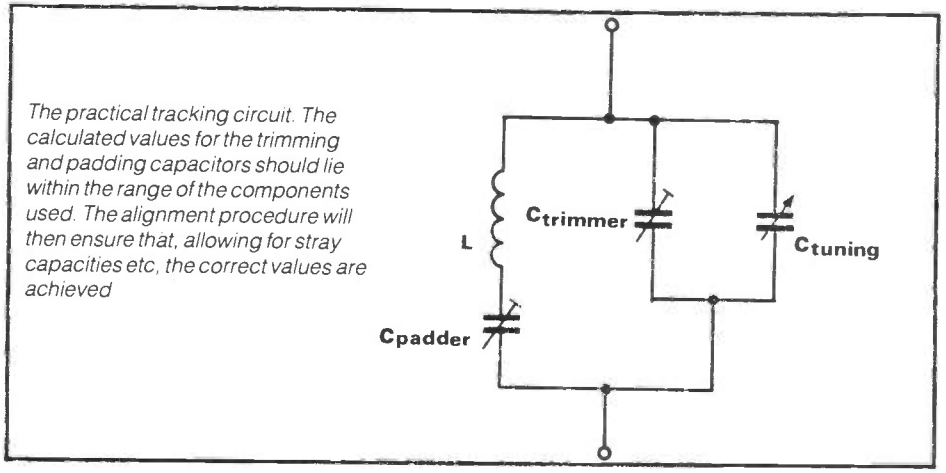
For amateur band only receivers the problem is less acute, for over the restricted frequency ranges tracking errors are often sufficiently small to go unnoticed due to the bandwidth of the RF tuned circuits.

Additonal factors

Returning to the original problem, however, even when commercial coils are used only part of the problem has been solved, for although the correct inductance is available the correct minimum capacitance and change of capacitance to realise the required frequency range have to be achieved. These are attained by the addition of two preset capacitors, one in parallel with the main tuning capacitor (known as the trimmer) and the other in series (known as the padder).

Considering the effect of these capacitors on the tuned circuit, it will be realised that the trimmer will control the minimum value of the combination of capacitors and be most effective at the higher frequency end of the tuning range, whilst the padder will control the maximum value of the combination and be most effective at the lower end of the range. As the padding and trimming capacitors are effectively in series adjustment of one effects the other, although this problem is easily overcome by correct alignment procedures.

If the radio frequency and oscillator circuits have been designed with the correct inductance and trimmer and padder capacities, it will be found that the circuits accurately align at points near the upper and lower frequency limits and at a third point toward the centre of the waveband covered. This is known as three point tracking and the calculation of appropriate values of inductance and capacitance is the problem which this month's computer program is intended to solve. In addition, this program will solve the more general problem of designing a tuned circuit for a given frequency coverage.



The practical tracking circuit. The calculated values for the trimming and padding capacitors should lie within the range of the components used. The alignment procedure will then ensure that, allowing for stray capacities etc, the correct values are achieved

As usual, this program has been written in standard Microsoft BASIC and has been tested on both Sanyo and BBC 'B' computers. Should a computer using any other 'dialect' of BASIC be used, minor changes may be necessary.

Using the program

For the sake of illustration, let us assume that we wish to compute the inductance and trimmer and padder capacitances for a superhet receiver using a 1.6MHz intermediate frequency and covering the 80 metre band with a frequency range of 3.5 to 4.0MHz. The tuning capacitor has a minimum capacity of 10pF and a maximum value of 100pF.

In this case the RF tuned circuits will obviously have to tune the range 3.5 to 4.0MHz. The oscillator will be displaced from these frequencies by 1.6MHz, most conveniently on the high frequency side. The oscillator tuning frequencies will therefore be 5.1 to 5.6MHz.

For convenience we would choose a mid-point tracking frequency of 3.75MHz at a tuning capacity of 40pF. The mid frequency need not necessarily be exactly half-way between the upper and lower frequencies, for it merely fixes the frequency at one point of the tuning scale. If the main station interest is CW, then it is obviously desirable to expand the lower end of the scale. This could be achieved by selecting a rather lower mid frequency – say 3.7MHz.

Having now loaded the program, the RUN key is pressed. On the screen appears the heading 'TUNED CIRCUIT TRACKING' followed by 'ENTER LO, MID AND HI FREQUENCY (MHZ)'.

Two separate calculations have to be made for the RF and oscillator circuits, so taking the RF calculation first enter: '3.5, 3.75, 4.0'.

This is followed by 'ENTER MAX, MID AND MIN CAPACITY (PF)', so we enter: '100, 40, 10'.

The necessary inductance and trimmer and padder capacities will then be calculated and printed on the screen, together with the accuracy of the calculation. For the example given:

INDUCTANCE	45.4419985 UH
PADDER	62.2543749 PF
TRIMMER	69.1085523 PF

CAP (PF)	FREQ (MHZ)
100	3.4999997
40	3.75001451
10	3.99999966

Components cannot be manufactured to anything approaching this accuracy. Furthermore, stray capacity and inductance which cannot be predicted are always present, so it is normal practice to provide preset variable capacitors in both trimmer and padder positions. However, if normal alignment procedures are applied, the preset elements will be adjusted sufficiently accurately to achieve the desired result.

It is now necessary to calculate the constants for the oscillator circuit. The frequencies for this will be 5.1, 5.35 and 5.6 with the capacities the same as before. In round figures these will give values of 30μH for the coil, 40pF for the padder and 72pF for the trimmer.

It now only remains to abort this program, load the inductance program which we published a few months ago and calculate the parameters for the RF and oscillator inductances.

The program

As may be expected, this program contains some rather complex mathematics, so we hope that we will be forgiven if we tend to 'gloss over' the actual method of calculation and merely describe the purpose of each section of the program. The formulae used have been derived from the well-known equations for capacities in series and parallel and the relationship between inductance, capacity and frequency.

The program commences with the definition of two functions: FNA(C) and FNB(C), the first of which calculates the equivalent capacity of the paralleled tuning and trimming capacitors in series with the padder, while the second function provides an LC to frequency conversion.

Lines 50 to 80 print the title, whilst lines 90 to 150 invite the entry of the lower, midband and upper frequencies with their associated capacities. The validity of the entered data is then checked. Should this be in error, such as entering the frequencies or capacities in reverse order or a zero value, a GOTO statement moves the program to line 570 which causes an 'ERROR IN DATA' message to be printed.

It is then necessary to transpose the data into mathematical form, this being achieved in lines 160 to 200.

Line 210 checks that the capacity swing available is adequate to provide the required frequency coverage. If it is not, a warning message is printed and the program jumps to line 460, which calculates the best available solution with the capacity ratio available.

Lines 240 to 300 calculate possible mid frequencies, first with no trimmer capacity and secondly with maximum trimming capacity. Should the required mid frequency be impossible to attain, a suitable warning is printed. In such circumstances the program moves to line 460 and the best compromise under the circumstances is calculated.

```
10 REM TUNED CIRCUIT TRACKING PROGRAM
20 REM J.M.HOWELL NOVEMBER 1984
30 DEF FNA(C)=YP+1/(CT+C)
40 DEF FNB(C)=159.154*SQR(FNA(C)/L)
50 CLS
60 PRINT
70 PRINT TAB(5);"TUNED CIRCUIT TRACKING"
80 PRINT
90 PRINT "ENTER LO,MID AND HI FREQUENCY(MHZ)"
100 INPUT F1,F2,F3
110 IF 0>=F1 OR F1>F2 OR F1>=F3 THEN 570
120 PRINT "ENTER MAX,MID AND MIN CAPACITY(PF)"
130 INPUT C1,C2,C3
140 IF 0>=C3 OR C3>=C2 OR C2>=C1 THEN 570
150 PRINT
160 CT=0
170 YP=0
180 R2=(F1/F2)^2
190 R3=(F1/F3)^2
200 CB=(C3-R3*C1)/(R3-1)
210 IF CB>0 THEN 240
220 PRINT "CAPACITY RATIO TOO SMALL"
230 GOTO 460
240 GOSUB 630
250 IF F>0 THEN 310
260 FA=F
270 CA=0
280 CT=CB
290 GOSUB 630
300 IF F>0 THEN 330
310 PRINT "MID FREQUENCY NOT FEASIBLE"
320 GOTO 460
330 FB=F
340 FOR I=1 TO 40
350 IF ABS(F)<.00001 OR ABS(FA-FB)<2E-07 THEN 460
360 CT=(FA*CB-FB*CA)/(FA-FB)
370 GOSUB 630
380 IF F<0 THEN 420
390 FB=F
400 CB=CT
410 GOTO 440
420 FA=F
430 CA=CT
440 NEXT I
450 PRINT "CAUTION - CONVERGENCE FAILS"
460 L=25330*FNA(C1)/F1/F1
470 PRINT
480 PRINT "INDUCTANCE",L;" UH"
490 IF YP>0 THEN PRINT "PADDING C",1/YP;" PF"
500 PRINT "TRIMMING C",CT;" PF"
510 PRINT
520 PRINT "CAP(PF)","FREQ(MHZ)"
530 PRINT C1,FNB(C1)
540 PRINT C2,FNB(C2)
550 PRINT C3,FNB(C3)
560 GOTO 580
570 PRINT "ERROR IN DATA"
580 PRINT
590 PRINT "RUN AGAIN? (Y/N)"
600 INPUT A$
610 IF A$="Y" THEN 50
620 STOP
630 YP=(1/(CT+C1)-R3/(CT+C3))/(R3-1)
640 F=R2-FNA(C1)/FNA(C2)
650 RETURN
```

The next section of the program, up to line 440, uses a mathematical ploy known as the 'secant method' to find the value for the trimmer capacitor at which the requested mid frequency is obtained with the specified capacity.

In this method, the program commences with two guessed trimming capacitor values which are known to lie on either side of the true value. All values of capacity within these are then considered until the correct value is found. The program can normally succeed in this within 10 iterations, thus giving an excellent demonstration of how effective this method can be.

If the search is not successful, a warning:
'CAUTION – CONVERGENCE FAILS' is printed. However, the authors have been unable to find a problem which the program could not solve within the 40 iterations allocated, so this warning is only a precautionary measure. This complete, the required inductance is calculated at line 460.

The results are printed by lines 480 – 500, whilst lines 520 – 540 indicate the actual frequencies which will be obtained at the specified capacities. Should a padding capacitor not be necessary, the corresponding line will not appear on the screen.

In conclusion, lines 580 to 610 invite a further calculation.

The test problems

We have provided a series of test problems for two reasons. Firstly, they will verify that the program has been typed in correctly, and secondly, they illustrate how the program handles a problem which cannot be solved.

The first problem is based on the practical example of a varicap diode which is required to tune the FM broadcast band with a linear frequency to voltage characteristic. The capacity

values correspond to a varicap bias of 1.0, 4.5, and 8.0 volts respectively.

The second test problem asks for a centre frequency which is equal to the maximum frequency. The program determines the highest possible centre frequency which does not compromise the other two.

The final problem defines a frequency swing which is too great for the variable capacitor. The program chooses an inductance which will give the low frequency exactly and the best possible compromise for the middle and upper frequencies.

Warning

Stray capacities exist in all circuits and, particularly at the higher frequencies, these may cause considerable errors if suitable allowance is not made. Furthermore, note that the majority of tuning capacitors are not linear, the capacity at the centre of the scale normally being considerably less than the average of the minimum and maximum capacities. This is deliberate, the purpose being to prevent the tuning scale being excessively cramped at the high frequency end. Allowance for this must be made when selecting the mid-range capacitance value. REW

```
    TUNED CIRCUIT TRACKING

ENTER LO,MID AND HI FREQUENCY(MHZ)
? 88 , 98 , 108
ENTER MAX,MID AND MIN CAPACITY(PF)
? 20 , 10 , 6

INDUCTANCE          .521493  UH
PADDING C           8.7871   PF
TRIMMING C          1.91549  PF

CAP(PF)           FREQ(MHZ)
 20                88
 10                98.0002
 6                 108

RUN AGAIN? (Y/N)
?Y
```

```
    TUNED CIRCUIT TRACKING

ENTER LO,MID AND HI FREQUENCY(MHZ)
? .55 , 1.6 , 1.6
ENTER MAX,MID AND MIN CAPACITY(PF)
? 300 , 100 , 20

MID FREQUENCY NOT FEASIBLE

INDUCTANCE          263.718  UH
TRIMMING C          17.5194  PF

CAP(PF)           FREQ(MHZ)
 300               .55
 100               .904051
 20                1.6

RUN AGAIN? (Y/N)
?Y
```

```
    TUNED CIRCUIT TRACKING

ENTER LO,MID AND HI FREQUENCY(MHZ)
? 1 , 2 , 3
ENTER MAX,MID AND MIN CAPACITY(PF)
? 200 , 100 , 50

CAPACITY RATIO TOO SMALL

INDUCTANCE          126.65   UH
TRIMMING C          0        PF

CAP(PF)           FREQ(MHZ)
 200               1
 100               1.41421
 50                2

RUN AGAIN? (Y/N)
?N
BREAK AT 630
```

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Hook-up ... 7/.2
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Heavy duty ... 32/.2
4 colours ... 15p
Extraflex
red/black ... 15p
Tinned copper per 40z reel
SWG16 ... 80p
SWG18 ... 85p
SWG20 ... 95p
SWG22 ... 95p
SWG24 ... 95p
En copper per 20z reel SWG14 ... 70p
SWG16 ... 80p
SWG18 ... 90p
SWG20 ... 90p
SWG22 ... 90p
SWG24 ... 105p
SWG26 ... 105p
SWG28 ... 105p
SWG30 ... 110p
SWG33 ... 110p
SWG34 ... 115p
SWG36 ... 125p
SWG38 ... 125p
SWG40 ... 150p
Figure 8 per metre 7/.25 ... 13p
Coloured ribbon per foot
10 way ... 20p
20 way ... 40p
34 way ... 80p
Mains per metre 2 core Oval 3A ... 20p
Round 6A ... 46p
3 core Round 3A ... 35p
Round 6A ... 50p
Round 13A ... 80p

Power
1 mm T&E ... 40p
1.5 mm T&E ... 46p
2.5 mm T&E ... 66p
6 mm T&E ... 150p
TV COAX ... 40p
Screened Single round ... 17p
Twin round ... 20p
Figure 8 min ... 20p
Figure 8 std ... 30p
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½" ... 46p
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47pF ... 15p
100pF ... 15p
470pF ... 15p
1000pF ... 11p
2200pF ... 11p
.01μF ... 5p
.022μF ... 5p
.047μF ... 8p
.1μF ... 8p
.47μF ... 15p
Polystyrene
22pF ... 13p
47pF ... 8p
68pF ... 8p
100pF ... 8p
150pF ... 8p
220pF ... 8p
330pF ... 8p
470pF ... 8p
560pF ... 8p
680pF ... 8p
1000pF ... 8p
1500pF ... 8p
2200pF ... 8p
3300pF ... 8p
4700pF ... 8p
5600pF ... 10p
6800pF ... 10p
.01μF ... 14p
.022μF ... 19p
.047μF ... 25p
.1μF ... 49p
Polyester
.01μF ... 8p
.015μF ... 8p
.022μF ... 8p
.033μF ... 9p
.047μF ... 9p
.068μF ... 9p
.1μF ... 9p
.15μF ... 15p
.22μF ... 11p
.33μF ... 16p
.47μF ... 16p
.68μF ... 26p
1μF ... 28p
2μF ... 49p
Electrolytic
μF/V 1/63 ... 8p
2.2/50 ... 9p
4.7/63 ... 9p
10/16 ... 8p
10/25 ... 8p
10/35 ... 10p
10/63 ... 13p
22/10 ... 8p
22/16 ... 10p
22/25 ... 10p
22/35 ... 11p
22/63 ... 15p
47/10 ... 10p
47/16 ... 11p
47/25 ... 13p
47/35 ... 15p
47/63 ... 24p
100/10 ... 11p
100/16 ... 13p
100/25 ... 15p
100/35 ... 19p
100/63 ... 25p
220/16 ... 15p
220/25 ... 20p
220/35 ... 23p
220/63 ... 33p
470/16 ... 23p
470/25 ... 27p
470/35 ... 31p
470/63 ... 48p
1000/10 ... 24p
1000/16 ... 29p
1000/25 ... 41p
1000/35 ... 46p
1000/63 ... 75p
2200/10 ... 39p
2200/16 ... 46p
2200/25 ... 56p
2200/35 ... 74p
3300/25 ... 74p
3300/35 ... 92p
4700/10 ... 59p
4700/16 ... 74p
4700/25 ... 103p
Non-polarised
1μF ... 25p
2.2μF ... 25p
3.3μF ... 25p
4.7μF ... 25p
6.8μF ... 50p
10μF ... 25p
22μF ... 35p
33μF ... 40p
47μF ... 40p
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4M ... 180p
4.19304M ... 320p
4.433619M ... 320p
6.144M ... 130p
10M ... 200p
18.432M ... 270p
26.54M ... 200p
26.59M ... 200p
26.64M ... 200p
26.69M ... 200p
26.74M ... 200p
26.79M ... 200p
26.8M ... 200p
26.995M ... 200p
27.045M ... 200p
27.095M ... 200p
27.145M ... 200p
27.195M ... 200p
27.245M ... 200p
27.255M ... 200p

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Croc clips ... 10p
Terminal post ... 40p
1mm plug ... 20p
1mm socket ... 15p
2mm plug ... 20p
2mm socket ... 15p
3mm plug ... 20p
3mm socket ... 15p
4mm plug ... 15p
4mm socket ... 15p
Phono plug ... 10p
Phono line skt ... 20p
Jack plug
2.5mm ... 15p
Jack plug
3.5mm ... 15p
Jack skt
2.5mm ... 15p
Jack skt
3.5mm ... 15p
Jack skt line
2.5mm ... 30p
Jack skt line
3.5mm ... 25p
Jack plug ¼" mono ... 20p
Jack plug ¼" stereo ... 30p
Jack skt ¼" mono ... 25p
Jack skt ¼" stereo ... 35p
Jack skt line mono ... 25p
Jack skt line stereo ... 30p

COAX plug ... 15p
COAX skt surf ... 30p
COAX skt flush ... 25p
COAX line skt ... 45p
COAX coupler ... 45p
CAR aerial plug ... 15p
FM aerial plug ... 20p
BNC plug ... 100p
BNC round skt ... 100p
BNC square skt ... 100p
BNC free skt ... 110p
BNC str. adapt. ... 140p
BNC T adapt. ... 300p
VHF plug PL259 ... 50p
Small reducer ... 20p
Large reducer ... 20p
PL259 rt.ang. ... 90p
VHF round skt ... 50p
VHFsquare skt ... 50p
Ebow adapt. ... poa
Straight adapt. ... 80p
VHF T adapt. ... 180p
Female T adapt. ... 180p
XLR line plug ... 180p
XLR chassis skt ... 330p
XLR line skt ... 230p
XLR chassis plug ... 160p
DIN plugs 2 pin ... 10p
DIN plugs 3 pin ... 15p
DIN plugs 4 pin ... 35p
DIN plugs 5 pin A ... 15p
DIN plug 5 pin 240° ... 20p
DIN plug 5 pin 360° ... 30p
DIN plug 6 pin ... 40p
DIN plug 7 pin ... 20p
DIN plug 8 pin ... 60p
DIN skts 2 pin ... 10p
DIN skts 3 pin ... 20p
DIN skts 4 pin ... 15p
DIN skts 5 pin A ... 15p
DIN skts 5 pin B ... 20p
DIN skts 6 pin ... 20p
DIN skts 7 pin ... 20p
DIN line skt 2 pin ... 15p
DIN line skt 5 pin ... 30p
D-type plug 9 W ... 80p
D-type plug 15 W ... 150p
D-type plug 25 W ... 150p
D-type skt 9 W ... 140p
D-type skt 15 W ... 200p
D-type skt 25 W ... 450p
D-type rt ang. skt 9 W ... poa
D-type rt ang. skt 15 W ... poa
D-type rt ang. skt 25 W ... poa
D-type rt ang. plug 9 W ... poa
D-type rt ang. plug 15 W ... poa
D-type rt ang. plug 25 W ... poa
Covers 9 ... 120p
Covers 15 ... 120p
Covers 25 ... 130p
Latches 9 ... 30p
Latches 15 ... 50p
Latches 25 ... 60p
Power plug 2.1mm ... 15p
Power plug 2.5mm ... 15p
IEC line skt ... 95p
IEC chassis plug ... 90p
IEC chassis skt ... 90p
IEC line plug ... 70p
Bulgin P429 ... 50p
Bulgin P646 ... 165p
Bulgin P430 ... 125p
Bulgin P649 ... 135p
Bulgin P650 ... 110p
Bulgin P635 ... 100p
Bulgin P636 ... 130p
Bulgin P561 ... 300p
Bulgin P562 ... 100p
Bulgin SA2403 ... 160p
Bulgin SA2404 ... 95p
Bulgin SA2190 ... 50p
Bulgin SA1852 ... 50p
Bulgin SA2111 ... 200p
Bulgin SA2019A ... 150p
Bulgin SA2020 ... 140p
Bulgin SA2367 ... 180p
Bulgin SA2368 ... 95p
Many other connectors, adapters & leads in stock.

OPTO
LED Std red ... 10p
LED Std green ... 18p
LED Std yellow ... 15p
LED Min red ... 10p
LED Min green ... 18p
LED Min yellow ... 18p
LED clip std ... 3p
LED clip min ... 3p
Large range of panel lampholders, de luxe LEDs, etc.

FUSEWARE
20mm panel holder ... 45p
1¼" panel holder ... 59p
20mm chassis holder ... 14p
1¼" chassis holder ... 17p
Line holder ... 14p
Fuse clips ... 3p
20mm fuses
100mA, 150mA, 250mA, 500mA, 1A, 1.5A, 2A, 3A, 5A ... 9p
20mm antisurge fuses 500mA, 1A, 2A ... 12p
1¼" fuses 100mA, 150mA, 250mA, 500mA, 1A, 2A, 3A, 5A, 10A, 13A, 15A ... 9p
1" fuses 2A, 3A, 5A, 13A ... 15p

RESISTORS
½ W 5%
E24 ... 2p
.4W 1%
E24 ... 7p
1W 5%
E12 ... 10p
3W ww L22-1R ... 30p
3W ww
2R2 ... 20p
7W ww ... 30p
10W ww ... 35p
25W ww ... 170p
Ww Pots.
3W High quality ... 275p
10R, 25R, 50R, 100R, 250R, 500R, 1k, 5k, 10k, 50k.

SEMICONDUCTORS
So extensive is the range of listed semiconductors
Please send large S.A.E. for details
Transistor mounts
TO3 ... 10p
TO66 ... 10p
DIL sockets 8 pin ... 9p
14 pin ... 11p
16 pin ... 12p
18 pin ... 16p
20 pin ... 17p
22 pin ... 20p
24 pin ... 21p
28 pin ... 24p
40 pin ... 35p

Range of heat sinks available — Phone for quotation

SPEAKERS
Miniature buzzer
6V or 12V ... 90p
Ultrasonic transducers ... 600p pair
Elliptical 5"x3" 198p
Elliptical 6"x4" 262p
Elliptical 7"x4" 314p
Elliptical 7"x5" 338p
Elliptical 8"x5" 5W ... 386p
Elliptical 8"x5" 8W ... 521p
Elliptical 9"x6" 431p
Miniature 1" ... 90p
Miniature 1½ ... 90p
Miniature 1¾ ... 90p
Miniature 2" ... 90p
Miniature 2¼ ... 90p
Miniature 2½" 8R 90p
Miniature 2½" 64R ... 100p
Round 5" 4W 174p
Round 5" 25W 409p
Round 5" 60W 1587p
Round 5¼" 10W 476p
Round 5½" 15W 771p
Round 6" 5W 297p
Round 6" 60W 1632p
Round 6½" 7W ... 423p
Round 8" 6W 359p
Round 8" 10W ... 423p
Round 8" 20W ... 963p
Round 8" 60W ... 1346p
Round 10" 10W ... 700p
Round 10" 20W ... 1113p
Round 10" 30W ... poa
Round 12" 60W ... 2862p
Round 12" 100W ... 4073p
Round 12" 150W ... 4336p
Round 15" 150W ... 7186p
Round 15" 200W ... 8735p
Round 18" 200W ... £108

Motorola piezo
tweeters 2" ... 231p
3½" ... 697p
2"x6" horn ... 938p
2"x5" horn ... 795p
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3¾" ... 624p
4"x10" ... 1435p
Crossovers
2 way 15W ... 188p
2 way 100W ... 690p
3 way 25W ... 193p
3 way 40W ... 338p
3 way 60W ... 502p
3 way 100W ... 1346p
4 way 80W ... 628p

SWITCHES
Toggle Std SPST ... 47p
Toggle Std DPDT ... 62p
Toggle Min SPST ... 68p
Toggle Min SPDT ... 70p
Toggle Min SPDT c/off ... 83p
Toggle Min DPDT ... 85p
Toggle Min DPDT c/off ... 117p
Toggle Min 4PDT ... 209p
Toggle Min 4PDT c/off ... 244p
Push to make ... 20p
Push to break ... 20p
Key sw spst ... 259p
Rotary 1P 12W ... 62p
Rotary 2P 6W ... 62p
Rotary 3P 4W ... 62p
Rotary 4P 3W ... 62p
Sude min DPDT ... 22p
Sude std DPDT ... 22p
DIP 4W ... 105p
DIP 6W ... 128p
DIP 8W ... 156p
DIP 10W ... 184p
Microswitch ... 83p

TRANSFORMERS
6-0-6 V, 100mA ... 167p
6-0-6 V, 250mA ... 185p
9-0-9 V, 100mA ... 167p
9-0-9 V, 250mA ... 185p
12-0-12 V, 50mA ... 155p
12-0-12 V, 100mA ... 171p
12-0-12 V, 250mA ... 188p
0-12/0-12 V, 500mA ... 369p
9-0-9 V, 1A ... 283p
12-0-12 V, 1A ... 350p
15-0-15 V, 1A ... 433p
20-0-20 V, 1.5A ... 538p
0-12-15-20-24-30 V, 1A ... 666p
6-0-6 V, 2A ... 440p
9-0-9 V, 2A ... 476p
12-0-12 V, 2A ... 538p
0-12/0-12 V, 2A ... 538p
0-12-15-20-24-30 V, 2A ... 900p
20-0-20 V, 2A ... 745p
30-0-30 V, 2A ... 933p
12-0-12 V, 3A ... 721p
0-15 V, 3A ... 647p
6-0-6 V, 4A ... 538p
9-0-9 V, 4A ... 687p
12-0-12 V, 4A ... 845p
0-15 V, 6A ... 949p
6-0-6 V, 8A ... 980p
12-0-12 V, 8A ... 1615p

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30VA 9V ... 950p
30VA 12V ... 950p
30VA 15V ... 950p
30VA 18V ... 950p
50VA 6V ... 1150p
50VA 9V ... 1150p
50VA 12V ... 1150p
50VA 15V ... 1150p
80VA 18V ... 1200p
80VA 22V ... 1200p
80VA 30V ... 1200p
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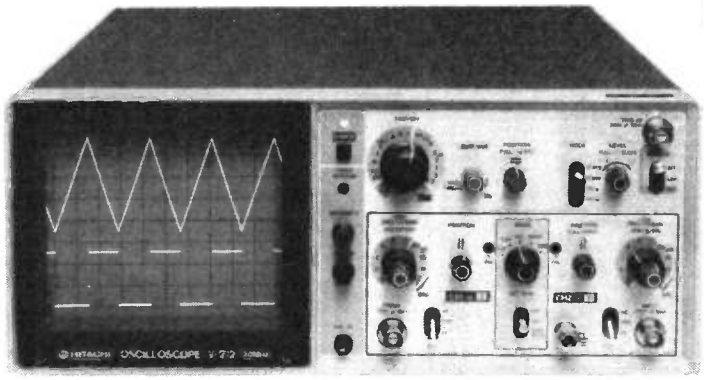

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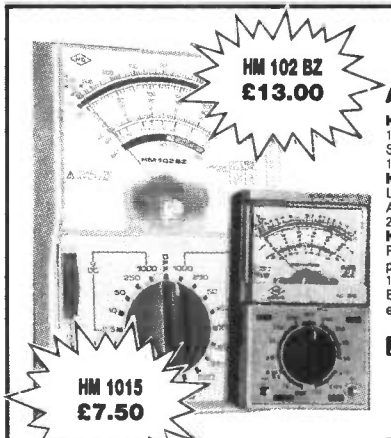

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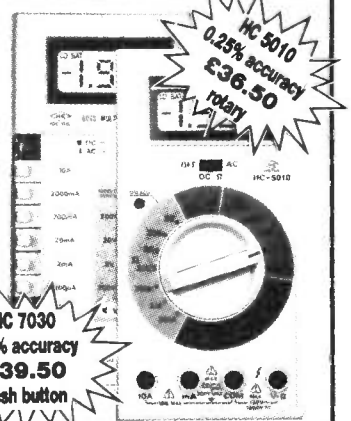

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PC900	1.25
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PCC89	0.70
PCC189	0.70
PCC805	0.70
PCC806	0.80
PCE82	0.80
PCF80	0.65
PCF82	0.60
PCF84	0.65
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PCF87	0.40
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UCF80	1.00
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UCH41	2.50
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UCH81	0.65
UCL82	1.75
UF85	1.20
UF41	1.15
UF42	1.15
UF80	0.80
UF89	2.50
UL44	3.50
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1LA6	1.00
1N1	4.50
1N2	4.60
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1N5GT	2.60
1P28	25.00
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1S5	0.70
1T4	0.70
1U5	1.00
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5AR4	2.00
5AU4	1.50
5B8	2.50
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5B-255M	19.50
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5B-258M	14.50
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5R4GY	3.50
5T4	5.95
5U4G	2.50
5U4GB	2.50
5V4G	1.25
5Y3GT	1.95
5Z4GT	0.85
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6A8G	1.50
6AC7	2.00
6AF4A	2.50
6AF9	4.15

6AG5	1.50
6AG7	1.95
6AH6	1.50
6AJ4	2.00
6AJ7	2.00
6AK5	1.00
6AK6	2.00
6AL5	0.60
6AM4	3.25
6AM5	6.00
6AM6	1.50
6AN5	2.65
6AN8A	2.65
6AQ5	1.50
6AQ8	0.85
6AR8	3.95
6AS5	1.50
6AS6	1.50
6AS7G	4.50
6AT6	0.75
6AT8	1.75
6AU4	2.00
6AU6	0.95
6AV6	0.75
6AW8A	2.50
6B8G	1.50
6BA6	0.95
6BA7	4.50
6BA8A	3.50
6BC8	1.00
6BD4	1.50
6BD6	1.00
6BE6	0.72
6BF5	1.60
6BG6G	3.00
6BH6	1.95
6BH8	1.50
6BJ6	1.20
6BK4	4.00
6BK7A	1.95
6BM8	0.58
6BN4	1.65
6BN6	1.65
6BN7	4.50
6BN8	2.35
6BQ5	0.75
6BQ7A	0.72
6BL7GTA	3.95
6BL8	0.65
6BR5	0.70
6BR7	4.95
6BR8	2.15
6BR8A	2.15
6BS7	5.50
6BS8	2.50
6BW4	1.50
6BW6	5.35
6BW7	1.50
6BW8	4.00
6BX6	0.48
6BX7GT	3.50
6BZ6	2.50
6BZ7	2.95
6C4	1.10
6C5	1.95
6C6	2.50
6C8G	1.50
6C11	2.50
6C15	2.50
6C18	2.50
6CA4	3.50
6CA7	3.50
6CB5	3.95
6CB6	1.95
6CD6GA	4.50
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6CL6	3.25
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6CY5	1.00
6CY7	2.50
6DC6	2.95
6DK6	1.15
6DQ5	3.35
6DQ6B	2.50
6DW4	2.15
6EA4	4.95
6EA7	2.50
6EA8	2.50
6EB8	1.75
6EM5	2.50
6EM7	2.50
6EU7	£1.95
6EU8	1.75
6EV7	2.95
6EW7	4.50
6EW6	1.50
6F1	2.00
6F5	4.95
6F7	5.50
6F6G	2.00
6F12	1.50
6F13	3.00
6F14	1.00
6F17	2.75
6F21	2.50
6F22	0.70
6F23	0.60
6F24	1.25
6F25	1.25
6F28	1.25
6F32	1.25

6F33	17.00
6FG5	1.95
6FH8	12.50
6G6G	5.50
6GH8A	0.80
6GK5	1.50
6GK6	1.95
6GS7	2.15
6GV7	2.50
6GW6	2.50
6H1	9.50
6H3N	1.10
6H6	1.95
6H6GT	1.95
6HS6	4.95
6J4	2.15
6J4WA	3.15
6J5	2.50
6J6	0.65
6JB6A	3.95
6JE6C	4.95
6JS6C	4.95
6JU8	2.50
6J7	2.60
6K7G	1.35
6K8Y	3.95
6KD6	5.60
6KM8	2.50
6KT8	2.95
6L1	2.50
6L19	3.95
6L6GC	2.95
6L6GC (GE)	3.95
6L6GT	1.15
6LD20	0.60
6LF6	4.50
6LJ8	2.50
6LQ6	4.95
6L15	3.15
6N7	2.50
6N7GT	2.50
6P15	1.50
6P25	4.00
6P26	4.00
6P28	2.00
6Q7	1.20
6Q7GT	1.20
6R7G	3.15
6S4A	1.50
6S7	1.10
6SA7GT	1.35
6SC7	1.50
6SG7	1.35
6SH7	1.35
6SJ7GT	1.35
6SK7	1.35
6SK7GT	1.35
6SL7GT	0.85
6SN7GT	1.35
6SQ7	1.35
6SS7	1.95
6U4GT	1.75
6U8	1.15
6U8A	1.50
6V6GT	0.85
6X2N	1.00
6X4	1.50
6X5GT	1.00
6X5GTY	1.00
6X8A	2.25
7A6	4.50
7A7	2.00
7AD7	1.75
7AU7	1.50
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7C6	2.50
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12BZ6	4.95

12CA5	1.95
12CX6	1.20
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12DW7	2.50
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12E14	28.00
12GN7	4.60
12HG7A	4.50
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12K5	1.00
12K7GT	0.60
12K8	1.10
12SA7GT	1.00
12SG7	4.75
12SH7	1.00
12SK7	1.00
12SJ7	0.60
12SN7GT	1.85
12SQ7GT	1.50
13D3	3.20
13D7	3.20
13D7	2.50
13D9	3.20
13DR7	2.95
13EM7	3.50
14S7	1.00
17EW8	0.95
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19Q6	9.00
20A2	10.50
30D1	0.70
20LF6	3.50
20L1	0.95
20P1	0.55
20P3	0.80
20P4	1.95
20P5	1.15
21LU8	2.50
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25L6GT	1.75
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29C1	19.50
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30F5	0.95
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30FL2	1.35
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30FL13	1.10
30FL14	1.28
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30L15	0.80
30L17	0.90
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30P12	1.00
30P18	0.80
30P19	1.00
30PL1	2.50
30PL13	0.60
30PL14	1.75
31JS6A	5.50
33A/158M	19.50
35A5	4.50
35L8GT	2.00
35W4	0.70
35Z3	1.85
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40KD6	5.50
42	6.95
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50A5	1.50
50C5	0.95
50CD6G	1.15
50EH5	1.50
52KU	2.00
53CG	15.00
60B5	1.00
60JY6	2.96
61SPT	4.50
75B1	3.50
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84	3.00
85A1	6.50
85A2	1.50
90AV	10.00
92AG	19.50
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1626	3.00
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3545	4.00
4313C	4.00
4328D	9.00
5642	9.50
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5654	1.95
5663	1.95
5670	3.25
5672	4.50
5687	4.50
5692	3.50
5696	2.75
5704	3.50
5718	6.15
5725	2.60
5726	1.50
5727	1.95
5749	2.50
5750	1.85
5751	2.95
5763	4.95
5814A	3.25
5829WA	6.50
5840	3.50
5842	11.00
5847	10.95
5879	8.50
5886	13.95
5894	39.50
5899	4.50
5963	2.00
5965	2.25
6005	1.85
6012	16.00
6021	3.65
6057	2.50
6058	3.95
6060	2.25
6062	4.50
6063	2.00
6064	2.95
6067	1.95
6072	4.20
6080	8.50
6080WA	8.50
6096	2.85
6132	10.00
6136	2.50
6146B	9.95
6157	2.50
6201	6.45
6211	2.50
6267	2.25
6350	2.00
6688	6.50
6870	11.50
6887	9.50
6873	4.50
7167	3.95
7189A	2.95
7199	6.15
7233	7.95
7239	17.50
7247	2.95
7360	10.50
7462	15.00
7475	5.00
7486	75.00
7551	6.95
7558	9.45
7586	15.00
7587	26.95
7591A	4.95
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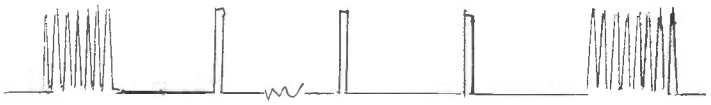
FURTHER DEVELOPMENTS IN FREQUENCY TRANSLATION

Bill Sparks G8FBX

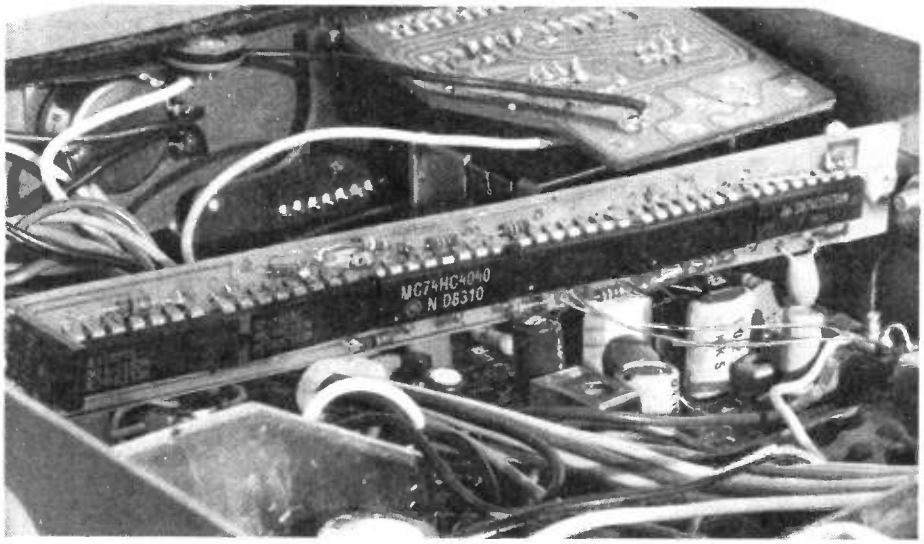
In the recent article on 27-29MHz conversions (***R&EW*** November '84) the method of frequency translation by a sophisticated system of frequency subtraction was described. Part of the discussion intimated that an alternative method of synchronisation of the two counter circuits may be desirable, and that further investigation was being made in an attempt to develop such a technique. The following note describes the method eventually evolved and shows a suitable double-sided board layout.

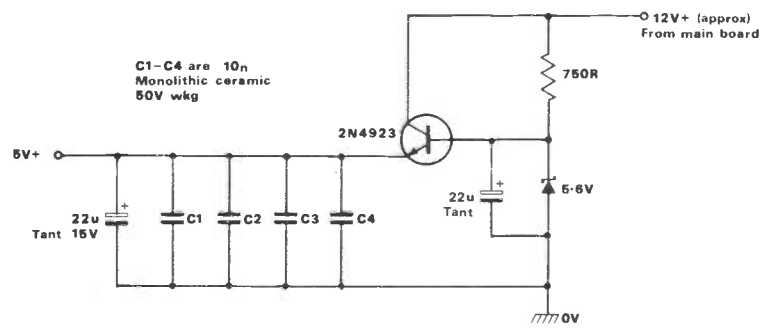
The problem under examination was one in which the random nature of the polarity and pulsewidth of the sequence initiating pulse created problems, and required additional circuitry in the form of a discriminator to clean it up. Even so, there was still an odd occasion when the pulse went wild and created a random count, thus causing irregularities in performance.

By selecting an alternative source for the initiating pulse and using a simpler approach in its sectionalisation a marked improvement in performance was achieved, with a considerable degree of economy in devices.



N-Pulses being subtracted – note only one allowed through





Power supply unit

New technique

The new technique can be established by referring to the diagram, which shows that the initiating pulse is now derived from the 10 240KHz reference oscillator.

This input frequency is divided by 2048 in the HC4040 to give a 5KHz reference at approximately 100nS pulsewidth, so the new signal is a 100nS pulse at a repetition every 200μS. This pulse is applied to the number of tens counter in a similar manner to the original circuit, and thus eliminates half of the ALS109 and the dual discriminator.

At the output of the 2048 divider the pulsewidth is, as stated, 100nS, but will be broader at the point of application to the HC193E pin 11 on both devices due to the time constant of the 47pF and 2K/3K resistor network on the 5V line. The relative time intervals, however, do not affect the operation of the timing sequences.

On odd occasions it has been found necessary to re-introduce the ALS109, and in this case the 47pF cap will feed to pin 12 and follow the line of the original circuit, using the 5.6K resistor to earth as shown in the output of the dual discriminator.

The revised connections to the 74HC00 are partly a matter of convenience in order to permit a more satisfactory track layout on the printed circuit board, as discussed later.

The voltage regulator shown indicates the necessity for heavy bypassing, and cannot be over-emphasised.

Improvement

The number of tens counters were changed to HC193Es in view of the improvement in transit time. The original circuit was stated to be operating at the boundary of the devices incorporated, and advantage has been taken of the availability of more suitable devices of higher speed capability.

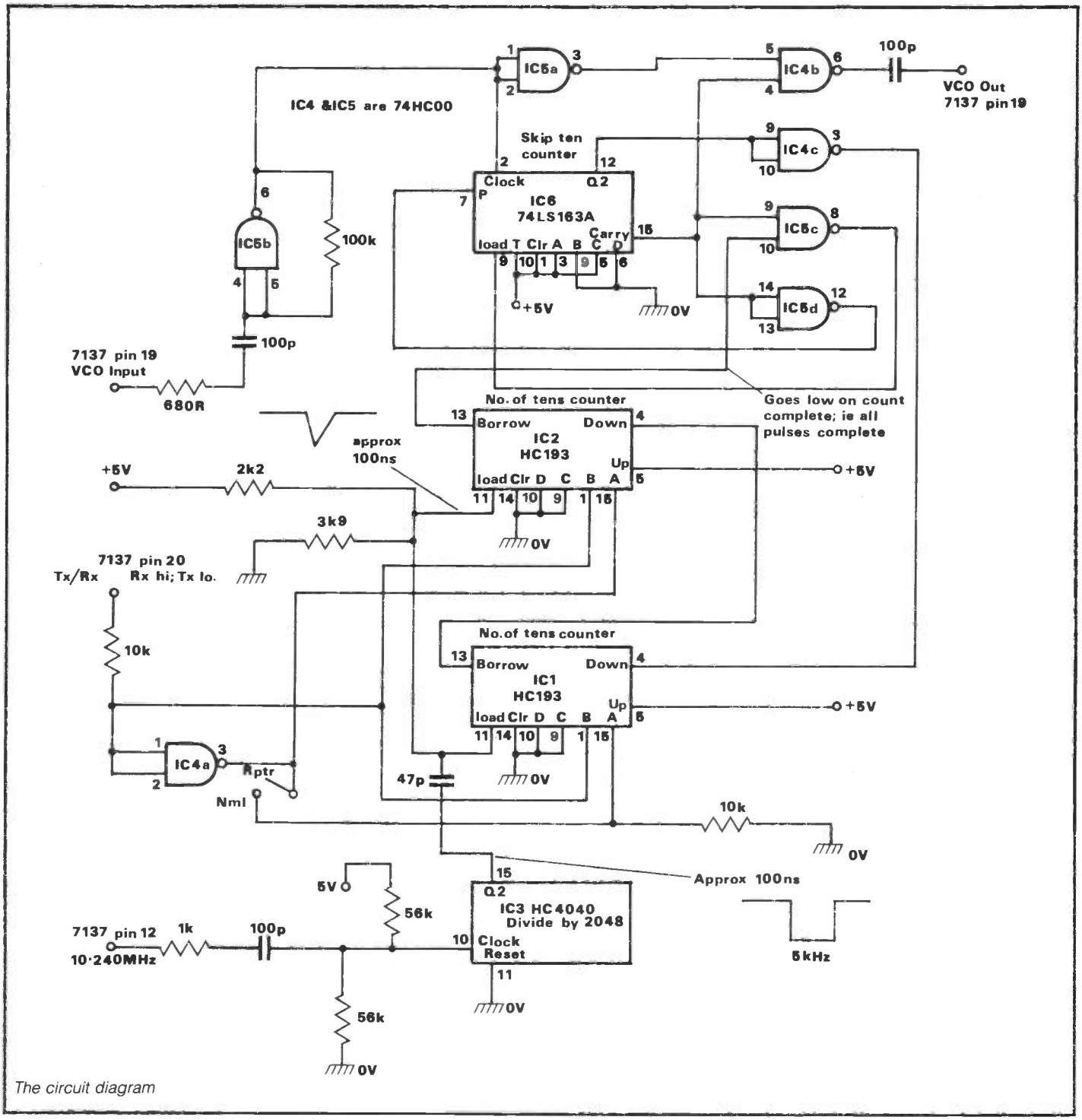
The diagrams illustrate the necessity for a high degree of bypassing in the dc supply.

Operating at relatively large HF values the possibilities of feedback are ever present, and the use of suitable caps with the shortest possible leads to the board is mandatory. It is essential to use tantalum electrolytics due to polarisation delays.

The board layout shown is necessary to provide adequate shielding between tracks.

The circuit analysis is as follows, assuming VCO max F = 19MHz:

(1) To stop 340 pulses it is necessary to stop the skip ten counter 34 times on receive and 17 times for the 170 pulses to



The circuit diagram

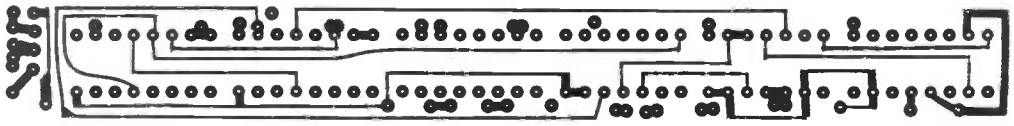
be subtracted on transmit. Using the suggested method of attack, only IC4, IC5 and IC6 need to operate at speeds near the limit of the logic family; even so gate propagation delays are borderline.

(2) The VCO frequency input goes to IC5b, and the feedback resistor raises the gate in its linear region so that the input sinewave amplitude is increased and to some degree is squared up. The output of this device operates as the clock to synchronise the skip ten counter.

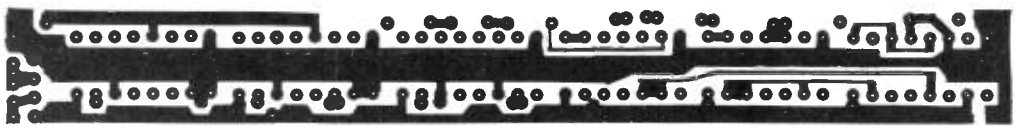
(3) In the absence of a load pulse at pin 9 of the skip ten counter, the counter will operate until a carry appears at pin 15 (high). This is inverted in IC5d and disables the count enable at pin 7 in IC6 (high count, low disable). The counter stays in this position until a new load pulse occurs.

(4) The carry, staying high, allows VCO pulses to pass through IC4b to the 7137 variable divider input (pin 19, LC7137). If the carry goes low, no pulses are allowed to pass.

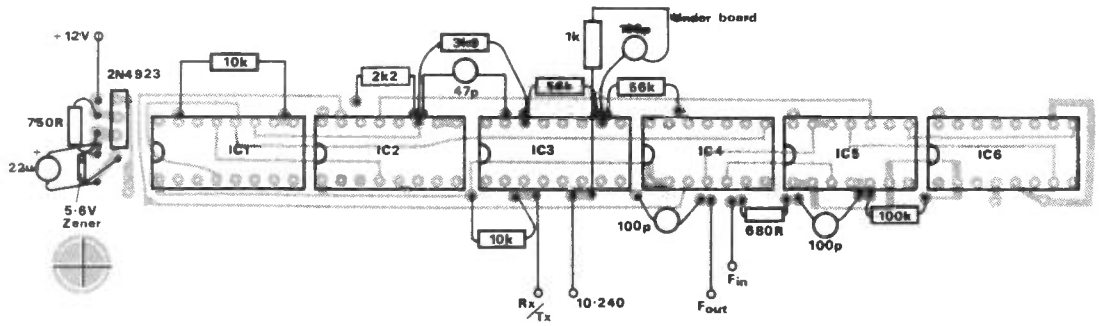
(5) The number of tens counter will inhibit the application of a load pulse to pin 9 of the skip ten counter unless a carry is present. If the count by ten counter goes to zero this creates a no load position at pin 9 and consequently permits the VCO pulses to proceed. Only while the number of tens counter is decrementing will the skip ten counter continue, so by loading a pre-determined number into the number of tens, the value of the VCO frequency may be adjusted at will.



Upper PCB foil layout



Lower PCB foil layout



Component overlay

(6) Briefly, the sequence is therefore: LC7137 count period complete, load a value into the number of tens counter; the skip ten counter then operates until this value reaches zero and then opens gate IC4b to permit pulses to pass for the remaining 7137 variable divider gate opening period. The 7137 therefore receives a lower number of pulses and takes the necessary action to raise the VCO frequency to cover for the missing pulses.

Since no mixing has occurred there is no possibility of spurious frequencies being developed.

At the completion of the count period in the 7137 the sequence is re-initiated.

To permit alternative frequency shifts to be adopted, the truth table for the number of tens counter is given, as used in either receive, transmit or repeater down shift.

Obviously a variety of shifts can be incorporated to suit a particular requirement.

Constructional points

To facilitate track orientation, advantage is taken of the fact that certain of the devices used have inactive pins. Due to track layout the path of the circuit was arranged to run through the unused pin positions. This means that the unused positions must be isolated, so the method adopted was to clip the narrow part of the pin to avoid contact with the board. The relevant pins are HC193s – pin 12 and HC4040 – pin 14.

The photograph indicates the position

Truth table for the number of tens counter

Function	Decimal	IC2				IC1			
		D	C	B	A	D	C	B	A
Receive	34	0	0	1	0	0	0	1	0
Transmit normal	17	0	0	0	1	0	0	0	1
Transmit 100KHz repeater offset	16	0	0	0	1	0	0	0	0

of the bypass caps. It will be noted that the connection between the cap and its associated positive connection is kept to a minimum length. The earth connection is made from the centre earth plane via a stiff wire to the nearest earth point on the main board. Only one earth connection is required, to avoid earth loops.

VCO core

One important point is to ensure that the modification will permit the VCO to shift to the new operating range. It is necessary to bring the VCO core out almost to its limit and secure with wax. In some cases it is advantageous to use aluminium cores (available from Cirkit) to reach the new range.

Occasionally, the padder switched across the VCO coil in the Tx condition will now be too low a value to tune it to the lower frequency required for transmit, once the coil has been adjusted for the higher frequency new Rx value.

It has been found that a further 2-3pF is required in parallel with the present padder. Some equipment has a variable padder already in position, and this may only require a slight adjustment to enable the VCO to operate at its new ranges.

The choice of a single LS device in preference to HC is taken in view of the advantage gained in propagation delay times. This is quite significant and is essential in the case of the 163 type.

In one case (the prototype) the physical size of the cases of the various ICs meant that insufficient gap spacing had been allowed. The use of Motorola devices, which are slightly shorter in length, overcomes this problem.

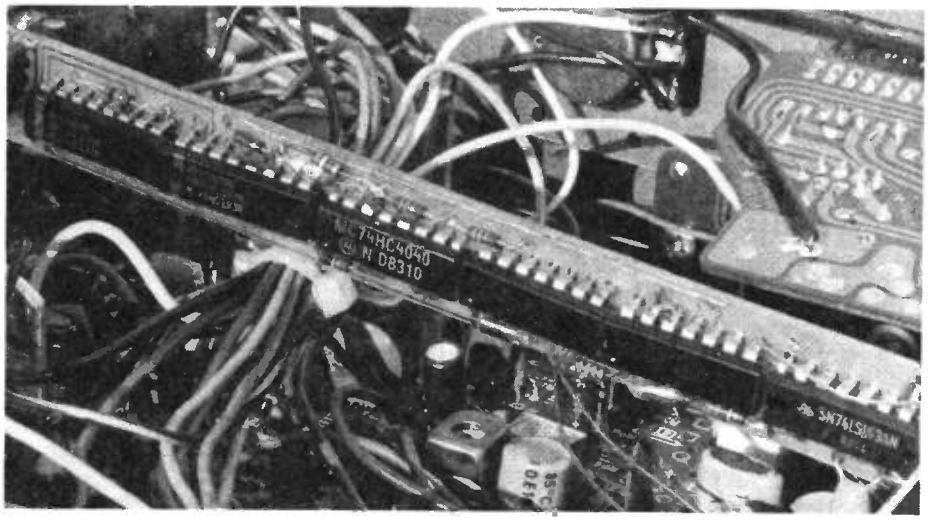
To probe the circuit during final frequency adjustment it is essential to load the probe end with a series 10K resistor. This prevents the probe capacity from loading the circuit and introducing erroneous readings when used for scope or DFM measurements. Even with a high cost HF probe this problem arose and caused some confusion.

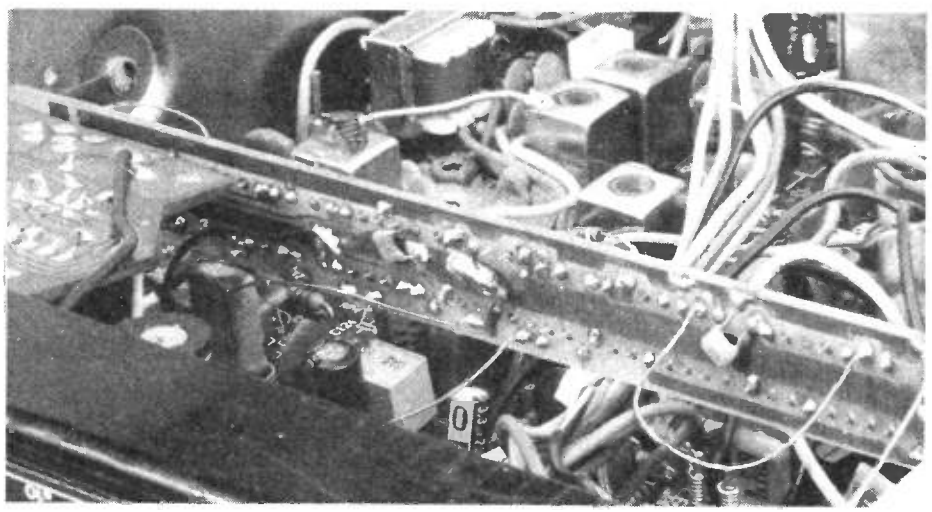
Earlier the earth connection was mentioned. It had been found advisable to take the main board earth to the earth return on the 7137 to reduce delay times still further.

The technique is considered to be unique and capable of extensive development in other fields. The writers would be pleased to hear of other suggestions or results of other applications, since it is considered that the technique is only at a low level of development in its present stage. NEW

The project outlined in this article is now available as a kit from ***R Withers Communications*** *for £22.50+£1p&p (see their ad in this issue).*

The November '84 issue of ***R&EW****, containing the original article by Bill Sparks G8FBX and Colin Horrabin G3SBI which outlined the theory behind this conversion technique, is available from the back issues department. There is a back issues order form elsewhere in this magazine*





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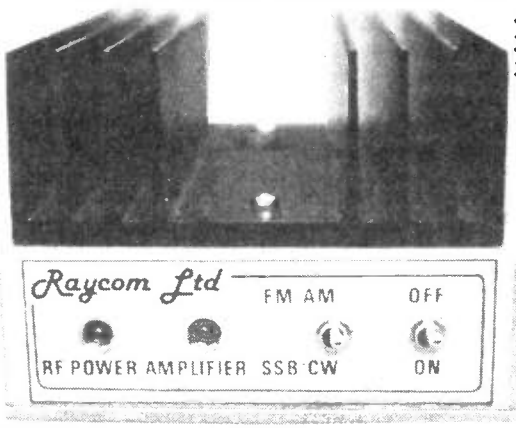

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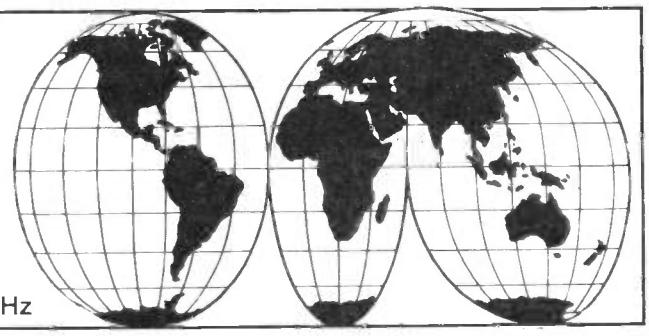
SHORT WAVE NEWS FOR DX LISTENERS



By Frank A Baldwin

All times in GMT, **bold** figures indicate the frequency in KHz

Now that the season for reception here in the UK of signals from the Far East and South East Asia is in full operation, I bring to the attention of interested readers that most difficult of all countries to log – Laos.

The People's Democratic Republic of Laos is bordered by Burma, Cambodia, China, Thailand and Vietnam and was formerly part of French Indo-China. Laos is an underdeveloped and isolated country, the economic centre being the Mekong valley. Much of the country has thickly forested mountains from which are derived the main export of hardwoods. Most of the population exists on subsistence agriculture for rice, and food imports are necessary.

There is no railway network at present, Luang Prabang, the old royal capital, lying some 150 miles or so to the north of the administrative capital Vientiane.

The government-owned National Radio of Laos currently operates both an External and a Regional Service, the former being based at Vientiane.

The External Service broadcasts to South East Asia on **7205** but this can vary up to **7209**. The power of this Vientiane transmitter is 10KW and it features programmes in Cambodian, English, French, Thai and Vietnamese. The schedule is from 0000 to 0130, from 0400 to 0630, from 1100 to 1330 and from 2300 to 2400. The English programmes are timed from 0100 to 0130, 0600 to 0630 and from 1300 to 1330.

Listing the Regional Domestic Services, the first is based at Houa Phan and operates on **4655** and irregularly in parallel on **6140** from 2300 to 0100, from 0400 to 0530 and from 1100 to 1300 with a power of 1KW. As with all these regional stations the programme language is mostly Laotian.

Luang Prabang is scheduled on **6978** from 2200 to 0100 (Sunday until 0200), from 0400 to 0600 and from 0930 to 1400 (Sunday until 1430). The power is 1KW.

Pakse occupies the **6589** channel from 2300 to 0200, from 0400 to 0600 and from 1000 to 1415 with a power of 1KW.

Savannakhet has a 3KW transmitter which operates on **7385** and according to my computer memory bank is on the air from 2300 to 0100, 0430 to 0530 and from 1100 to 1400.

The Vientiane regional programme 'National Radio of Laos', is timed from 2130 to 0230, from 0330 to 0700 and from 0900 to 1600 on **6130** with a power of 25KW.

Xieng Khouang uses **5660** from 2300 to 0030, from 0400 to 0530 and from 1100 to 1200. The power is 1KW.

I mentioned at the outset that Laotian signals are difficult to hear for West European DXers, and in fact it is probably the most rarely reported country in South East Asia.

Although it has been logged by UK-based DXers from time to time, and I did manage it some years ago, it does most certainly represent a considerable DX feat.

Good luck with your Laotian adventures!

AROUND THE DIAL

Make yourself comfortable, switch on the receiver, adjust the dial or digits to the frequencies at the times listed here and you may log some of the following.

AFRICA

Algeria

Algeria on a measured **7246** at 1055, YL with songs in a local vernacular (Berber or Kabyle) during a programme in the National Network II, scheduled on this frequency from 0500 to 2200 daily.

Burkina Faso

Radio Nationale de Burkina, Ouagadougou on **4815** at 2104, OM with a talk in French. RN de Burkina is scheduled on this channel from 0530 (Thursday from 0800, Saturday and Sunday from 0700) to 0900 (Saturday and Sunday until 0800) and from 1600 to 2400 with a power of 20KW. The frequency can vary slightly at times.

Burkina Faso was formerly called Upper Volta.

Cape Verde

A Voz de Sao Vicente, Mindelo on **3930** at 2117, OM with a talk in Portuguese then YL with a local pop song. This is a change of frequency from **3931** and would appear to be permanent, having been logged several times on the new channel.

This 10KW transmitter is on the air from 1200 to 1400 and from 1800 to 2400 Monday to Friday inclusive and on Saturday from 1200 (Sunday from 0900) to 2400. Cape Verde lies off the west coast of Africa.

Central African Republic

Bangui on **5035** at 0557, OM with announcements and a talk in vernacular. Radio Centrafrique operates from 0430 to 0700 and from 1630 to 2300 with a power of 100KW. The frequency can vary from **5032** to **5035**.

Chad

Radiodiffusion Nationale Tchadienne, N'djamena on **4904** at 2034, YLs with songs in vernacular complete with local orchestra backing in typical style. The evening session of this one is from 1730 to 2100 (Saturday until 2200) and the power is 100KW.

Guinea

Conakry on **4910** at 2150, OM with a talk in French. This station is scheduled from 0600 to 0800 except Sunday and from 1230 (Sunday from 0800) to 0100. There is an English programme timed from 1830 to 1930 and the power is 18KW.

Senegal

Dakar on **4890** at 2059, OM with a talk in French. The schedule is from 0600 to 0800 and from 1800 to 0100 with a power of 100KW. Also noted in parallel on a measured **4951**, this being a new channel.

Swaziland

TWR (Trans-World Radio) Mpangela on **4760** at 0338, OM with a sermon in vernacular, this being followed by some hymns.

With a 25KW transmitter, Mpangela is on the air from November to March inclusive, being timed from 1630 to 1700 in German and from 1700 to 2015 in English. Obviously the transmission logged is an amendment of schedule.

Tanzania

Zanzibar on **3339** at 0315, OM with announcements in Swahili then some local-style music.

Radio Tanzania is on this channel from 0300 to 0500 and from 1430 to 2000 (Ramadan until 2100) in Swahili. The power is 10KW.

Togo

Radiodiffusion de Kara, Lome on **3222** at 1953, OM with a talk in vernacular. Lome, now called Kara, is on the air from 0525 to 0830 and from 1630 to 2305 with a power of 10KW.

The frequency can vary at times to **3223**.

Zaire

Radio Candip, Bunia on **3390** at 1912, OM with a talk in French.

This one is scheduled from 0330 to 0730 and from 1500 (Saturday and Sunday from 1230) to 2000 (Saturday until 1730, Sunday until 1900) with a power of 1KW.

SHORT WAVE NEWS

THE AMERICAS

Bolivia

Radio Norte, Montero on a measured **4939** at 0225, YL with a ballad, OM with announcements and station identification at 0230, this being followed by YL with a political harangue in Spanish. Listed on **4937,** Radio Norte is on the air from 1000 to 1230, from 1600 to 1730 and from 2200 to 0230 (Sunday from 1200 to 2000). The power is 1.5KW. Obviously an extended schedule for political reasons. Underground political activities are now rife in many Latin American countries and gauging from the now more frequently heard political harangues and tirades, governments are increasingly hard put to maintain the status quo in their respective countries.

Brazil

Radio Nacional, Port Velho on **4945** at 0403, OM with a newscast in Portuguese. Many mentions of place names including two of Tegucigalpa in Honduras. R Nacional is on the air from 0800 (varies to 0900) to 0200 but varies to as late as 0500. The power is 50KW.

Colombia

Ondas del Meta, Villavicencio on a measured **4885.5** at 0220, OM with a folk song in Spanish with local-style wind instrumental backing. The schedule is from 1000 (varies to 0900) to 0500 but this closing time can vary to 0330. Just to fool us all however it sometimes works on a 24-hour schedule. The power is 5KW — and the frequency can vary!

Costa Rica

Faro del Caribe (Lighthouse of the Caribbean), San Jose, on **5055** at 0246, OM and YL with a discussion in Spanish about religion. Faro del Caribe is on the air from 0300 to 0400 and the power is 5KW. Note however that this station has been reported closing on occasions as late as 0740.

Ecuador

Radio Nacional Espejo, Quito on **4680** at 0336, OM announcer then YL with songs in Spanish. This 5KW transmitter is scheduled around-the-clock but the frequency can vary to **4683** at times.

Radio Quito on **4920** at 0249, OM with a talk in Spanish with mention of Maritima Argentinos. R Quito is scheduled from 1000 (varies to 1200) to 0500 (Sunday until 0300) with a power of 5KW.

Honduras

La Voz Evangelica, Tegucigalpa on **4820** at 0447, OMs with hymns in Spanish. LV Evangelica is timed on the air from 1030 to 0600 in Spanish. On Monday there is an English transmission from 0300 to 0500. The power is 5KW.

Peru

Radio Difusora San Martin, Tarapoto on **4810** at 0348, YL with a political harangue in Spanish, being followed later by an OM in similar vein, being an anti-Shining Path (Maoist organisation) broadcast. RD San Martin is on the air from 0930 to 0500 (Sunday until 0300) with a power of 1KW, but sometimes operates around-the-clock.

Radio Andina, Huancayo on **4996** at 0345, OM with announcements (noticias) then YL with a folk song. This 2KW transmitter operates from 0930 (Sunday from 1000) to 0500 (variable to 0600) and is part of the Emisoras Cruz del Peru network.

ASIA

Bangladesh

Radio Bangladesh, Dhaka on **17670** at 0900, pips and tone time-check, YL with the station identification and a newscast in the Bengali programme for Europe, timed from 0830 to 1000. Also logged in parallel on **21640.**

China

Radio Beijing on **7480** at 2105, YL with the English presentation for North and West Africa, scheduled from 2030 to 2130.

India

AIR (All India Radio) Lucknow on **3205** at 1535, YL with a newscast in English. This is the North Regional Service which is scheduled on this channel from 0025 to 0215 and from 1215 to 1740 with a power of 10KW. English news at 0032, 1530 and at 1730.

Iran

Teheran on **7230** at 2120, OM with quotations from the Holy Quran, OM with announcements, a military chorus and band. Not in parallel with the **9022** channel until 2130.

Iraq

Baghdad on **13700** at 1900, chimes time-check then OM with the station identification and a newscast in Arabic. Schedule on this new channel unknown at the time of writing.

READER LOG

M Mehta of Gloucester sent along a log of Tropical Band stations he has received on his Sony 2001, the list being comprised of three Bolivians, eighteen Brazilians, six Colombians, eight Ecuadoreans, twelve Venezuelans and four Peruvians. Amongst this wealth of DX I note R Illimani on **4945** at 0225, the Brazilians R Poti on **4965** at 0100, R Timbira on **4975** at 0130 and R Copacabana on **5015** at 0200.

Noted also are the Colombians La Voz del Cinaruco on **4865** at 0200 and R Super de Medellin on **4875** at 0400; from Ecuador there is R Iris on **3380** at 0330, R Zaracay on **3395** at 0315, R N Espejo on **4680** at 0300, R Em Gran Colombia on **4910** at 0355 and R Quito on **4920** at 0330; from Peru, R Atlantida on **4790** at 0200. A creditable performance indeed.

MEDIA NETWORK

The latest publication to hand from Media Network of Radio Nederland Wereldomroep is entitled *'InfoDutch,'* this being a 20 page booklet packed with information of direct use to all computer hobbyists using their equipment in conjunction with a short wave receiver. This wealth of useful information is divided into the following chapters: General Hints, Software for Radio Use, Hardware, Bulletin Boards, Radio Related Software Information/Suppliers Addresses and Conclusions. Thoroughly recommended, this most useful booklet is available free of charge direct from *InfoDutch,* 'Media Network', Radio Nederland Wereldomroep, PO Box 222, 1200 JG Hilversum, The Netherlands.

SOUTH EAST ASIA

Australia

Melbourne on **7135** at 1340, OM with the Cantonese programme for South East Asia and the Far East timed from 1230 to 1430; on **7205** at 1355, pops, YL with station identification then OM with the news in English.

CLANDESTINE

Radio Camilo Cienfuegos on **7400** at 0347, OM song in Spanish, guitar backing, OM with station identification at 0351 and at 0400, chimes then OM with a talk in which two mentions of 'Gran Britannia' were made, all in a CID programme.

Radio SPLA (Sudanese People's Liberation Army), OM station identification in English at 1300 on **9610,** military music, programme review and a talk. This English transmission is timed from 1300 to 1330. Transmitter thought to be based in Libya.

NOW LOG THIS

VORE (Voice of Revolutionary Ethiopia) Addis-Ababa on **7110** at 1553, YL with a song in vernacular, YL with station identification at 1600 then into Arabic with quotations from the Holy Quran.

NOW HEAR THIS

Mogadishu, Somalia on **7200** at 2028, OM with a tribal chant then OM with a clear identification at 2032.

RRI Sibolga, Sumatra, Indonesia on **5257** at 1541 on a good day for Indonesians, YL with a song in Indonesian then local-style music with gongs etc, heard under some CW QRM.

DOTS AND DASHES

As a change of occupation, a few forays onto the CW portions of the amateur bands were made over a three day period resulting in signals from (Top Band) CT1BCM, EA6EA, EA9CE, HB9G, IK2EYP, K1ZM, K2EK, K8CCV, LA1GCA, LZ2CX, OE5KE, OH3JR, RT3UO, SM0TW, UA1WZM, UP2BZR, UQ2PQ, UR1RWX, W2PLE, YU5YA and ZB2EO.

On 7MHz Morse code signals were heard from CE8PD, CE9AJ (Antarctic), CP8AK, PY2RCZ, UD6DC, VP2VCW, YV2KL and 5B4DH. KW

LATEST LITERATURE

Clubs, manufacturers, publishers and agents are invited to send details of new books, catalogues, data sheets, etc for inclusion on this page

AMATEUR RADIO, SUPER HOBBY!

By Vince Luciani K2VJ

Vince Luciani has written an absorbing introduction to amateur radio for any newcomers to the hobby, and has managed to describe amateur radio and the people who practise it in a highly readable and non-technical manner.

Being an American, the author has naturally described the amateur radio scene in his native country. However, there is much common ground that makes this a very interesting and useful book for novices in this country, despite differences in such areas as licence requirements etc.

It is not only newcomers to amateur radio who will enjoy this book. Established amateurs will be fascinated by the description of the American view of the hobby. As well as an outline of the 'nuts and bolts' of the hobby there are brief biographies of prominent members of the community who are radio hams, as well as of hams who have made significant achievements (such as a *four year old* who passed the novice exam!).

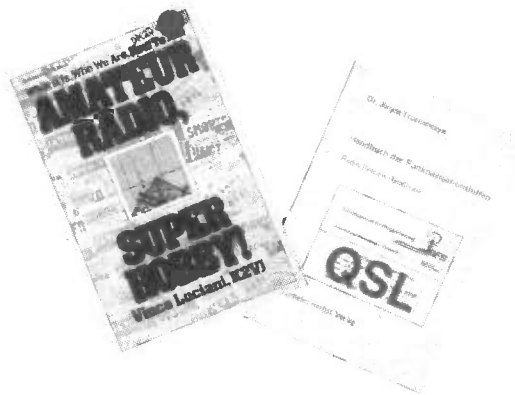
Such items as the description of CARI (Chess and Amateur Radio International, an organisation launched by the author and his son) make this required reading for anyone who likes a book that he will not want to put down.

McGraw-Hill Book Company (UK) Ltd, £8.75. ISBN 0-07-038959-4.

COMPUTER AND TELECOMMUNICATIONS HANDBOOK

By Jeff Maynard

This hardback volume, published on 24 January, has been produced as a reference book for professionals in the telecommunications,



electronics and computing industries, as well as hobbyists, students and computer enthusiasts.

The author has brought together a wealth of information relevant to computing and telecommunications, from international frequency allocations to international paper sizes, and listed it all under a dozen chapter headings. The areas covered include various codes in use internationally (eg ASCII, Morse, Telex answerback etc), international standards, materials, measurements, radio (signal reporting codes, international frequency allocations, world TV systems etc) and a miscellaneous section with such items as world time and the phonetic and Greek alphabets.

The more elementary information frequently required has not been omitted. There is coverage, for example, of component colour codes and symbols, electrical formulae and a list of useful addresses.

As the author points out in the preface, such a book can never be exhaustive. However, the coverage of this volume is such that this book will be of immense use to anyone who regularly requires technical information in the field of telecommunications.

Collins Professional and Technical Books, £12.00. ISBN 0-246-12253-6.

RADIO BEACON HANDBOOK

By Dr J Trochimczyk

Readers wishing to know more about the long and medium wave radio beacons mentioned by Nigel Cawthorne in this month's *Spectrum Watch* may well be interested in this comprehensive listing of such stations worldwide.

The thousands of stations recorded here are divided into ten geographical regions, with the entries for each separate area presented alphabetically. The book lists over 2,000 beacons from Europe and the Soviet Union alone.

The information given for each beacon (where known) includes callsign, frequency, name and location of station with country, geographical co-ordinates (lat/long), power or range in nautical miles, and some indication of its purpose (civil, military, maritime, etc).

Due to limitations of space the authors have not included details of transmission times or the order in which networks of sequential NDBs operate, and there is very little information included concerning the background and purpose of such radio beacons, but in a book whose prime use is as a reference book for identifying these radio beacons when heard this is not a major drawback.

Published under its German title *Handbuch der Funknavigationshilfen* with an introduction in English, this book is available direct from the publishers.

Wilhelm Herbst Verlag, PO Box 450506, D-5000 Köln 41, West Germany, £9.00 (DM 30). ISBN 3-923 925-00-X.

PROFESSIONAL AND BUSINESS USES OF THE QL

By Colin Lewis

This book is intended to allow the professional user of the new Sinclair QL to set up and use this microcomputer with the minimum of detailed instruction in the mysterious language of computing. The computer is supplied with four software packages, covering word processing, worksheet, database and graphics applications, and the author outlines the use of these for people with no knowledge of programming (and no wish to acquire such knowledge).

From the outset the emphasis is predominantly practical. Before describing the four packages, the author gives foolproof instruction in how to set up the hardware, and examines the essential features of the operating system (QDOS).

There are many useful examples included, and much sensible advice (all tested by the author on a QL/Epson FX-80 printer combination).

The appendix describes a SuperBASIC program which will allow the copying of a complete microdrive cartridge, and is simplicity itself to follow even for those entirely ignorant of programming.

Collins Professional and Technical Books, £7.95. ISBN 0-00-383005-5.

LATEST LITERATURE

Catalogues, etc

Weston Developments

The range of aerials available from Weston Developments, covering the 28-180MHz section of the spectrum, is detailed in a short catalogue available free of charge from the company.

As well as amateur radio applications, the range covers TV/FM DXing, the air and marine bands, cordless phones and satellites. The company will also provide one-off aerials to special order.

To obtain a copy of the catalogue send a foolscap size SAE to the company.

Weston Developments,
33 Cherville Street,
Romsey,
Hampshire SO5 8FB.

Cambridge Electronics Laboratories

Available from Cambridge Electronics is an application bulletin covering the use of sine, square and shaped wave ringing generators in sensitive voice and data equipment. It is intended to update designers on the latest engineering and economic factors pertaining to this particular aspect of telecom devices, and covers the company's PCB-mounting sine-wave generator.

Cambridge Electronics Laboratories,
PO Box 205,
Cambridge,
Massachusetts 02140, USA.

Rapid Recall

Readers who are unfamiliar with the definition of microprocessor benchmarking, or don't know about the Sieve of Eratosthenes, can now obtain an enlightening and informative pamphlet from Rapid Recall.

Entitled *A System/Architecture Approach to Microcomputer Benchmarking,* and written by R Billig and R Cronk of the Digital Equipment Corporation, this interesting publication surveys the more common microprocessor benchmarking techniques. It also describes the various areas of system performance and proposes a performance measuring method with an example of its application.

The pamphlet is available free on application to Rapid Recall.

Rapid Recall Ltd,
Rapid House,
Denmark Street,
High Wycombe,
Bucks HP11 2ER.
Tel: (0494) 26271.

Coutant Electronics

Now available from Coutant Electronics is a new publication designed to help system engineers take advantage of the potential cost/performance benefits that accrue from the use of switch mode power supplies (SMPS).

Entitled *A Guide to Switch Mode Power Supplies,* this 30 page A4 booklet covers the background of SMPS and their counterparts, linear series regulators, then describes in considerable detail all aspects relating to design, specification and application of the equipment.

The booklet is clearly illustrated with both circuit and explanatory diagrams; relevant formulae and tabular data are also included. Additionally, Coutant's ML and SL series of switch mode power supplies are fully described.

Free copies of the publication can be obtained direct from Coutant.

Coutant Electronics Ltd,
Kingsley Avenue,
Ilfracombe,
Devon EX34 8ES.
Tel: (0271) 63781.

Electronic Brokers

A 20 page two colour catalogue, recently published by Electronic Brokers, details the company's vast range of test and computer equipment.

Divided for easy reference into product types, the catalogue has sections on oscilloscopes and logic analysers, multimeters, generators, counters and counter/timers, power supplies, line conditioners and EPROM programmers.

Comprehensive coverage is given of Electronic Brokers' DEC and Tektronix ranges of computer equipment.

Basic technical details are given for each product together with part numbers and prices, many of which are specially discounted.

Electronic Brokers Ltd,
140-146 Camden Street,
London NW1 9PB.

GE Intersil Semiconductor

GE Intersil Semiconductor has published a 24 page short form catalogue detailing the key parameters of its current ranges of transistors and diodes.

The company manufactures a wide variety of semiconductor devices including microwave diodes, ultra high speed switching tunnel diodes, back diodes, programmable unijunctions, silicon control switches, signal and power transistors covering applications ranging from telecommunications, military equipment and computers to industrial control systems, and welding equipment. The catalogue lists more than 700 currently available devices and all the major parameters of each device, which allows design engineers to select a particular device for their application.

Copies of this catalogue are available free of charge upon request.

GE Intersil Semiconductor Division,
Intersil Datel UK Ltd,
Belgrave House,
Basing View,
Basingstoke,
Hants RG21 2YS.
Tel: (0256) 57361.

Danesbury Instruments

Danesbury Instruments have just published the fourth and enlarged edition of their catalogue of test and measurement instruments. It now includes a wide range of scopes, DMM and other digital instruments, signal sources from 0.01Hz to 950MHz including audio, video and TV, counters and timers, plotters and chart-recorders, field strength meters, LCR meters, etc.

Principals include Hitachi, Keithley, Unaohm, Coline, Rikadenki Mitsui, Thandar and other leading makers. Delivery is normally ex-stock.

Danesbury Instruments,
22 Parkway,
Welwyn Garden City,
Hertfordshire AL8 6HG.
Tel: (07073) 38623.

Motorola

Motorola has published a new data book covering the range of Motorola 16/32-bit microcomputer board-level products.

16/32-bit Microcomputer System Components includes chapters on VME-modules, VERSAmodules, I/O modules, operating systems, development systems, system bus technical summaries and customer support. Technical specifications, photos, charts and graphs are used to describe a variety of board, system and software products. The board-level products are based on the M68000 microprocessor family, and include a mono-board microcomputer utilising the MC68020 – Motorola's new, full 32-bit MPU.

A copy may be ordered by requesting DL127 from *Motorola Literature Distribution Center, 616W 24th Street, Tempe, Arizona 85282, USA.*

In addition, a complete brochure on Motorola's integrated circuits for voice/data systems is now available. This comprehensive brochure is a valuable reference tool for all those involved in telecommunication design. It covers Motorola's complete line of ICs for voice/data systems, giving a brief description of available integrated circuits and systems.

Motorola Inc,
Logic and Special Functions Products Division,
3501 Ed Bluestein Blvd,
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Texas 78721, USA.

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DX-TV

RECEPTION REPORTS

Compiled by Keith Hamer and Garry Smith

What had the airwaves to offer DX-TV enthusiasts during November? Quite a lot judging from the selection of reception reports. Tropospheric DX was very poor, so consequently much of the DX was confined to Band I channels. Sporadic-E activity occurred mainly at the beginning and at the end of the month, whereas meteor shower (MS) reception was noted on most days.

November Sporadic-E

November 2nd became extremely active during the morning and at lunchtime, according to several reports. Signals came from Central Europe and the south-east. Strength and quality were comparable to those received during the main summer season, which lasts from May until September. The MUF reached 74MHz and the OIRT FM band favoured by Eastern Bloc countries (between 64MHz and 73MHz) became crowded with stations.

The low-power Austrian channel E3 TV relay at Birkfeld appeared at lunchtime in Derby. It was accompanied by the more usual channel E2a 60KW outlet at Jauerling, as well as signals on E4 from Patscherkofel. The network was showing the PM5544 test pattern with 'ORF FS1' identification. This later switched to the monoscopic Telefunken TO5 test card.

An interesting channel to watch was R2. The 'RS-KH' EZO-type pattern from Ceska Budejovice in Czechoslovakia was alternating with a PM5544 carrying the inscription 'SR1 TV' at the top and 'BRATISLAVA' at the bottom. Later an FuBK test card was noted as co-channel to Czechoslovakia. The identification 'TVR BUCURESTI' could be made out confirming reception from TVR in Rumania.

Trops during the month

It was a very disappointing month for trops. Vigilance towards the end of the month resulted in several Dutch and Belgian stations being seen in Bands I and III but at a very low level. During the evening of the 29th the Dutch NOS-1 outlet on E4 (Lopik) improved in strength to provide 'entertainment quality' signals towards the end of transmissions.

DX log for November

This month we are featuring the DX-TV reception noted by John Bray in Cambridgeshire.

2/11/84: ORF (Austria) E2a displaying the 'ORF FS1' PM5544 and the monoscopic Telefunken TO5 test card; CST (Czechoslovakia) on R1 with the electronic 'RS-KH' EZO-type test pattern; MTV (Hungary) R1 with 'MTV-1 BUDAPEST' PM5544. All reception via Sporadic-E.
11/11/84: RAI (Italy) on channel IB with the 'RAI 1' test card.
12/11/84: RAI with programmes on channel IA.
13/11/84: CST R1 radiating the EZO-type test pattern and later the 'CST 01' FuBK before programme commencement.
14/11/84: SR1 (Sweden) E2 with the 'TV1 SVERIGE' PM5534 test card.
15/11/84: NRK (Norway) from the Melhus transmitter on E2 showing the 'NORGE MELHUS' PM5534.
16/11/84: NRK on channel E2 radiating the 'NORGE GULEN' PM5534.
19/11/84: CST on R1 with the EZO-type test card.
20/11/84: TVE (Spain) on channels E3 and E4 with programmes via Sporadic-E.
21/11/84: ORF E2a showing the Telefunken TO5 monoscopic test card.
23/11/84: RAI on channel IA with test transmissions.

What is DX?

Kevin Jackson of Leeds recently raised an interesting point, and would welcome any feedback on the subject. The above might seem an unusual question but most DXers are able to receive signals on a daily basis and over a greater distance than the optical horizon. Kevin, for instance, can receive the French 'Canal Plus' transmissions from Lille at a distance of 450Km come rain or shine! Admittedly the signals are very weak, even with narrowband receiving equipment, but they can usually be produced on demand.

Similarly, Clive Athowe over in Norfolk can resolve daily signals from the RTE-1 channel H transmitter at Kippure in Eire. From an easterly direction signals from the East German outlet at Inselsberg will appear on channel E5 in Band III on many days if a receiver is left running. Usually reception is only of short duration. On the other hand, a weaker but closer station may only be present during an intense tropospheric lift.

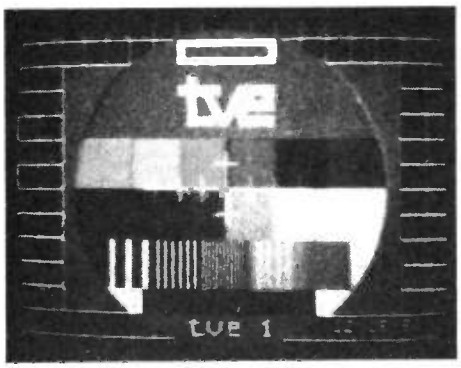
Kevin would like to know just what does qualify as genuine 'DX-TV'.

New French DX club

Pierre Godou has sent a cutting from the October 1984 issue of *'MHz'* for which he writes. He has recently formed the 'Association International de Reception TV à Longue Distance' (or 'AIRTVLD' for short!). It should appeal to all DX enthusiasts who are well versed in French. Further details may be obtained from Pierre at: *16Bd Oscar Leroux, F-35100 Rennes, France.*

Norway's Band I to go?

Iain Menzies has advised that Norwegian television transmissions in Band I are due to be phased out within two years to make way for a 6 metre amateur radio band at 50MHz. Initially only a few experimental licences are to be granted in a similar manner to the UK.



Colour test card radiated by TVE in Spain. Photograph courtesy of John Bray

Current affairs programme caption from TSS in Russia. Received on R1 by John Bray

Digital version of test card 'F' with new stylised identification

There are approximately 21 NRK transmitters distributed throughout the country using Band I frequencies. Twelve of these are high-power and a total of five use channel E2. Unlike most countries where much of the main network consists of high-power, UHF outlets, Norway's is currently formed by transmitters operating in the VHF Bands I and III. These are complemented by very low-power UHF relays in areas shielded from main transmitters.

In view of this it does seem rather strange that licences will be granted. This would lead to the whole network having to be re-engineered in record time.

The cost of DXing

A letter arrived recently from a reader asking about the cost of DXing. Well, there's no definite answer to that since tropo DX can be received on a standard UK TV set during a good lift, provided the aerial is facing the right way (see notes on propagation later in this column).

An improvement in reception will be possible by utilising an aerial with higher gain instead of a standard domestic type. Wideband aerials are available which embrace the entire range of UHF frequencies. These will cost anything from about £20 to £60 depending on the size and type.

Some form of rotation is desirable for best results, and this can be arranged manually if funds do not permit the purchase of an electric rotator. Many DXers find it fascinating to receive long-range signals via Sporadic-E or meteor shower, and regard the expense of buying a rotating system well worthwhile.

Successful reception of DX-TV signals calls for equipment covering Band I frequencies, and most UK receivers will not be fitted with suitable tuners. The same applies for trop DX at Band III.

There are two ways of dealing with Bands I and III reception. One is to purchase a receiver equipped with the necessary channels, ie E2 to E4 in Band I and E5 to E12 in Band III. These channels are found on one or two portables currently available or on imported colour sets. Unfortunately their wide bandwidth IFs mean that selectivity can be rather poor. The reception of adjacent channels such as E2 and R1 during a Sporadic-E opening usually results in signals on these channels floating with each other.

The new 'Canal Plus' service, received in Derby on channel 5

The other method is to use a converter such as the D-100 as mentioned in the December 1984 issue of ***R&EW***. These units are mains-operated and simply plug into the aerial socket of virtually any UHF TV receiver. This particular converter has its own in-built tuner and switching arrangements for narrowband IF which provide enhanced selectivity.

The typical price for a multi-channel portable or a converter is about £65. Aerials need not be too elaborate for Sporadic-E work at Band I frequencies. A home-brew array will suffice. Indeed, a simple dipole with each rod cut to 50 inches will be adequate for initial experimentation.

Reception reports

Harold Brodribb has written again from his St Leonards-on-Sea location with further reports of DX. He first noticed the Sporadic-E opening of November 2nd at 0950 when Russia and Czechoslovakia were encountered on channels R1 and R2. Both networks were radiating test cards. The Russian pattern was the familiar 'Leningrad' type, while from Czechoslovakia Harold saw the 'RS-KH' electronic test card. This was later seen alternating on channel R2 with the 'SR1 TV BRATISLAVA' PM5544.

Using an RL85 monitor for the sound, he counted no less than 29 Eastern European FM stations between 66 and 73.3MHz. At 1215 there were no fewer than 39 of them. Within an hour the opening had completely disappeared.

There were aurorae galore during November, according to Iain Menzies of Aberdeen. They were present on the 11th, 12th, 13th, 14th, 15th and 16th and the whole of Band I was affected at times. Reception included the characteristic 'sleigh-bell' sound which is usually associated with aurorae.

Much of Iain's reception comes from Norway (NRK), and on the 15th the band was open to that country on channels E2, E3 and E4. He was able to identify *'Jewel in the Crown'* at 1940. He also saw Sweden (SR) on test card after closedown at 2200.

Simon Hamer of New Radnor in Powys logged Switzerland on E2 during a lunchtime opening on the 15th. Signals were via Sporadic-E and the '+PTT SRG1' FuBK test card was being radiated. On the 25th, strong and prolonged meteor-shower activity produced viewable pictures on channels E3, R2 and E4 at 1950, but identification was impossible.

Tony Privett of Basingstoke forwarded an excellent log for the month. He too saw the major Sporadic-E opening of the 2nd. Signals identified included CST (Czechoslovakia) on R1 and R2 transmitting the 'RS-KH' EZO-type electronic test card and the PM5544, plus ORF (Austria) on channel E2a with the 'ORF FS1' PM5544 and Telefunken TO5 test cards.

Sporadic-E was also encountered on the 1st, 3rd, 4th, 17th, 20th, 26th and 28th. Spanish and Italian DX formed most of Tony's log. However, on the 20th at 1650 the Icelandic channel E4 outlet of RUV was noted broadcasting the PM5544 test card which carried the identification 'RUV ISLAND'.

In St Neots, John Bray usually has his DX-TV equipment in operation for about 30 minutes before work and again during lunchtime. Fortunately most TV services transmit a test card during these periods, which helps immensely with identification. John has commented that RTBF (the French language service in Belgium) from the Wavre transmitter on E8 and NOS-1 (Netherlands) from Lopik on E4 are seen around midday on an almost daily basis.

An interesting letter arrived from Fred Pilkington G3IAG (Newmarket, Suffolk). He spends a fair amount of his time in warmer climes – on the Spanish Costa del Sol. He's been experimenting with reception of the TV service in neighbouring Gibraltar (GBC) at his location some 90Km away.

Transmissions from GBC are low-power and officially the maximum ERP is 250W. The Gibraltar Broadcasting Corporation have now deserted their previous channel allocation of E11 in favour of E12. The original channel suffered from interference caused by an RTM outlet in Morocco, despite the use of 45 degree polarisation to counteract problems from the horizontal RTM broadcasts.

Needless to say, while Fred is in Spain he can always receive Moroccan TV, and on one visit he even managed to tune into Senegal, which is quite a distance to the south.

Chris Howles telephoned his log through from his Lichfield location. He too enjoyed the Sporadic-E opening of the 2nd. At 1030, TSS (Russia) appeared on channel R1 with the 'Leningrad' test pattern. TSS were also noted on R2 at 1115. At 1133 the PM5544 test card was logged from TVP in Poland on channel R1. As usual it had a darker background than the standard PM5544.

Signals from TVE (Spain) were noted just before lunchtime when the colour electronic test card emerged on channel E3. The clock caption from Austria was the next visitor at 1205 on E2a. This was followed by the PM5544 and Telefunken test cards.

Possibly the highlight of the day came at 1250 when Chris received the FuBK test card from Rumania on channel R2. The identification was 'TVR BUCURESTI'. On November 7th he

received DDR:F on E4 via meteor shower. This was the first time Chris had received signals from East Germany.

Danish TV scene

Its good to know that ***R&EW*** is read in Denmark. Michael Summers Larsen has written from Taastrup near Copenhagen with details about television services in his country.

In 1981 the Danish parliament gave the go-ahead for local television services to be established. At present all the stations operate from transmitters with 200W ERP in the UHF band.

The original idea behind local TV was to provide services for minority groups. Over the past few years most stations have received huge financial backing.

In Copenhagen there are four different organisations. Three of the networks share transmitters and programme time to minimise the vast expenditure required to keep them on the air. It is expected that transmissions from these services will be scrambled in the near future and they will become local 'pay-TV' companies. Apparently the Finnish Salora company will be providing the scrambling equipment. The extra revenue will of course be welcomed by the stations since it has already cost almost 14 million Krone (that's about £1M) to get just one network on the air.

The three main stations in Copenhagen are known as 'Kanal 2', 'Kanal Plus' (not to be confused with the new French service, 'Canal Plus') and 'KKR & T' (an abbreviation for Copenhagen Christian Radio and Television). The deposit charged to watch Kanal 2 is around £50 and the annual subscription is approximately £100. The fourth network is owned by a group of newspaper proprietors. They have invested about £230,000 and, naturally enough, they broadcast mainly items of news.

At present there are two transmitters in service; the north of Copenhagen is served by an outlet on channel E53 and the inner city areas receive programmes on channel E56. The state-owned service of Danmarks Radio (DR) currently radiates the PM5534 test card, but the new stations use the FuBK type. It may well be possible for some DX-TV enthusiasts in the UK to receive the new services during favourable tropospheric conditions. The FuBK test card will be radiated whenever there are no programmes, so the test card could show up anytime during the night!

There are also a number of local radio stations on the air in Denmark – in fact, about 80. They operate in the 100-104MHz spectrum and all transmitters have an ERP of only 10W. In Greater Copenhagen alone there are no less than 14 stations. It is interesting to note that commercials are not allowed on Danish radio and television stations.

Our thanks to Michael (callsign OZ1GOY) for sending the above information about Danish television. We hope to receive photographs of the Danish FuBK test card in the near future.

Notes on propagation

Probably the easiest mode of propagation for DX-TV newcomers to experiment with is 'Tropospherics'. Provided the enthusiast is not too interested in receiving sound channels a domestic UHF TV receiver can be used. If the standard aerial is facing in the right direction signals can be picked up from several European countries, including Belgium, West Germany and the Netherlands.

The troposphere extends to approximately 7,500 metres above the surface of the Earth. At irregular intervals, slow moving areas of high pressure (known as anticyclones) can affect television reception. Anticyclones usually produce clear blue skies by day and clear but cold nights.

Long-distance television signals will be enhanced via improved tropospheric conditions mainly in the UHF bands (Bands IV and V) in the early morning and late evening. Reception will normally come from the near Continent but a cold front at the boundary of a region of high pressure can extend the range. Almost ten years ago an exceptionally good tropospheric opening in the UK produced signals which originated some 900 miles away.

Enthusiasts wishing to try this form of propagation should watch the weather forecasts on BBC 1 at 1758 and 2125, at which times the Atlantic chart is shown featuring high and low pressure systems.

During periods of anticyclonic weather, the Earth warms up during the day because of lack of cloud cover. In the evening the heat which has accumulated during the day is allowed to escape quickly because there is little or no cloud to keep it in. This heating and cooling process leads to inversions of temperature. The troposphere then acts as a waveguide which directs TV signal of above approximately 60MHz back to the Earth.

DX signals can sometimes be received for several days via enhanced tropospheric conditions.

This form of propagation has the advantage that signals are not usually subject to rapid fading and little phase distortion occurs. This is not the case with reception via Sporadic-E, trans-equatorial skip or F2-layer propagation.

Although reception via trop can be quite spectacular, with programmes being enjoyed in full colour at times, signals are only noted infrequently. For more frequent reception enthusiasts can turn to meteor shower propagation. Unfortunately signals can be seen for only very short periods, typically 2 to 5 seconds.

Meteor showers

When meteors enter the Earth's atmosphere they burn up in the E-layer leaving an ionised trail which can reflect TV signals. Meteor shower propagation (often abbreviated to 'MS') can occur at any time of the day or night. Band I frequencies are most likely to be favoured via MS, but occasionally intense ionisation in the E-layer can produce reception in Band III.

Although reception of TV signals via meteor showers is completely random there are certain times of the year when showers appear more frequently. The table shows the predicted meteor shower dates for 1985, and it can be seen that the best showers for DX-TV reception are the Lyrids, Perseids and Geminids. It should be stressed that enthusiasts require a good deal of patience to receive long-distance signals via this mode of propagation. The meteor shower dates were kindly supplied by Peter Sturgess (Derby).

Meteor shower dates for 1985

Shower	Beginning	End	Remarks
Quadrantids	Jan 3rd	Jan 4th	Average
Lyrids	Apr 19th	Apr 22nd	Good
Aquarids	May 1st	May 13th	Long showers
Perseids	Jul 27th	Aug 17th	Very good
Orionids	Oct 15th	Oct 25th	Poor
Taurids	Oct 26th	Nov 16th	Poor
Leonids	Nov 15th	Nov 17th	Fair
Geminids	Dec 9th	Dec 13th	Excellent

Service information

Denmark: According to reports from Copenhagen, the planned second network of Danmarks Radio (DR) will not come into service until at least the end of the decade.

United Kingdom: The digital version of the famous BBC test card 'F' now includes stylised identification. The test card is transmitted prior to 'Ceefax AM' which starts at around 0600 on weekdays. Test card 'F' is also radiated prior to 0900 on BBC 2 following *'Open University'* programmes. Regular BBC trade test transmissions were discontinued in May, 1983. REW

ATV ON THE AIR

Presented by Andy Emmerson G8PTH

Time flies and it is time for our three-monthly round-up of live TV activity again. It really does not seem long since I was writing the last one, but I suppose that means I must have been enjoying myself! Anyway I have a load of letters to condense into a few hundred words here – my thanks to all of you who wrote in. As I write it is mid-December and we have just had a pretty respectable lift on 70 and 23. The local grapevine worked as well this time: whoever is first on phones someone else and so the message is passed on – this way nobody misses out.

Seventy centimetres

Much of our 70cm news is from foreign parts, so let's start with a couple of short reports from foreign ATVers. In Australia John Ingham VK5KG says all local activity is on 70cm, but as they have the use of 420 to 450MHz that may be understandable. A recent development is aeronautical ATV mobile by Geoff Summers VK5GO. He has used both fixed wing model planes and helicopters – sounds like fun.

John is also organising a small group of ATVers to assist with airborne ATV for bush fire spotting on board the State Rescue helicopters.

In Belgium Jose Robat ON7TP writes about the Liege ATV group of which he is a member. About ten folk transmit a two hour programme of news, techniques etc every Saturday at 2pm.

The station's call is ON6PM/T and dates from 1977. Next construction activity is for 24cm.

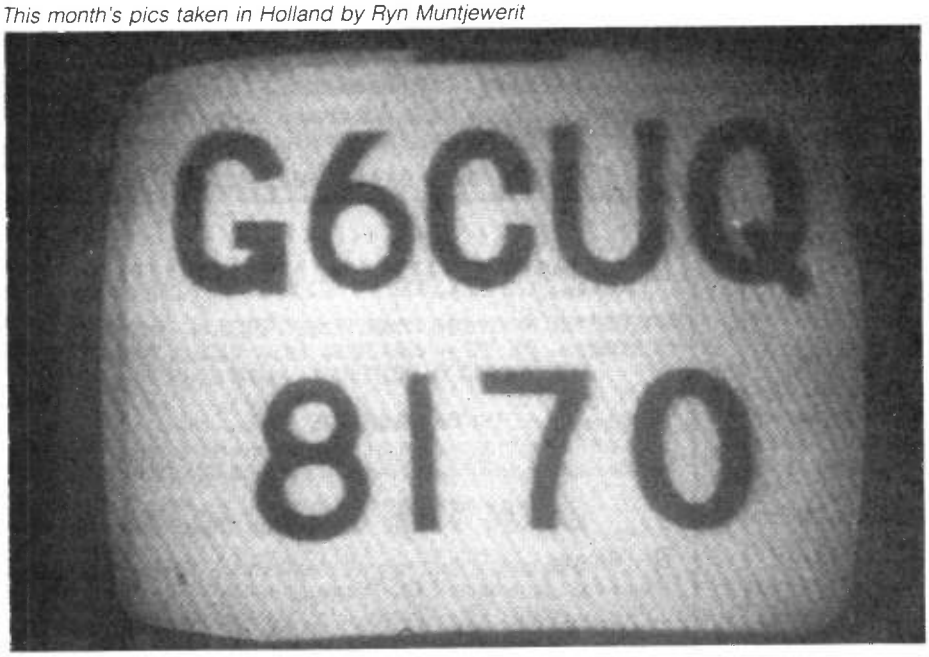
North of the border

I am not sure whether Scotland counts as foreign, but who cares? At the Scottish Amateur Radio Convention twenty-three new TVers were signed up for the BATC. Included among the new stations are Des GM1BVK from Mount Vernon and Bill GM4UBJ in Motherwell after a long apprenticeship as an eyewig. On receive are GM4UQG (Robbie, Hamilton), GM1AYT (John, Milton of Campsie), GM4YAA (John, Paisley), GM6KTP (Ken, Hardgate), GM3ZDH (Bob, Carmunnock) and GM4XLU (Eddie, Cumbernauld). The number of stations now receiving ATV in central Scotland is estimated to be around 50, with about a dozen stations transmitting.

More significant is the greater level of activity. GM3KXQ received pictures from GM1FAI/M in the Bathgate Hills via a reflection off hills on 17th September. 3KXQ uses a Wood & Douglas pre-amp into a modified 70 to 2 transverter, the antenna being a double quad in the roof-space. GM6HFH and GM4UBJ have exchanged P4 both ways, while GM6AOR (George, Longridge) received UBJ at P3. Gordon GM3ULP and Bill GM4UBJ, both in Motherwell, swap P5 with ease. GM4YAA (ex-GM6KEC) in Paisley has given P1 to GM4BVU and GM3ULP and P2 to GM4UBJ over what is a very difficult path, and again must be reflection off the hills. 3ULP has had good reports from GM4CXM, GM4PSV and GM3ZDH. Thanks to Norrie's news agency for this lot.

Returning to the December 10th/11th opening, it seems to have been a patchy affair with lots of ducting (which went straight over the heads of some stations). For some people, especially coastal stations, it was excellent and for most people 70cm was favoured. John G8UWS in Folkestone had a field day on the 11th, making two-ways with ON7XM, ON1KRG, DL9GX, DL6ZAC, DG1KAO, DF7KN, ON6XN, ON1AHT and ON4PT. 'All went dead at 22.39'; nice to see some German stations worked anyway.

This month's pics taken in Holland by Ryn Muntjewerit



The quarter metre band

We start in North Britain this time, so back to the GM4BVU news service. The Moray Firth ATV Group (GM4AVT) held a demonstration of 23cm ATV on November 18th in the Community Centre, Lossiemouth. Ewan Crawford GM4GUQ of Inverness gave a live talk on how the transmitter – kindly loaned by Wood & Douglas – was designed. The programme was transmitted from another building outside the Community Centre. Attendance was very good and included ATV enthusiasts from the Fort William Group. A static display of video equipment was on show during the afternoon. It was a very successful meeting and the first time 23cm ATV had been seen in the Moray area.

Peter G4RNA writes from High Bradfield near Sheffield. He is assisting G3PYB with the latter's design work for you-know-who by putting out an FM TV signal on 1290MHz. As the QTH is 1250 feet above sea level even QRP should do well!

24cm mobile

Allan G8CMQ has been doing a lot of 24cm mobile operation lately. He is running 10W into a single quad element with both horizontals bent 90 degrees

into a 'V' type formation in order to achieve horizontal polarisation. The whole affair is mounted atop a 4ft mast and guyed on the car roof. At the end of October this set-up was installed for a Jamboree on the Air event and during the session P5 pictures were received back at the JOTA main station. These were re-transmitted on 70 to other amateurs. Signal strength remained quite constant over a 5 mile radius although terrain and greater distances made the signal vary considerably. The JOTA station, GB2WES, was run by G1APD.

A few days later Allan and Mike G8LES sent mobile pictures to G6GXG in Romsey. Later, while static mobile in the New Forest, a good contact was made between the mobile and G4WHO in Wimborne, Dorset, a distance of some 20 miles. Pictures from the mobile were also picked up by G1DSO in Havant, who also re-radiated them on 70 for the benefit of other TVers. Allan adds that he is Tx-only whilst mobile, not wishing to upset the local constabulary.

He also took his 10W mobile set-up to St Boniface Down (near Ventnor on the Isle of Wight) on 18th November. P4 or better results were received in Southampton, Havant, Chichester, Worthing and Brighton. G6MPE was the Brighton station: this was a distance of 55 miles and John could see Allan P1 using just a 2 metre quarter-wave whip! Allan says thanks to all who participated, *viz* G6MPE, G4WTV, G8KOE, G5NBX, G6CSX, G1DSO, G6RSV, G1APD and G4JQU.

As Allan was using an omni-aerial all stations could see at once, which makes it a super site for a repeater. Who is going to ask the CAA nicely, then? Another good site is Stoney Cross in the New Forest – Allan made a 20 mile haul to G4WHO in Wimborne from there, again using 10W and an omni-quad.

Odds and ends

More snippets of news from the south coast... The lift of 11th December enabled G6MPE to hook up with F3LP in Le Havre. Another person who has worked France recently is Peter G4LXC (ex-G8EIM and author of several *CQ-TV* articles); he has moved to Hove and worked F1EDM with P5 results for 1.5

watts. He mentions that GB3VR is scheduled to move up to Race Hill, Brighton, from where it should give improved coverage all along the south coast (and to France!). The aerial system is a dual Alford Slot.

Final 24cm word: the dual quad antenna from the *'UHF Compendium'* works very well, giving 11dB gain. Use aluminium mesh or expanded metal for the reflector panel.

Slow-scan events

Some more info from John Cowie GM6KJD in Aberdeen who answered my call for more SSTV reports. John uses an FRG7700 and a 10 metre wire antenna; this feeds audio to a homebrew interface box and then to a BBC microcomputer running homebrew software. Pictures are then saved to disc and dumped to the printer. The interface itself is very similar to the analogue board in a 1983 RadCom, except that the ADC is a ZN449E. This generates three bits of video and syncs for the user port on the BBC micro.

After many months of design, Veroboard fabrication and keyboard bashing John says he fair leapt in the air when he received the first results! Since then he has improved the program and has also written a Tx routine, although unless some activity starts on 2 metres this is of little use. Reception is mainly on 14.230MHz, with European SSTVers and a lot of inconsiderate phone operators.

John says the main disadvantage of the Beeb for SSTV is the limit of 8 bits for the greyscale, though faces are still recognisable. He asks if there is a norm for gamma of SSTV pix – some received images have a lot of black-crushing, which has caused John to design a black-stretcher in the interface. All in all he enjoys the challenge of snatching frames out of warbly tones on 20 metres.

G3WW signs in . . .

G3WW is our only other purveyor of SSTV news, so here goes with the news from Wimblington. More and more Ws are appearing on 20 metres using the new Robot colour system, and have been worked two-way using either 12, 24, 36 or 72 second single frame colour, the last two being today (9/12/84) in the persons of WA2WFF and N2WA, near neighbours in Patterson NJ. Both use Robot 1200C models with Tandy TRS-80 computers for control and graphics generation. They will be able to work both our G2BAR and G4UFV, also 1200C-equipped.

Recent short-skip on 20m enabled G3WW and G3WIL to swap Robot 450C colour pictures, while on 2 metres G2BAR and G3WW have played out each other's 'replays' in colour.

The various SC model scan converters around Europe supplied by Volker Wrasse (DL2RZ) continue to give their owners 2x SSTV QSOs with G3WW in 8, 16 and 32 second b/w frames and 24 (and now 48) seconds single frame colour. Eight seconds b/w and 3x3 or 2x2 RGB remain the standard type of SSTV transmissions.

Shuttle SSTV?

There seems to be a possibility of SSTV being transmitted from next April's scheduled 51-H space shuttle flight of Tony England W0ORE. In the USA 'concern' – a surprisingly mild word for it considering the letter which the editor of *A5* magazine has written to ARRL's KD1N thereon – has been expressed over the picture mode formats to be used! Maybe the RSGB can reserve the UK two metre SSTVers a QRM-free frequency? 'Some hope!!' opines Richard.

Richard received a letter from Maurice Webb G1AMR on Merseyside saying that SSTV is on the increase around there. All are using ZX-Spectrum computers and Maurice has sent pix to five other stations, none of whom could send him any back but they hoped to record his signals. He has had two-ways with G3CCH, G4NJI, G8NSE, G3KLL, G6YBC, G6ICR, G1BIF and G6HDD (the last three using Spectrums).

G3WW was apparently the only person to write to the RSGB protesting at the loss of *'SSTV Scene'* (speaks for itself!) but recommends the new magazine *'SSTV Today'*. Write to him at the callbook address for details.

Richard comments on the latest update of the Wraase SC-1 (with 'excellent 48 sec single frame colour') and the Robot 450C, as well as the DRAE SSTV receive-only converter. He concludes that there is no real 'best-buy': all three offer different facilities at different prices, so you tend to get what you pay for...! REW

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QSO

On these pages we present details of interesting contacts from clubs and individuals. We would be happy to receive any similar items from readers

VIP radio amateur

It may surprise some people to learn that the new Premier of India, Rajiv Gandhi, is a radio amateur and holds the callsign VU2RG.

He became interested in amateur radio after seeing his uncle's station in operation, and passed the 1st Grade examination in 1974. Since then he has been active on 21/28MHz and, more recently, 144-146MHz.

During his school years he had an interest in electronics, and was a keen homebrewer. Consequently he made his first homebrew HF CW/SSB transceiver and a two-element cubical quad antenna within three months of obtaining his callsign. This set up remained in use until 1980.

Rajiv Gandhi has a keen interest in computers, and as well as promoting their use in schools is making a constant effort to relax the burden of import duty and tax, etc on the Indian electronics industry (through his efforts Indian radio amateurs currently enjoy duty-free import of amateur equipment, accessories and components).

On a more personal level of involvement he has displayed an interest in packet radio (with the aim of using his FT-1 and TR7850).

He was also instrumental in gaining permission to set up a repeater for 144-146MHz, which has the callsign VU2RRG. Equipment for this has yet to arrive from abroad. When it does, this will be the first repeater in India.

His wife, Sonia, passed the 1st Grade exam in 1975 and has the callsign VU2SON. Their son Rahul (14) and daughter Priyanka (12) are currently studying for the exam, and hope to be on the air in the near future.

Amateur radio can be an immensely useful hobby in India, where it has been shown that communication between amateurs can be maintained during cyclone and flood emergency periods after civil communication has failed.

Canal Plus litigation

It seems that all is not sweetness and light in the offices of Canal Plus, the new French TV service described in January's ***R & EW.***

A court order was recently issued to prevent the technical radio magazine *Radio Plans* from publishing information which would allow the illegal decoding of the TV transmissions (ie without paying the subscription).

The object of the code is, of course, to prevent anyone who has not paid for a decoder unit from watching the channel. The eight figure code is changed every month, each subscriber having his own code. The technical staff of Canal Plus had previously claimed that the decoder unit was pirate-proof.

As Keith Hamer and Garry Smith have mentioned, the Canal Plus service can be received in parts of southern England, although not in exactly watchable form (due to the lack of a decoder).

For those interested, a Parisian daily newspaper, *Le Quotidien,* has published a drawing of the electronic code (minus instructions on code-breaking). Consequently this paper is being sued by Canal Plus (whom *Le Quotidien* calls 'Banal Plus', a reflection on its programming).

Used equipment auction

After many years of trading in secondhand amateur radio equipment, G3RCQ Electronics has launched another service to would-be buyers and sellers of secondhand equipment.

The service is to operate alongside *List-a-Rig*, which is an advertising service. *List-a-Rig* is free to anyone who sends G3RCQ an SAE. There is a small charge if you wish to enter your for sale/wanted advert onto the list.

The new service is to be called G3RCQ's Auctions. The auctions will be monthly and conducted in the first instance via post. Potential sellers of equipment will send details to G3RCQ together with a small fee which is returned if the equipment is not sold. In return G3RCQ will include full details onto *List-a-Rig* together with national advertising.

Each month there will be a list of equipment placed in the amateur radio press. Participants in the auction will be requested to send their bids to G3RCQ who will then forward them onto the owner of the equipment. The owner then selects the highest bid and contacts the bidder direct to conduct the sale.

Further details can be obtained from David Cole G3RCQ, 65 Cecil Avenue, Hornchurch, Essex RM11 2NA.

RTTY contest

Peter Adams G6LZB has sent us some information on the BARTG Autumn RTTY Contest 1984:

'The vast increase in our membership certainly showed in the number of stations active throughout the contest. However, I still only received 22 logs for the single operator section and 13 for the multi-operator section. I wonder why stations don't send them in?

'Conditions certainly improved during the contest and a number of stations worked well into the Continent. The best DX contact appeared to be the one between GW2OP and PE1IML at 682Km.

'With such a large number of stations active, the possibility of claims for the VHF Century Award seem very good'.

Here are some of the comments lifted from logs:

'Had trouble getting my back off the bed'. – G6YYP.

'I wonder which lucky devil worked Jack in Luxembourg after I had phoned him for a sked? Perhaps that station would like to refund the cost of two phone calls'! – G8RBY.

'Pity about some of the high power stations working on the same frequency as other stations'. – G6KHW.

'Most enjoyable – marred by some stations' apparent incapability to listen after QSY to check frequencies not in use'. – G4VXF.

G6LZB reports that 191 British stations participated in the contest.

The Spring VHF/UHF RTTY Contest will take place between 1800 GMT on Saturday 13 April and 1200 GMT on Sunday 14 April. Further information and contest rules are available from the *BARTG Contest Manager, Peter Adams G6LZB, 464 Whippendell Road, Watford, Herts WD1 7PT.* Completed logs should also be sent to this address.

Weather satellites

All those interested in weather and other remote sensing satellites are invited to an informal meeting to be held at the VHF Convention at Sandown Park on the 23rd March 1985. The meeting is convened by Henry Neale, Fishersgate, Sutton St James Spalding, Lincolnshire. After his recent appeals for interested people to contact him he has received 278 letters. If you write to Henry expressing an interest in remote sensing satellites please enclose an SAE.

Repeater group

We have received information from the Cambridge Repeater Group, one of the more active groups of its kind, that GB3PS (RM3) is now on the air from Barkway.

The repeater transmits on 1297.05MHz continuously, radiating an FSK (inaudible on FM) callsign every 15 seconds.

Also, GB3PY (RB14), mentioned in *QSO* December 1984, has been successfully moved to a new site on the roof of the Pye Telecom Site One complex in north Cambridge. It was reported in the latest newsletter that: 'Such was the amount of volunteer effort that the repeater was removed from Madingley at

dinner-time and fully reinstated at Cambridge by 5pm'.

One of the other repeaters at Barkway, GB3PT (RB12), is experiencing little activity at the moment. This repeater runs stacked dipole aerials similar to GB3PY.

Apparently, work on the new receiver for GB3PI (R6 Barkway) is progressing well and hopefully this will be fitted within the next couple of months.

The Cambridge Repeater Group will be holding a 'Junk Sale Extravaganza' on 24 February at 10.30am. The venue is Pye Telecommunications Ltd, St Andrews Road, Cambridge.

Anybody interested in the group can find members in the Green Dragon, Water Lane, Cambridge every Friday lunchtime.

ATV contest

Congratulations to G8MNY for coming first on 70cm and to G8VBC for winning the 23cm section in the September ATV contest. Certainly conditions were not at their best: G6WOR/P, who could almost see the Channel, worked no continentals and ON7ZI and GU8FBO were the only DX stations available in the south – and then for only a few minutes at a time!

However, the level of activity on both 70 and 23 was better than ever and shows just how much interest continues to grow in ATV.

We received the following comments from contestants:

'We hoped this year would have better weather but a storm in the middle of the night took out the 70cm mast at 45 feet, which snapped in two but was put back up to 28 feet within an hour at 0345!' – G8MNY.

'Diabolical weather! How about fixing up the international contest for summertime?' – G6WOR/P.

'Conditions were horrible but I enjoyed it.' – G8VBC.

'The 23cm receiver could have been better if we had fitted the masthead pre-amp the right way round!' – Anon.

ATV enthusiasts' attention is drawn to the annual Summerfun Contest scheduled for 0900 to 1600 GMT on Sunday 16th June, this being the first ATV contest using the new Maidenhead locators.

Please note that the contest organiser (G3VZV QTHr) prefers entries on BATC log sheets, available from him on receipt of an SAE.

Another date for your diary is May 5th, when the British Amateur TV Club will hold its renowned annual rally/exhibition at Rugby.

Packet radio

At the RSGB VHF Convention at Sandown Park on 23 March 1985 Ian Wade G3NRW, of the British Amateur Radio Teleprinter Group (BARTG), is presenting a talk entitled 'How Packet Radio Works'.

The lecture is aimed at beginners to data communications, and Ian first takes a brief look at the problems of RTTY and AMTOR which initially prompted the development of packet radio, then moves on to the basic features of the AX. 25 packet radio protocol. Many practical uses of packet radio will be described, together with details of the hardware and software needed to run it. The talk is illustrated throughout with slides, tape recordings and visual aids, including a very special piece of string . . .

Ian has already presented this talk on behalf of BARTG to several clubs in the south-east of England, and finds that interest in this exciting new mode of data communication is increasing rapidly. For more information contact him at *7 Daubeney Close, Harlington, Dunstable, Beds LU5 6NF.*

Mobile rally

The Maidstone Amateur Radio Society will be holding its bi-annual mobile rally on 26 May at 11am. The venue is the *MCA Sportscentre, Melrose Close, Cripple Street, Maidstone ME15 6BD.*

Racal user group

Readers who are users of Racal products will be interested to know that the organiser of the Racal User Group, Peter Barker G8BBZ, has changed address.

He can now be contacted at *15 Epping Green, Woodhall Farm, Hemel Hempstead, Herts HP27 7JP.* REW

NOTES FROM THE PAST

Learning from experiments. . .

Among the interesting letters received this month is one concerning Lossev's experiments with oscillating crystals. The correspondent still has his notebooks (circa 1924) containing a summary of Lossev's original articles dealing with experiments with natural and synthetic zincite used with steel catswhiskers.

For those with a taste for experimental work with transistors he recommends a collection of papers *'Some Conducting Materials'* (Henisch 1951) published by Butterworth, which includes one on *'Crystal Triode Action In Natural Lead Sulphide'*. It seems that galena can produce the transistor effect almost, but not quite, as well as germanium – the natural being somewhat superior to the synthetic in this respect.

Since galena is cheap and easily obtainable, there would appear to be considerable scope in this field for those with a taste for original research.

It is by no means unusual for important and original ideas to spring from this kind of experiment. Frequently discoveries only remotely related to the work on hand are made. The history of invention is studded with examples of major discoveries being made by people with infinite enthusiasm for following up a specialised interest, and when concentrating on some significant (and often unexpected) result suddenly perceiving a new use to which it can be put.

Hide and seek

The new low-power BBC relay station serving the Folkestone area, which came into service on 23rd December on 206 metres, is temporarily being operated from a caravan measuring only twenty by seven feet. With the building situation in its present state, a similar caravan relay station, which will be sited near Barnstaple, is also to be put into service very shortly. While this neatly solves the housing problem, I think we can take it for granted that the BBC won't play ball and fit them out with portable aerials so they can join in the fun and games when local clubs have their field days!

A reader asks if any special equipment is necessary to enable photographs to be taken of cathode ray tube traces and TV pictures. Oddly enough, I did make some of the earliest published pictures of TV – back in early 1937, I believe. I remember I took an exposure reading and obstinately decided it was all cock-eyed, and then proceeded on trial and error lines – only to find out the meter was near enough right after all.

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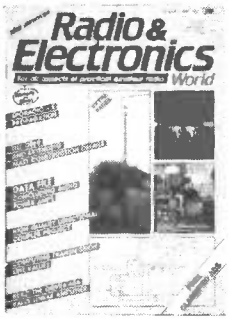
For all aspects of practical amateur radio

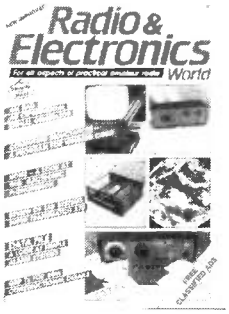
BACK ISSUE SERVICE

All issues from October 1981 onwards are still available, with the exceptions of January and February 1982, and December 1983. All orders must be pre-paid, the cost of each issue being £1.00 inclusive of postage and packing. A contents index spanning the issues from October 1981 to September 1983 is available on receipt of a stamped addressed envelope. To ensure that you don't miss any future issues, we suggest that you place a regular order with your newsagent or complete the subscription order form found in this issue.

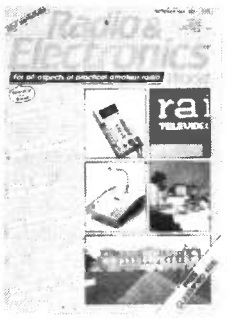
JULY 1984
Projects — VLF converter, a unit for the very low frequency; Teleprinter Terminal Interface; Multifunction Test Instrument, a versatile piece of test equipment; Building the Fortop TVT-437; Improving Indoor Aerials, getting better reception without an aerial amplifier; Logic Probe for CMOS and TTL's.
Features; Amplicon Digital Panel Printer; Oscar 10; Yaesu FC102 Review; Data File — audio power amplifiers; Images of the World, a new publication review.



AUGUST 1984
Projects – High Quality Directional Coupler, a coupler for frequencies above 432 MHz; QQV06-40A Linear amplifier, a 100 watt valve linear amplifier, 40ft Tilt-over and extending mast, a home construction project; One night's work, adapting a portable typewriter; BBC Micro volume control; TV and Video interface.
Features – Twenty Questions; Sporadic-E propagation; Data File – Audio amplifiers; BBC Micro Morse tutor; Improving Resistors; Data Communication; Computing Transmission Lines

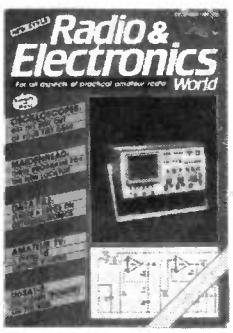


SEPTEMBER 1984
Projects – Low Power Transmitter, an 80m CW design, AM RAD, an experimental signal generator; Spectrum Analyser, further update on this project; Five Station Scanner, an add on unit for the 720 channel airband receiver.
Features – Computing Inductances, a program for winding coils; Data File, a look at alarm systems; Satellite Update, more information about weather satellites; Noise, a look at this electronic phenomenon; Distance and Bearing Program, an aid for station location; Super-Transmatch, a review of Tau Systems ATU kit.



OCTOBER 1984
Projects — Base Mic, construct this processor controlled accessory; One night's work, build an indoor UHF TV aerial.
Features — Modems, the link between computers and radio; Non-linear elements, a look at multipliers; Data File, continuing the look at alarm systems; SSTV for the BBC Micro, getting started in this mode; Testing! Testing! how to use your test gear: multimeters.

NOVEMBER 1984
Features – cellular mobile radio; computing attenuators for calculating resistance values; small aerials, coping with problems of space; 27-29MHz conversions; Data File, concluding the series on security systems; FETs – a beginner's guide; Non-Linear elements, log and anti-log; QSO, interesting contacts from clubs and individuals; ATV on the air, with a look at a range of aerials for the average pocket.



DECEMBER 1984
Features — Cable TV goes on the air; Simple speech processor, a simple device to increase a stations 'talk power', Uosat-2 telemetry, decoding satellite signals using this BBC Micro program; Tatung Einstein review; Testing! Testing! oscilloscopes; ATV — getting started; Data File, LED circuits and opto electronic principles; Morse test, self study course; Computing Maidenhead, three programs relating to the Universal (Maidenhead) Locator; QSO, club and event news; ATV on the Air, with news from the air waves.

JANUARY 1985
Features — Canal Plus, Europe's first VHF/UHF pay-TV service; Phased Vertical Arrays, a computer program for the design and modelling of antenna systems; Russian Satellites, the first part of a series looking at the equipment used to decode signals from the navigation satellites; RF small signal amplifiers, some of the obstacles encountered when constructing radio frequency devices; Principles of Z80 Morse Decoding; Data File, a look at LED sequencer and analogue-value indicator circuits.

FEBRUARY 1985
Features — Airborne TV, some fascinating experiments involving TV transmissions from an aircraft in flight: Direct Broadcast by Satellite, the systems of TV reception via satellite: Touch-sensitive joystick, zapping Klingons is made quicker and easier with this project: The Horseshoe Nail Syndrome, Brian Dale questions the policies of major manufacturers with regard to chip production: Long Waves Live on!, Nigel Cawthorne details the problems of design for long wave broadcasting: Low-pass Filter, clean up your signals with this relatively cheap high power project: Russian Satellites – Part two, an explanation of the complete receive section: Data File, more opto-electronics from Ray Marston.

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For all aspects of practical amateur radio

SYNCHRONOUS RECTIFIERS

Dr CJD Catto examines the use of synchronous rectifiers and phase-sensitive detector devices

SPECTRUM WATCH

This new series continues with Nigel Cawthorne taking a further look at what's new on the airwaves

DATA FILE

Light-sensitive and light-controlling circuits form the basis of Ray Marston's informative feature next month

WEATHER SATELLITES

Terry Weatherley describes a new ROM for the BBC Micro which aids in the display of weather satellite pictures on this computer

934MHz – DEAD OR ALIVE?

Some popular misconceptions are laid low by Andy Emmerson's review of 934MHz activity

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FOR SALE

■ Icom IC120 transceiver – covers 1260 to 1300MHz FM. Perfect condition but no activity round here. Nice price (for you!) £250. Andrew Emmerson G8PTH. Tel: Northampton (0604) 844130.

■ Receiver AR88D 500KHz to 32MHz. Has just had a new set of valves fitted. Very good condition £60 ono. Tel: Hebburn, Tyne and Wear (0632) 834876 after 6pm.

■ Seven Agavox audio typist's dictaphone recorders in working order. With console for connecting to internal office telephone system, with all accessories, including stethoscope headphones, connecting cables, blank discs etc, any offers or WHY in high band PMR equipment or frequency meter/counter. Walker, 23 Forest Hill, Yeovil, Somerset BA20 2PF. Tel: Yeovil 25225.

■ Tektronix storage oscilloscope type 564, dual trace, 10MHz 10mV, good condition with manuals £245. Hewlett Packard current source model 6181B £55. Marconi signal generator model TF144H/S £55. T J L Haley. Tel: (01) 868 4221.

■ Contents of service workshop, includes 2 Tektronix scopes and 3 type CA plug-in units, Airmec RF/AM signal generator type 201, Airmec LF signal generator type 252, Goltermann level meter. All with spare valves handbooks and all working except one scope requires attention on EHT circuitry. Some valves, components, meters, etc. All at £200. But would prefer exchange for gauge 00/N. Rolling stock, locomotives, especially kits, trams, locos etc. Tel: (0526) 7222.

■ Experimenter's computer range, etc for sale to finance and leave room for new project. Carriage, etc arranged with buyer(s). Science of Cambridge Mk14 (SC/MP based) with RAM/10 chip, revised and original monitors, extra RAM fitted, homebrew working keypad on board, RC clock (original crystal provided), separate 1/2 amp PSU, cassette interface built but not fitted, full documentation plus 'A Guide to SC/MP Programming' by Drury and Smart. The machine has a fault in its display. Compukit UK101 (6502 based and related to the Ohio Superboard) with 8K RAM on board, Premier's CEGMON and BASIC 1/3/4 chips fitted, and power-on reset. Built boards for Centronics interface, 3-channel sound, and 128K RAM (64K fitted), ready for fitting. Computer has an annoying but not serious fault – it doesn't like even line numbers in BASIC. In ex-PO metal case, with improved PSU on rear panel. All documents plus 10 cassettes of software, two volumes + of OSI/Compukit Users Group Newsletter, and some tips from Premier. NASCOM II (Z80 based) with 32K RAM, PSU, and sound board, in custom wooden rack for access and protection. Cassette interface 300/1200/2400 baud, and many cassettes of software. Full documentation. Ex-mainframe core memory system boards for 32K by 13 bits. All core planes and circuit boards except power regulator card (complete data included in the full documentation). PSU/test unit (gives all 5 required power rails), but no card frame. Stock of valves from experiments on radio, TV and analogue computers, including singles and multiples, diodes, triodes, tetrodes and pentodes; mostly miniature, but some subminiature or larger types. A few bases and screening cans included. 16K RAM cards (1 kit, 1 built) from Greenweld's ('metal computer') InteRak range. Can be stretched to 32K per card using spare gates if you don't mind piggybacking 16K RAM chips. Cards are international standard size (4½ x 8in), with 43 way Isbus edge connector. Homebrew 5-way backplane available if required, though Isbus card is (much) better. Boards assume a Z80 processor controlling refresh. Contact Jim Henry. Tel: Belfast (0232) 640251 (home) or 701444 (office).

■ Grundig Stenorette dictaphone plus access. Philips AG8108G 7in reel 3 speed recorder. Cabinet auto 35mm slide projector plus mags. WWII No19 MkIII ZA10479 transceiver complete and with mains power pack. Offers tel: Tasker, (0476) 860421.

■ Enthusiast's clearout. Relays assorted types. Some new. 10 sent for £8 post free or call to pick and choose. Multicore cable, new, 20 way telephone type. Any length cut off roll for 45p/metre. 100 metres or more for 30p/metre (up to 600 metres available). Component packs, resistors, capacitors, transistors, 100 assorted, mostly new, £2.50 post free. Other items for callers. Details tel: (021) 472 3688. Bailey, 40 Seymour Close, Selly Park, Birmingham B29 7JD.

■ Yaesu FT7B HF 50W mobile + FM, swap for BBC A or B computer. Mr I Foord G8JDE, 53 Russell Row, Lewes, E Sussex. Tel: (Lewes) 478080.

■ Yaesu FRG7700M with FRV770 140-170 converter, FRT7700 ATU, FRA7700 active antenna, all boxed and in excellent condition £375. Tel: Formby (07048) 77322.

■ R1000 communications receiver. 200KHz-30MHz includes dc kit. Can deliver/demonstrate South-East England £215. Also wanted: back issues of Radio & Electronics World Jan and Feb 1982 can collect. Tel: (07914) 2823 (Brighton area) evenings/weekends only.

■ Exchange Vic 20 computer, 1530 Datasette, manuals, plus 'Adventure Land' cartridge for HF Tx/Rx for new Class 'A' op, eg FR50/FL50 or WHY. Must be in good condition/working order. G0AIF. Tel: Blandford (0258) 53670 (evenings).

■ Yaesu FT1, all modes £800 ono. Diawa cross needle ATU, nearest offer £90. Yaesu 290R £200. Sharp V22000 music centre, vertical tracking deck APSS cassette Dolby portable, mint cond, cost £310 offers. 12in bass drivers £10. Goodmans Sanyo Walkman £25. VB2300 £25. TRS80 VDU cassette, loads of cass, Morse program £80. Mr Baines, 53 Maple Road, Penge SE20.

■ TRS-80 model 1, level 2, 16K, with numeric keypad, 32K expansion interface, voice recognition unit, PSUs, software, cables, manuals, technical manuals, books etc. Any offers? Will split. Tel: Leeds (0532) 695876.

■ 934MHz transceiver. With 50ft of co-axial cable and plug, also four element beam antenna. This is the latest in CB transceivers, still under guarantee. Equipment cost new £340, will sell the lot for £250. The transceiver is still in box and only used twice. Mint condition as new very good buy. Tel: Galston 820654 anytime. James Auld, 48 Meadowside Road, Galston, Ayrshire KA4 8BQ, Scotland.

■ TRS80 64K model 4 twin disk computer with Seikosha DMP. Quality printer complete with paper, 130+disks, disk storage, many books, programs w/pros, file, reports, edit/ass scripsit and manuals, mains filter system, lots more sell offers, or exchange for VHF/UHF base station WHY 4 months old, for this bargain tel: 04738 5526.

■ Canon C50 photocopier, working but needs slight attention on carriage. Have a set of spare boards for above, hence bargain price of £50 ovno. Signal generator, type 101, UHF 400-610MHz, £35 ono. Singer electric typewriter, needs attention, has the RTTY tape punch £5 ono. Jim Anderson. Tel: Tamworth 51591.

■ Yaesu FT730, mint £225. Microwave Modules converter 144MHz, 4-6MHz IF, £12. Withers 28MHz to 144MHz transverter, QQV0640 PA £50. Marconi signal generator TF390G/3 8-145MHz £25. TF801B for spares, £15. Hudson FM208 transceiver, high band £25. Knightkit valve-voltmeter £25. Pye base Tx, QQV0640 PA on 2 metres, AM £15. Silver Sentinel 9MHz SSB filter and carrier crystals £15. Practical Wireless VDU, Elektor Morse decoder boards, built but need setting up, £7 each. Ham Radio (USA) Morse keyboard, working £12. All with handbooks or data. Offers considered. 8MHz crystals for 2 metre repeater input channels, £1 each. Also some 9MHz, same price. G3NXT. Tel: Kings Lynn (0553) 828339.

■ Icom IC-255E 2m FM 25W transceiver, scanning mic, mobile mount, boxed £125. Tel: Earls Colne (07875) 3442.

■ 108 Wireless Worlds, 1950 to 1959, including complete year issues (1950, 1954, 1955, 1956, 1957). Also 1960 to 1976, 22 random issues. B Crown, 9 York House, Stratton Close, Edgware, Middx HA8 6QA. Tel: (01) 952 0396.

.058 Liner 430, Liner 2 homebrew PSU/stand handbooks £150. FDK 700E mobile 2m FM Tmcvr mounting bracket etc boxed £110. UHF FM Tncvr Burndept mobile 5W o/p working and Xtalled on RB0 £40. A Jefford, 78 Churchill Road, Exmouth, Devon. Tel: Exmouth (0395) 264872.

■ Television camera, black and white, for sale £80. Tel: (0684) 310683 (Worcestershire).

■ Packer absorption frequency meter WB-2 90-200MHz £20; Howland West audio stereo headphones CIS-550 £10; Microwave Modules RTTY to TV converter MM2000 £50; G3WPO 2metre pre-amp 12V dc £5; 29MHz pre-amp Telford Communications £7; 9mm Specto projector with wide angle lens; Pathe Prince camera with holder for Zenascope lens and W/A finder WHY or cash. Dr A C Gee, 21 Romany Road, Oulton Broad, Lowestoft, Suffolk NR32 3PJ. Tel: (0502) 65726.

■ Yaesu FT200 HF transceiver with PSU and 2 mics, all 10m Xtals fitted, also fan £200 ovno, complete with manual. Delivery extra. Donald Berry G4DFB QTHr. Tel: 01 360 3614.

■ Gresham P/S GX 30/10A/13 30V £25. SX27 VHF Rx 27-143MHz, works OK but really needs a pre-amp £20. Heathkit SB102 Tx/Rx 10-80m 'ham' bands, immaculate condx, inc p/pack spkr, mike and Junker key £210. AVO CT38 240V multimeter £10. Very rare Howard 450 Rx c 1937. Xtal filter etc, a collectors Rx £90. US Signal Corp freq meter, BC906D. Needs VT172 tube + 45V supply £10. 18 AVT, by Hy-Gain, vertical £35. Hokushin HF-5R 5 band radial kit for above £20. Exchanges for Rx on above gear. Tel: Milton Keynes (0908) 314095.

■ Pensioner selling up. R206 in excellent working order. 1155 – suitable for spares. Power supply unit No8. Haddon transformer 230V 24V@ 2amps. Other t/formers 325-0-325 (ex T1194) others 250-0-250 plus LT. Many valves mostly boxed. EF80, 6B7, 6V6, 6H6, 6C6, 6D6, KTW62, 42, EF50, 6SG7 plus many others. New telescopic aerial with all accessories. Extends to about 27ft. Lots of odds and ends. H McMillan, 26 Tuckett Road, Woodhouse Eaves, Loughborough, Leics LE12 8SE. Tel: (0509) 890940.

■ Govt surplus wireless equipt handbook, £5 p&p £1. Radio TV Servicing 1973/74, new condition, £9 p&p £1. Taylor AM signal generator 100KHz to 240MHz, £60. Collect or pay carriage extra. Large quantity of resistors, bags of 100 £1.50 inc p&p. Pye Westminster W30 AM handbook, £7.50 p&p £1. C Cooper. Tel: Cosham (0705) 386254.

■ Nascom-2 Z80 computer 64K RAM. Basic and machine code programming. Two 8-bit ports. Full circuit, details and help available. £170 ono. Tel: (01) 398 1948.

■ Receivers: radio shack DX300 digital 100KHz-30MHz £100. Racal RA17 CW matching Redifon RA10 ISB/SSB adaptor. New front panel, £125. Eddystone EB35 AM/FM 150KHz-22MHz plus FM band. All CW handbooks/circuits, fully working and good clean condx. W Blanchard, The Trundle, Tower Hill, Dorking, Surrey RH4 2AN. Tel: (0306) 884359.

■ Microdot 2. Trios TM201A, TM401A. FRT7700

ATU. 160m – marine – 80m Rx. AR22 2m synth Rx. LPM 885 SWR/wattmeter 20 – 200 – 1000W. 2m and 70cm mobile antennae. pF1 nicad charger. Icom spkr/mic. W/mach motor. Seafarer log needs attn. 16ft x 2in Ali pole. Components of all types for disposal. All items vgc, with manuals, nicads and chargers as appropriate. Lockwood G3XLL, Gislingham, Eye, Suffolk IP23 8HX. Tel: Mellis 596.

■ Sharp MZ80B computer, 72K RAM, 40/80 character display, typewriter style keyboard and Pnumeric pad, monitor and cassette deck built in. 'Basic', 'Assembler', books, software. £395 ono or swap for amateur radio gear. Tel: Abingdon 27703.

■ Quantity of analogue panel meters, all ex-WD and mostly in original packing. All movements and ranges 0-1mA 0-10mA 10-0-10mA 50μA 0-300V, all sizes available. Must clear garage. £2.00 each for meters, plus postage or better buyer sort through and collect. Also Philips Pal colour pattern generator type PM5508 in excellent working condition £120. Mike Townsend, 16 Laton Avenue, Henwick Park, Worcester. Tel: (0905) 42608 (anytime).

■ 144MHz PA boards, 1 watt drive, 80 watts plus output, 24V supply. £25. Switching power supply, output 24V 10A £42. 1n0 and 10n disc ceramics, 50 for £1.00. 2V lead-acid battery and charger £1.95. Tel: 0277 214406.

WANTED

■ RGB decoder panel complete, in working order, for Ecko CTV 262. Panel as used in Pye 731 chassis series. Details, prices etc to Barlow, 18 South Ave, Heywood, Lancs. Postal charges and exps will be paid. Tel: Heywood (0706) 624604.

■ Change wheels for AVO wave winder or complete wave winder. Enamelled copper wire, especially fabric covered. HP410C in any condition. Sulzer frequency standard. USM140 main frame. Large sheets glass fibre PCB, both SS and DS. S J Branson, 111 Park Road, Peterborough PE1 2TR. Tel: (0733) 67604.

■ Manual or copy or circuit for Dumont oscilloscope type 241. D E Simmons, 132 Oadby Road, Wigston, Leics. Tel 886605.

■ Belcom liner 2 or liner 10 2m or 10m Tx/Rx. WHY. Contact G4ANW tel: (0730) 61859.

■ FT707 with PSU, must be in good working order WHY. Tel: Formby (07048) 77322.

■ Oscilloscope suitable for amateur Scopex or Crotech ideal, J Anderson, 22 Landau House, Chatsworth Road, London NW2 4BW.

■ Any useful ham related software for Osborne 1 80 column. Also for Microlog ATR6800 or Sharp PC-1251. Particularly Oscar 10, log listings and search, propagation, etc. G3AAG. 'Upper Durford', Petersfield, Hants. Tel: (0730) 892143 or 893534.

■ Tektronix EHT transformer, circuit designation T801, part number 120-0308-00 for oscilloscope 545B or details of number of turns to rewind same. Also 6AU5GT valve; Bird Thruline elements, particularly 250H; info on Atari disk drive; Heathkit barograph ID2090E; Bare Commodore 64 – no cassette unit or books etc needed; 'Pan and Tilt' head; IEEE to RS232 bi-directional interface unit. A McCann, 105 Todd Lane North, Lostock Hall, Preston, Lancs PR5 5UP. Tel: (0772) 37815.

■ B40D must be immac and most recent model. Enquiries to Mr Baines, 53 Maple Road, Penge SE20.

■ Low Band AM transceiver suitable for 86MHz. Prefer Pye Motafone but would consider valve set if very low price. Tel: (0602) 256178.

■ Non-working HRO receivers or parts for spares. Condition unimportant. Also original HRO PSUs and speaker units. Tel: St Albans 39333.

■ Circuit and construction details for varicap type tuner, to cover 200MHz to 400MHz AM with IF O/P on 144MHz 2 metre band or complete Rx circuit with IF/AF stages. Also any mods to trick the logic of the Fairmate AS-32320 scanning Rx to cover the freq gaps. A Blair, 55 Burnopfield Road, Rowlands Gill, Tyne and Wear NE39 1QQ.

■ One Storno personal radio as used by HM forces etc. In working condition, with or without crystals, plus original rechargeable battery and manual. Reasonable price will be paid. Mr Martin Byrne, 4A Portnall Road, London W9.

■ DF loop 27MHz and 144MHz, either kit or ready made. L Williams, 16 Glan-Yr-Ystrad, Johnstown, Carmarthen, Dyfed SA31 3NY. Tel: (0267) 234777.

■ Handbooks or circuits for Hitachi VM910E/K monitor, Pye 848008 monitor, Hewlett Packard signal generator 608C. G3NXT. Tel: Kings Lynn 828339.

■ Circuit diagram req for Leson power base mic, type DT251 with built-in processor. Chris Dadds, 55 Worlaby Road, Scartho, Grimsby, South HumberP-side. Tel: (0472) 70399.

■ Ex-govt manuals for wireless sets: TR1196, CNY, B2, AMK111, ZC1, WS12, WS13, WS21, WSA40, WSA41, good price paid, others wanted but too many to list WHY. Bob Warner, 45 Eastry Close, Ashford, Kent. Tel: (0233) 36185.

■ 16mm GSAP Bell Howell cine gun camera, ex govt electric, 24Vdc drive mag load. Also 16mm Beaulieu R16. One with faults considered no lens required. Have Bendix Rx GC WWII aircraft Rx and Hewlett Packard scope (no valves) for sparks or repair. Wanted old microphones pre-war. Tel: Melksham (0225) 706795.

■ Circuit diagram for WKS1001. Please contact Mr Martin Fuller, 37 Greenfield Close, Eccles, Nr Maidstone, Kent. Tel: M/Stone 70485.

■ AR88, £60 offered. RA17L, £160 offered, copy of Amateur Radio Techniques, Pat Hawker 1972 edition, £5 offered. Copy of The Radio Amateurs Handbook, 1970 or thereabouts, £6 offered. Valve type GDO. Valves 7360, 6BZ6, 6BA6, 2 of each type. Four gang variable capacitor, about 320pF per section. Plug in coils and bases, 180-10 metres. H Lear, Flat 86, Block 205, Wensley Road, Reading, Berks.

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NOTTINGHAM: TEL: 0602 280267
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	single	£47.00	£88.00	£158.00
	double	£94.00	£176.00	£316.00

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For **ALL** Amateur Radio, Vintage Wireless, Audio, Television, Video, Test Equipment etc. etc.
Thousands stocked. LSAE enquiries and quote **by return** plus **FREE** catalogue.

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Advanced machine code programs with split-screen type-ahead operation, any baud rate, saveable memories etc.

AMTOR
Superb full-feature system for Dragon 32/64 & Tandy at one third the cost of current alternatives.

MORSE DECODER & SENDER
MORSE TUTOR: BASICODE KIT
Available for Dragon 32/64. Large SAE for software/hardware details.

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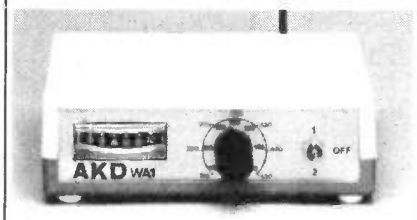

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ADVERTISERS INDEX

Radio & Electronics World
For all aspects of practical amateur radio

ADVERTISING RATES & INFORMATION

ABC membership approved pending first audit Jan-Dec 1984

DISPLAY AD RATES

depth mm x width mm	ad space	1 issue	series rates for consecutive insertions: 3 issues	6 issues	12 issues
61 x 90	⅛page	£91.00	£86.00	£82.00	£73.00
128 x 90 or 61 x 186	¼ page	£160.00	£150.00	£145.00	£125.00
128 x 186 or 263 x 90	½ page	£305.00	£290.00	£275.00	£245.00
263 x 186	1 page	£590.00	£560.00	£530.00	£475.00
263 x 394	double page	£1140.00	£1070.00	£1020.00	£910.00

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colour rates exclude cost of separations

depth mm x width mm	ad space	1 issue	series rates for consecutive insertions: 3 issues	6 issues	12 issues
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*Dates affected by public holidays

issue	colour & mono proof ad	mono no proof and small ad	mono artwork	on sale thurs
Apr 85	14 Feb 85	20 Feb 85	22 Feb 85	11 Mar 85
May 85	7 Mar 85	13 Mar 85	15 Mar 85	11 Apr 85
Jun 85	11 Apr 85	17 Apr 85	19 Apr 85	9 May 85
Jul 85	16 May 85	22 May 85	24 May 85	13 Jun 85

CONDITIONS & INFORMATION

SERIES RATES
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Previous copy will automatically be repeated if no further copy is received.
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Display Ad and Small Ad series rate contracts are not interchangeable.

If series rate contract is cancelled, the advertiser will be liable to pay the unearned series discount already taken.

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No additional charges for typesetting or illustrations (except for colour separations).
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Colour Ad rates do not include the cost of separations.

Printed — web-offset.

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All single insertion ads are accepted on a pre-payment basis only, unless an account is held.
Accounts will be opened for series rate advertisers subject to satisfactory credit references.
Accounts are strictly net and must be settled by publication date.

FOR FURTHER INFORMATION CONTACT
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(0277) 219876

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Commission to approved advertising agencies is 10%.

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10% discount if advertising in both Radio & Electronics World and Amateur Radio. A voucher copy will be sent to Display and Colour advertisers only.
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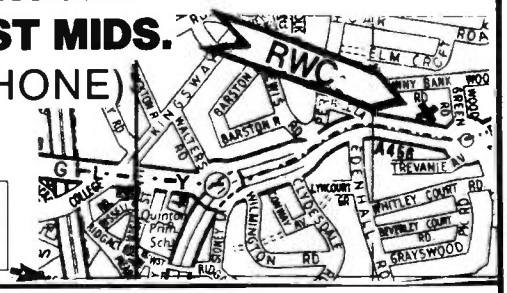
Tel: 021-421 8201/2 (24 HR ANSWERPHONE)



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WHILE STOCKS LAST
2 Mtrs

TURN THAT BEAM KOPEK ROTATORS

50KG LOADING
FULL 1 YEAR WARRANTY OUTSTANDING VALUE **£38.50**

GOOD QUALITY FIELD-STRENGTH VSWR METERS

IN-LINE DESIGN WORK VERY WELL ON 2 METRES
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FREE * HB9CV
***NI-CADS**
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£199 *CHARGER
3 LEFT*POST INC
70cms

NEW RANGE OF LINEAR AMPLIFIERS FROM RAYCOM LTD SEND SAE FOR FULL DETAILS

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FOR DNT 40FM AND LCL2740
INC 2-XTALS + XTAL FILTER
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THIS PRICE INCLUDES
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3 ONLY

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Professional 4 channel 27MHz hand helds inc case & batteries. "Crystals fitted." Superb quality easily convts to 10 Mtrs. Fantastic value only **£37.95** "Ni-Cads and charger available." "2 watts output"

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QUALITY LOWE TX40G
*SUPER SENSITIVE RECEIVER
*4 WATTS OUTPUT
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*REPEATER OFFSET INCLUDED

ONLY 50 AVAILABLE
JOIN IN THE GROWING ACTION ON TEN-FM. ONLY **£49.50**

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RWC MOD KIT FOR LC71367 CHIPS (IE MOST CB RIGS) NOW AVAILABLE. IT WILL MODIFY ANY CB RADIO, WITH THE ABOVE PLL CHIP UP TO AND BEYOND 30MHZ IN 10KHZ. 40 CHANNEL STEPS. THE UNIT HAS BUILT IN REPEATER OFF-SET, AND HAS ONLY 8 WIRES TO SOLDER INTO EXISTING RADIO. WITH RE-ADJUSTMENTS ON VCO, RX, RF & TXRF. PRICE ONLY **£22.50** FOR BUILT AND TESTED MODULE AND FULL INSTRUCTIONS. SEE OTHER ADVERTISEMENTS.

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FT225R/D, IC202E/S, FRG-7, IC2E, TR2300 BEST PRICES PAID - WORKING OR NOT

FARNELL 10 AMP OK ON 2MTU

PSU REGULATED AND FULLY PROTECTED SWITCH (LIST **£185**) MODE LAST FEW **£39.50**

AKD WAVE METER. A MUST FOR ALL VHF STATIONS **£24.95 inc p**
THE BEST

SPECIAL
'8 C SIZE NI-CADS
1800MaH
£18.50

RWC'S HB9CV

2 Mtrs **£6.99.**
70Cms **£5.99**
post & pck **£1.00.**

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FOR FDK YAESU ICOM TRIO ETC. EG 25W 2 MTRE WRITE FOR FULL LIST. FROM **£35.00**

BARGAIN
ONE ONLY COMPUTATOR ROTATOR CT1000
½ PRICE **£299**

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HOXIN
DC GROUND ½ WAVE MOBILE ANT
INC PL259 +CO-AX **£9.50**
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S0239 MOUNT
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Thorn 10Ω 20W (3500) R751 Safety Resistor	75p
Pye 713 Speaker 5" × 3" 70Ω	1.00
Pye 713 Complete Tube Base Panel with Focus Slider & Leads	2.75
Pye 713 Control Knobs	4 for 50p
Tube Base Socket ITT CVC32	45p
Tube Base Socket Thorn 3000/8000 etc	50p
IC Inserter 16 Pin	50p
Large IC Extractor	50p
Crystal 4.43MHz	65p
EHT Lead & Cap for Split Diode Lopt	90p
Anode Cap	47p
Sanyo Anode Cap Assy + Lead 12TCD-CT-1G	65p
Degause Thermistors. PT37P. ITT/GEC	35p
Degause VOR E299D/HP230 3000/8000	25p
Casters Set of 4	1.90
Double Fuse Holder on Small Pax Board 20mm type	10p
Single Fuse Holder on Small Pax Board 20mm type	5p
Direct Panel Mounting 20mm Fuse Clips	(pair) 15p
Single Fuse Holder on Small Pax Board. As per early 3000 mains input	6p
EHT Cable	Metre 25p
13A Plugs	12 for 4.80
BF259 with Heatsink	14p
TIP110 with Heatsink	40p
L129/130/131 Coil	10p
6MHz Ceramic Filter	25p
OL700 (Philips) Chroma Delay Line	1.00
DL50 Chroma Delay Line	1.00
T9006A Lum Delay Line	1.00
8K5/9K Lum. Delay Line	65p
Plastic Cover for 3K5 SP8385	5p
TX9 Back Ground Control 10K	15p
TX9 Gain Control 100R	15p
1500 Metal Chassis Supports Pair	40p
Thorn 8K5 Focus Pot	2.40
Thorn 4000 Focus Pot	2.75
Thorn 18Ω 9W (3K5) R752	30p

SERVICE AIDS

Ambersil MS4 Silicone Grease	12oz	2.15
Ambersil Freezer	12oz	1.99
Ambersil Amberlube	6oz	1.89
Ambersil Ambertron	16oz	1.95
Ambersil Anti-Static Screen Cleaner	7oz	1.95
Ambersil 40+ Protective Lubricant	14.1oz	2.15
Ambersil Amberclens Foaming Cleaner	13oz	1.26
Ambersil Circuit Lacquer	14oz	2.15

THICK FILM RESISTOR UNITS

3500 Thorn (5 Pin Connection) video	1.70
4000 Thorn (4 Pin Connection)	1.90
725/731 Pye (6 Pin Connection)	2.20
713 Pye (6 Pin Connection)	2.20

FUSES

20mm			1¼"	
50MA	10 for 70p	250MA	10 for	65p
315MA A/S	10 for 50p	750MA	10 for	65p
500MA	10 for 50p	7A	10 for	50p
1A	10 for 50p	10A	10 for	50p
2.5A	10 for 1.00	20A	10 for	50p
3.15A	10 for 1.00	50A	10 for	50p

Thorn Mains TX 3000/3500	7.50
Thorn Mains TX 8000/8500	10.00
Thorn S.O.P.T 8000/8500	3.50
Thorn Scan TX 3000/3500	6.00
Thorn EHT TX 3000/3500	6.00
Thorn LOPT 9600	12.00
Thorn LOPT 1615	7.25
Thorn LOPT 1590/91	7.25
Thorn LOPT 8000	9.80
Thorn LOPT 8500	9.80
Thorn LOPT TX9	9.85
Pye LOPT 713	10.00
Pye LOPT 725	9.85
Pye LOPT 731	10.18
Philips LOPT G9	8.80
Philips LOPT G11	13.75
GEC LOPT 3113	7.40
Diode Split LOPT AT2076/35	14.75
Sanyo LOPT AM–WM–21	6.75
Sanyo LOPT AM–WM–4	7.30
Philips LOPT G8	7.80
Sanyo LOPT (CW21) 4-2751-44700	5.00
ITT LOPT CVC5-9	9.60
ITT LOPT CVC30	8.75
ITT LOPT CVC45	9.75
Baird 8750	10.25
Baird 8752	10.25
Korting AZ9100	10.25
Korting B92-170	10.25
Korting AZ2101	10.25
Korting AZ2103	10.25
Korting ZTR1001	10.25
Siemens V1155	11.75
Siemens V1823	11.75
Zanussi BS2222	10.25
Zanussi BS2223	10.25
Salora FR0057	10.25
Salora FR0029	10.25

300 Mixed Resistors	1.50
300 Mixed Capacitors	1.50
150 Mixed Electrolytics	2.00
100 W/W Resistors	1.00
20 Mixed Conv Pots	1.00
40 Mixed Pots	1.50
20 Mixed Sliders	1.00
40 Mixed Presets	60p
20 Mixed VDR & Thermistors	1.00
20 Mixed Ferrite Cores	50p
100 Mixed Ceramic Discs	1.00
20 Mixed Valve Bases	1.00

10 Spark Gaps	1.00
10–16 pin Quil IC Socket	90p
20 Assorted TV Knobs	1.00
10–16 pin Quil to Dil IC Socket	90p
100 Mixed Diodes	1.00
50 Mixed Mica Washers	65p
300 Mixed Resistors & Capacitors	1.50
10–16 pin Dil to Dil IC Socket	1.00
50 Electrolytics & 50 Capacitors	1.00
50 Mixed Poly Capacitors	1.00
30 Mixed Neons & Bulbs	1.00

AC128	39	BC172	9	BC559	8	BF167	24
AC131	40	BC174B	23	BC595	8	BF173	29
AC138	40	BC177	24	BCX33	22	BF179	32
AC141K	39	BC182LB	12	BCX34	11	BF180	33
AC142K	38	BC183L	12	BD115	49	BF181	30
AC153	39	BC184L	13	BD131	30	BF184	30
AC176	33	BC187	24	BD132	46	BF185	30
AC176K/		BC204	15	BD133	59	BF194	16
AC128K	93	BC208	9	BD139	36	BF196	16
AC188	38	BC212L	9	BD140	38	BF197	15
AD142	1.18	BC213L	12	BD144	1.70	BF198	19
AD143	1.08	BC237	12	BD150	50	BF199	15
AD149	98	BC238B	8	BD163	98	BF223	18
AD161	32	BC238L	8	BD201	74	BF224	19
AD162	32	BC250A	15	BD203	78	BF238	20
AD263	1.05	BC251	8	BD204	99	BF240	9
AF127	45	BC252A	20	BD222	48	BF241	21
AF139	38	BC294	37	BD225	52	BF255	10
AF239	41	BC301	32	BD232	50	BF256S	20
BC107	15	BC303	31	BD233	60	BF257	28
BC108	15	BC307	10	BD234	60	BF259	28
BC109	15	BC308	8	BD237	55	BF271	25
BC115	16	BC309	14	BD238	65	BF274	11
BC117	21	BC327	18	BD241	59	BF337	29
BC125	26	BC328	18	BD244	85	BF338	34
BC126	23	BC337	17	BD278A	81	BF355	40
BC139	27	BC338	17	BD386	68	BF362	50
BC141	34	BC347	8	BD433	71	BF391	21
BC142	30	BC394	8	BD437	83	BF394	16
BC143	31	BC454	8	BD592	1.20	BF422	47
BC147	12	BC455	8	BD589	1.20	BF423	53
BC148	12	BC456	10	BD677G	1.35	BF450	43
BC149	12	BC460	40	BD707	95	BF453	53
BC153	16	BC463	22	BD708	95	BF458	37
BC154OR	16	BC546	8	BDX10	93	BF459	40
BC154YL	16	BC547	12	BDY20	1.09	BF461	59
BC157	12	BC548	12	BDY82	99	BF566B	35
BC158	12	BC549	8	BF137	20	BF596	15
BC159	15	BC557	10	BF153	20	BF694	16
BC171	9	BC558	10	BF154	25	BF757	62
						BFR52	31

BFR62	28	NKT276	20				
BFR81	29	NKT453	1.65				
BFR87	25	OT112	1.92				
BFR90	1.74	OT121	2.08				
BFR91	2.08	R1038	80				
BFT42	30	R1039	80				
BFT43	30	R2008B	1.40				
BFX38	40	R2010B	1.10				
BFY50	30	R2030	70				
BFY51	34	R2265	1.30				
BFY52	34	R2305	80				
BRC116	1.50	R2322	50				
BRC1693	1.43	R2443	25				
BU105	1.00	RCA16446	30				
BU126	1.10	RCA16599	1.25				
BU207	1.05	RCA16600	1.40				
BU208	1.15	RCA16799	1.13				
BU208A	1.15	RCA16800	1.42				
BU326A	1.30	RCA16802	1.38				
BU407	1.70	S1299	2.25				
BU408	2.76	S28000	1.25				
BU500	2.30	S6080A/B	3.50				
BU526	2.46	T6050V	1.30				
BU807	2.94	T6052V	1.30				
C1129	9	T9003V	1.25				
C1172B	9	T9010V	1.45				
E5386	54	T9053V	1.30				
E9003	28	T9054V	1.00				
E9005	25	T9039V	1.10				
ME0404	10	TIC45X	50				
ME0412	10	TIC46	48				
ME6002	10	TIC106C	40				
MJ2501	2.36	TIP29	42				
MJ3001	2.21	TIP30	42				
MJE182	47	TIP31	35				
MJE340	50	TIP32	43				
MJE520	50	TIP33	61				
MJE2955	1.40	TIP41	42				
MJE3055	1.50	TIP42	45				
NKT241W	8	TIP110	61				
NKT241G	8	TIS91	25				
NKT241Y	8	ZTX550	30				

INTEGRATED CIRCUITS

BRC1330	1.40	SN76013ND	1.80	TBA530	1.26	TDA2002	2.80
BRC3064	1.00	SN76023N	1.80	TBA540	1.00	TOA2030	2.10
BRC/M/200	1.00	SN76033N	2.00	TBA550Q	1.82	TDA2522	2.10
BRC/M/300	1.00	SN76115	2.00	TBA560C	1.50	TDA2530	2.61
CA3060	1.58	SN76131N	1.58	TBA641	2.05	TDA2540	3.50
LM1303P	1.48	SN76226N	1.25	TBA651	2.50	TDA2560	3.50
ML231B	2.20	SN76227N	1.00	TBA720A	2.49	TDA2581	3.00
ML237B	2.00	SN76530P	1.30	TBA750	2.20	TDA2591	1.96
ML239B	2.86	SN76622N	1.00	TBA800	1.62	TDA2611A	1.95
MC1327AP	1.25	SN76660N	80p	TBA810S	1.00	TDA2640	2.90
MC1358P	1.30	SN76666N	75p	TBA810AS	1.00	TDA2690A	1.50
MC1455P	18p	SN76744	1.92	TBA920	2.08	TDA3560	6.00
MC14516BCP	60p	TA7117P	1.00	TBA950	1.95	TDA9503	2.90
SAA1025	7.20	TA7109AP	2.80	TBA1440	1.92	TCEP100	3.48
SAA1124	4.50	TAA611	1.40	TCA270SA	1.05	TEA1009	1.95
SAA5010	6.00	TBA120B	1.20	TCA270C	1.05	MC14426P	4.80
SL432A	1.80	TBA120C	1.20	TCA270CQ	1.05	MC14429P	4.50
SL1430	2.50	TBA120CQ	70p	TDA1004A	4.00	MC14514	5.00
SN15846N	60p	TBA120S	70p	TDA1035T	3.50	UA758PC	2.50
SN74123N	65p	TBA120U	1.00	TDA1037	2.72	UA1008A	2.66
SN74154N	1.40	TBA395	1.00	TDA1200	2.42	ULN2165	1.30
SN76001N	1.40	TBA480Q	1.40	TDA1270	3.90	ULN2216A	1.25
SN76110N	1.14	TBA510	1.90	TDA1327	2.53	UPC1365C	5.75
						SC9488P	1.40
						SC9511P	1.40
						SW153	2.50

Thorn 8/8K5 ex equip panels untested		**Thorn 3/3K5 ex equip panels untested**		Thorn 4000 PSU panel ex-factory	2.50
PSU	2.88	PSU	3.75	Thorn 3K5 beam limiter board new	1.75
FTB	3.75	LTB	3.75	Thorn 3K5 PSU bottom board PC206 new	2.75
Decoder	4.00	Video	2.50	Thorn 3K5 IF panel new	3.00
		Chroma	2.00	Thorn 3/3K5. EHT & scan TX + R2008B on alum chassis ex-equip	1.80
Thorn 9K ex equip panels untested		FTB	2.75	Thorn 8/8K5 damaged FTB for spares	1.25
PSU	12.00	IF	1.75	Thorn 8/8K5 damaged decoder for spares	2.25
Decoder	5.00	Conv. 3K	3.00		
		Conv. 3K5	3.75		
Thorn 9K6 ex equip panel untested		Autovox Oecoder FG/01 new boxed	5.00		
Decoder	5.75	Thorn 4000 Convergence panel ex-factory	3.75		

UHF TV Aerial for portable Indoor Aerial Parabolic Type Reflector to Help Combat Ghosting Problems	50p	Coax Plugs	10 for 1.65
		Band Change Switch Assy. Pye 725	40p
	2.50	Flush Mounting TV/FM Diplexer	1.00
Line Connectors	38p	Switched Flush Fitting Aerial Outlet	1.00

Pye 78+161	50p
Pye 147+260	50p
Thorn 56+1K+47+12	1.24
Thorn 50+40+1K5	60p
Thorn 128+16+1K7+ 116+462+126	50p
Thorn 120+72+300	50p
RBM 250+14+58 (TV161)	63p
Pye 3R5+15+45 (713)	90p
Philips 2R2+682	90p
Philips 47R	52p
Thorn 350+20+148+ 1K5+317	1.40
Thorn 6+1+100	92p
Thorn 3000 Metal	1.45
Thorn 8/8500 Plastic	1.45

EHT TRAYS

Thorn 3000	5.50
Thorn 8000	3.50
Thorn 8500	6.00
Thorn 9000	7.90
Thorn 9600	6.00
Thorn 900/950	1.50
Pye 713 5 lead	5.97
Pye 725	6.35
Decca Bradford	5.00
Baird 8750	7.10
Korting AZ9100	7.10
Philips G8 (520)	6.50
Philips G8 (550)	6.50
Universal	5.00

MULTISECTION CAPACITORS

100+150+150	350V 50p	200+200+100	350V 55p
220+47	350V 65p	200+200+75+25	350V 60p
200+150+50	350V 60p	50+50+8	300V 55p
200+200+100	325V 54p	100+50+100	350V 55p
32+32+16	275V 52p	100+150+50	350V 55p
200+200+100+32	350V 70p	2500+2500 (Thorn 8K)	63V 1.20
100+50+150	350V 58p	150+150+100	300V 1.80
400+400	200V 72p	200+47	250V 65p
32+32+16	350V 52p	500+500 175V	
200+32+300+100	350V 70p	Thorn TX9	1.00
225+25	350V 50p	175+100+100	350V
200+200+100	350V 70p	Thorn 3K5	2.25
200+100	325V 65p	400 400V Thorn 9K	2.50
200+100+100+50	350V 60p	470 250V Philips G11	1.50

CAN TYPES

0.2MF 250V	50p	1250MF 40V	50p
2MF 250V	50p	1250MF 50V	50p
22MF 275V	50p	1500MF 70V Thorn 3K	1.00
50MF 275V	50p	1500MF 100V	1.05
100MF 150V	65p	2000MF 30V	50p
100MF 250V	70p	2200MF 40V Thorn 4K	95p
100MF 450V	75p	2200MF 63V Philips G9	1.25
220MF 400V Thorn 9K	1.30	2500MF 35V	65p
220MF 450V Thorn 4K	1.30	2500MF 40V	65p
400MF 350V Thorn 8K	1.00	3000MF 30V	65p
800MF 250V Print type	80p	3300MF 16V	50p
800MF 250V	70p	3300MF 25V	60p
		4700MF 16V	72p
		4700MF 40V	75p

Thorn/Decca/GEC On/Off Switch. Push to make	75p
Philips G11 On/Off Switch. Push to make	75p
ITT CVC8 On/Off Switch	65p
ITT CVC9 On/Off Switch + Relay	90p
Philips G8 On/Off Switch	75p
Thorn 3/3500 A1 Switch	50p
Thorn 4000 A1 Switch	50p
Korting Shift Pot 50Ω	65p
2.5A Push to make on/off switch	15p

DIODES

AA112	8p	IN4003	4p
AA119	8p	IN4004	5p
AA143	8p	IN4005	5p
BA115	8p	IN4006	5p
BA154	8p	IN4007	6p
BB103	8p	IN4148	2p
BB105B	30	IN4149	6p
BR103	52p	IN4742A	8p
BT106	1.50	IN5254B	8p
BT116	1.00	IN5349	14p
BT119	2.56	IN5400	12p
BT120	2.82	IN5401	12p
BT151 650	1.00	IN5402	14p
BY127	12p	IN5404	12p
BY188	16p	IN5406	16p
BY204	26p	IN5408	16p
BY206	16p	IS025	8p
BY207	16p	IS131	8p
BY208/800	38p	IS1658	8p
BY223	95p	MR854	35p
BY225	1.20	SKE1/02	20p
BY227	28p	MCR106/1	1.00
BY298	22p	MCR406	35p
BYX22/400	30p	2N4444	1.50
BYX55/600	30p	Y827	80p
BYX71/350	80p	Y969	75p
BZV15 C12R	1.16	ZX150	12p
BZV15 C24R	1.16	OA91	5p
IN60	8p	MCR106/7	1.00
IN2070	8p	MCR106/8	1.50
IN4001	4p	TD3F800H	2.80
IN4002	4p	TD3F800R	3.00
		BY255	30p