Morgan

JANUARY 1985 99p

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AERIAL DESIGN:
PHASED VERTICAL ARRAYS

IN THE CELLS:
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DATA FILE:
LED ANALOGUE-VALUE INDICATOR CIRCUITS

RF SIGNAL AMPS:
PITFALLS OF DESIGN AND CONSTRUCTION

SPECIAL READERS' OFFER
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EAST CORNWALL COMPONENTS

TRANSISTORS DIODES

Type	Price (£)
AC126	0.35
AC127	0.30
AC128	0.30
AC128K	0.34
AC132	0.55
AC141	0.25
AC141	0.26
AC141K	0.40
AC142	0.45
AC142K	0.45
AC151	0.45
AC152	0.45
AC176	0.28
AC176K	0.46
AC187	0.42
AC187K	0.48
AC188	0.44
AC188K	0.50
ACY40	0.88
AD142	1.10
AD143	1.10
AD149	0.96
AD161	0.42
AD162	0.42
AD161/AD162	0.98
AF106	0.48
AF114	2.10
AF115	2.10
AF116	2.10
AF117	2.10
AF118	0.85
AF121	0.62
AF124	0.48
AF125	0.48
AF127	0.48
AF139	0.68
AF178	0.68
AF239	0.68
AF279S	0.72
AL100	2.50
AL102	5.90
AL113	2.20
ASY80	1.75
AU110	1.40
AY102	4.32
BA102	0.34
BA110	0.67
BA121	0.40
BA129	0.38
BA148	0.16
BA154	0.08
BA155	0.10
BA156	0.08
BA157	0.28
BA164	0.14
BB104B	0.52
BB105B	0.30
BB105G	0.48
BB110B	0.42
BC107	0.10
A or B	0.12

Type	Price (£)
BC108	0.10
A B or C	0.12
BC113	0.14
BC114	0.12
BC115	0.12
BC116	0.15
BC117	0.22
BC118	0.17
BC119	0.30
BC125	0.12
BC140	0.28
BC141	0.42
BC142	0.30
BC143	0.30
BC147	0.08
A or B	0.10
BC148	0.08
A or B	0.10
BC149	0.09
BC157	0.10
BC158	0.10
BC159	0.10
BC160	0.30
BC161	0.30
BC168B	0.12
BC169C	0.10
BC170	0.14
BC170B	0.12
BC171	0.10
BC171	0.10
A or B	0.08
BC172	0.08
A or B	0.12
BC177	0.20
BC178A	0.22
BC182	0.08
A B or C	0.09
BC182L	0.09
A B or C	0.09
BC183	0.09
A B or C	0.10
BC183L	0.06
A B or C	0.12
BC184	0.10
A B or C	0.10
BC207	0.15
BC208	0.16
BC212	0.09
A B or C	0.10
BC212L	0.08
A B or C	0.10
BC213	0.09
A or B	0.10
BC213L	0.10
A or B	0.11
BC237	0.10
BC238	0.12
BC239	0.14
BC251	0.12
A B or C	0.14
BC301	0.30

Type	Price (£)
BC302	0.32
BC303	0.32
BC307	0.10
BC308A	0.10
BC323	0.99
BC327	0.14
BC328	0.14
BC337	0.12
BC338	0.12
BC350	0.14
BC440	0.30
BC441	0.32
BC461	0.32
BC547	0.12
BC548	0.12
BC549	0.12
BC550	0.18
BC550C	0.18
BC557	0.12
BC558	0.12
BCX34	0.27
BCY70	0.15
BCY71	0.17
BCY72	0.18
BCZ10	1.68
BCZ11	1.45
BD124P	0.80
BC130Y	0.68
BD131	0.34
BD132	0.34
BD131/BD132	0.95
BD135	0.32
BD136	0.36
BD137	0.36
BD138	0.38
BD139	0.38
BD140	0.38
BD144	160
BD145	1.82
BD150A	0.51
BD159	0.65
BD160	1.65
BD165	0.45
BD175	0.60
BD182	1.00
BD183	1.10
BD184	1.20
BD201	0.72
BD202	0.87
BD204	0.80
BD222	0.80
BD225	0.86
BD232	0.45
BD233	0.60
BD234	0.62
BD235	0.63
BD236	0.63
BD237	0.66
BD238	0.56
BD241	0.60
BD243A	0.80

Type	Price (£)
BD244A	0.65
BD375	0.32
BD410	0.76
BD434	0.68
BD436	0.68
BD437	0.76
BD438	0.75
BD439	0.68
BD507	0.48
BD508	0.53
BD509	0.54
BD510	0.48
BD517	0.56
BD520	0.66
BD699	1.25
BD707	0.88
BDX18	2.35
BDX32	2.10
BF115	0.32
BF117	0.54
BF119	0.82
BF120	0.38
BF123	0.40
BF125	0.42
BF127	0.38
BF152	0.16
BF154	0.23
BF157	0.40
BF158	0.22
BF159	0.24
BF160	0.23
BF167	0.30
BF173	0.25
BF177	0.42
BF178	0.30
BF179	0.32
BF180	0.35
BF181	0.35
BF182	0.32
BF183	0.32
BF184	0.32
BF185	0.32
BF194	0.08
BF195	0.10
BF196	0.10
BF197	0.10
BF198	0.14
BF199	0.16
BF200	0.48
BF222	0.48
BF224	0.20
BF224J	0.16
BF240	0.20
BF241	0.26
BF244	0.26
BF244A	0.28
BF244C	0.24
BF245A	0.26
BF254	0.15
BF256	0.40
BF257	0.32

Type	Price (£)
BF258	0.30
BF259	0.32
BF262	0.30
BF263	0.30
BF270	0.30
BF271	0.26
BF273	0.18
BF274	0.32
BF323	0.92
BF336	0.26
BF337	0.26
BF338	0.26
BF355	0.42
BF363	0.82
BF367	0.24
BF371	0.27
BF422	0.38
BF450	0.38
BF457	0.33
BF458	0.36
BF459	0.44
BFR39	0.22
BFR40	0.22
BFR41	0.22
BFR51	0.30
BFR61	0.32
BFR62	0.28
BFR88	0.34
BFR90	1.72
BFT41	0.38
BFT43	0.36
BFW10	0.79
BFW44	0.76
BFX29	0.28
BFX30	0.30
BFX80	3.56
BFX84	0.24
BFX85	0.26
BFX86	0.26
BFX87	0.26
BFX89	0.65
BFY50	0.21
BFY51	0.21
BFY52	0.21
BFY57	0.40
BFY90	0.90
BFY90S	1.34
BR100	0.20
BR101	0.44
BR103	0.58
BRC443	1.76
BRY39	0.38
BRY56	0.42
BRY61	0.86
BSS17	0.56
BSS27	0.92
BSX19	0.34
BSX20	0.34
BSX59	0.62
BSX76	0.29
BT100A/02	0.94

Type	Price (£)
BT101/300	1.15
BT101/500	1.25
BT102/300	1.35
BT102/500	1.65
BT106	1.50
BT108	1.30
BT109	1.18
BT116	1.25
BT119	3.62
BT120	3.60
BT121	3.02
BT138/600	1.30
BT151/560R	0.90
BT151/300R	1.15
BTY79/400R	2.80
BU100A	2.30
BU104	2.00
BU105	1.20
BU105/02	1.56
BU108	1.80
BU124	1.75
BU126	1.25
BU133	1.80
BU204	1.35
BU205	1.30
BU206	1.70
BU208	1.55
BU208A	1.63
BU208/02	2.05
BU326S	1.75
BU407	1.65
BU407D	1.80
BUX80	3.70
BUY20	1.75
BUY69A	2.60
BUY69B	1.98
DBY101	0.48
BY118	1.10
BY122	0.68
BY126	0.12
BY127	0.10
BY133	0.16
BY135	0.25
BY164	44
BY179	0.66
BY182	0.87
BY184	0.40
BY187	0.72
BY189	4.75
BY198	0.44
BY199	0.47
BY206	0.24
BY207	0.24
BY210/400	0.25
BY210/600	0.26
BY210/800	0.30
BY223	1.20
BY227	0.26
BY229	0.30
BY238	0.68
BYX10	0.24

Type	Price (£)
BYX36/150	0.22
BYX36/600	0.28
BYX48/300	0.72
BYX49/300	0.47
BYX55/350	0.29
BYX55/600	0.33
BYX71/600	1.18
BYZ12	0.42
C106D	0.80
E1222	0.40
E5024	0.30
GET872	0.48
ITT44	0.04
ITT2002	0.11
ME0402	0.20
ME0404/2	0.24
MEU21	0.60
MJ400	1.25
MJ2955	0.90
MJ3000	1.98
MJE240	0.60
MJE340	0.54
MJE370	0.88
MJE520	0.48
MJE2955	0.99
MJE3055	0.70
MPSLO1	0.28
OA47	0.10
OA90	0.08
OA91	0.09
OA95	0.18
OA200	0.06
OA202	0.15
OC25	2.10
OC26	1.70
OC28	1.50
OC29	2.47
OC35	1.75
OC36	1.75
OC42	0.72
OC42K	1.40
OC44	0.72
OC45	0.58
OC71	0.50
OC72	0.52
OC81	0.68
OC200	2.45
OC202	2.20
ORP12	0.85
R2008B	1.50
R2010B	1.52
SHG15	0.40
TAG1/100	1.40
TAG3/400	1.78
TIC44	0.40
TIC45	0.45
TIC46	0.48
TIC47	0.70
TIC106A	0.70
TIP30A	0.46
TIP31C	0.54

Type	Price (£)
TIP32	0.40
TIP32C	0.60
TIP33A	0.63
TIP34A	0.72
TIP41C	0.46
TIP42A	0.52
TIP47	0.60
TIP110	0.88
TIP2955	0.60
TIP3055	0.60
TIS43	0.32
TIS88	0.40
TIS90	0.25
TIS91	0.28
ZTX108	0.12
ZTX109	0.12
ZTX212	0.28
IN4001	0.05
IN4003	0.05
IN4004	0.06
IN4006	0.07
IN4007	0.07
IN4148	0.05
IN5400	0.12
IN5402	0.15
IN5405	.16
IN5406	0.18
IN5408	0.20
IS920	0.08
2N697	0.55
2N706A	0.33
2N2904	0.28
2N2906	0.24
2N2926G	0.10
2N3053	0.22
2N3054	0.56
2N3055	0.45
2N3702	0.10
2N3704	0.10
2N3708	0.10
2N3772	1.90
2N3773	2.70
2N3904	0.16
2N3906	0.16
2N5294	0.48
2N6107	0.71
2N6126	0.68
2SB337	1.60
2SC1172Y	2.90
2SC1173Y	0.82
2SC1302	1.40
40251	0.95
40361	0.58
40362	0.50
40411	3.72
40530	0.80
40673	0.80
40964	1.54
2SJ 50	5.20
3SK 88	0.66
3SK135	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

CONVERGENCE POTENTIOMETERS

5, 7, 10, 15, 10, 50, 100, 200, 500R **38p each**

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30, 120, 270, 470 all at 20p each

CAPACITORS

Metallised Paper

2n2F 1500V DC	60p
2n2F 600V AC	24p
3n6F 1700V DC	60p
4n7F 1500V DC	22p
10nF 1000V DC	22p
10nF 500V AC	80p
15nF 300V AC	30p
22nF 300V AC	32p
100nF 1000V DC	46p
470nF 1000V DC	85p

HV Disc Ceramic (†)

1kV 1.5nF	18p
3kV 1.5nF	20p
8kV 10, 47, 56, 82, 100, 120, 150, 180, 200, 220pF	30p
270, 300pF	39p

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
PCC84	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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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 **87p each**
20W Stud 75-75v **£1.31 each**

INTEGRATED CIRCUITS (£) EACH

Type	£
AN240P	3.42
AN214Q	3.88
AN715Q	2.90
CA3065	1.75
CA4031P	2.88
CA4102	3.00
CA4250	3.50
CA4400	2.98
CA4422	3.57
LC7120	5.33
LC7130	5.26
LC7137	5.16
LM380N	0.80
LM1303N	2.52
HA1151P	3.12
MC1307P	1.85
MC1310P	1.85
MC1312P	2.25
MC1327P	1.75
MC1330P	0.83
MC13449P	1.85
MC1350P	1.20
MC1351P	2.50
MC1352P	1.50
MC1357P	.88
MC1358P	1.30
MC1496L	1.15
ML231B	2.10
ML232B	2.10
ML237B	2.30
NE555	0.50
C-mos 555	0.88
NE556	0.80
SAA1024	5.35
SAA1025	8.40
SAS560A	2.50
SAS560S	1.85
SAS570S	1.85
SAS580	2.85
SAS590	2.82
SC9503P	1.10
SL432A	4.00
SL901B	5.20
SL917B	6.25
SL1327Q	1.10
SN76003N	2.44
SN76013N	1.90
SN76023ND	2.90
SN76033N	2.45
SN76110N	1.12
SN76115N	2.00
SN76131N	1.65
SN76226DN	1.80
SN76227N	1.10

Type	£
SN76530P	1.40
SN76533N	1.60
SN76650N	1.05
SN76660N	0.75
SN76666N	0.80
STK015	6.50
TA7108P	3.20
TA7120P	2.20
TA7129AP	3.65
TA7130P	1.65
TA7172	1.80
TA7193	5.50
TA7172P	1.80
TA7176	2.50
TA7202P	4.18
TA7204P	1.86
TA7205AP	1.50
TA7208P	3.25
TA7210P	.50
TA7222P	2.12
TA7223P	3.68
TA7227P	5.60
TA7310P	1.80
TA7609P	4.28
TA7611AP	2.88
TAA263	2.46
TAA310A	2.68
TAA550	0.50
TAA570	1.99
TAA611A12	3.50
TAA611B12	2.85
TAA630S	3.90
TAA661B	1.70
TAA700	2.80
TAA840	3.38
TAD100	2.80
FM FILTER	1.20
TBA120A	1.00
AS,S,SA,SB	1.30
Q,T,U,UQ	1.32
TBA120B	1.30
TBA231	1.45
TBA281	2.65
TBA395	1.20
TBA480Q	1.50
TBA400	2.30
TBA510	2.60
TBA510Q	2.60
TBA520Q	1.60
TBA530/Q	1.30
TBA540/Q	1.40
TBA550/Q	1.52
TBA560C	1.70
TBA560CQ	1.60

Type	£
TBA570	1.50
TBA641BX1	4.50
TBA651	2.80
TBA673	2.40
TBA700	2.85
TBA750	2.80
TBA800	1.60
TBA810P	1.10
TBA810S	1.20
TBA820	1.60
TBA890	3.88
TBA920/Q	3.00
TBA950/2A	3.05
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
DA1190	3.50
TDA1200	2.98
TDA1270Q	3.70
TDA1327A	1.66
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	3.80
TDA2541	3.80
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
UPC1032H	0.90

Type	£
UPC1156H	4.20
UPC1157H	0.76
UPC1163H	0.98
UPC1181H	1.60
UPC1185H2	3.75
UPC1212C	1.30
UPC1230H	3.90
UPC1350C	4.25
UPC1367C	3.40
UPC1378H	4.40
UPC2002H	2.80

BRIDGES

1½A 50V	0.27
100V	0.28
200V	0.32
400V	0.40
600V	0.50
800V	0.58
3A 100V	0.52
200V	0.55
400V	0.61
600V	0.67
800V	0.76
6A 100V	0.66
200V	0.68
400V	0.74
600V	0.80
800V	0.86
10A 50V	2.20
100V	2.24
200V	2.35
400V	2.50
600V	3.50
25A 50V	2.05
100V	2.25
200V	2.40
400V	3.20
600V	3.95

SERVICE AIDS

ALL SERVISOL PRODUCTS

Switch Cleaner	0.88
Circuit Freezer	0.96
Foam Cleanser	0.84
Aero Klene	0.78
Silicone Grease (Aerosol)	1.00
Antistat Spray	0.82
Plastic Seal	0.88
Excel Polish	0.76
Fire Extin 640g	2.80
Video Head Cleaner	0.88
Silicone Grease (ICI) 75g tube	1.00
Solda Mop (Std)	0:72
Solda Mop (L/Gauge)	0.72
Additional P&P on above 30p	

RESISTORS CARBON FILM 5%

¼W 1R0 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 1M 730 pieces	6.00
½W pack 5 each value E12—2R2 to 1M 365 pieces	3.50
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 1Ro 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 3.3A **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	0.95	ea-	**10/7.00**
HP11	2.30	ea-	**4/8.50**
HP2	2.35	ea-	**4/8.75**
PP3	4.45	ea-	**4/16.00**

Fuseholders

20mm Panel Mounting	0.28
20mm Chassis Mounting	0.06
¼in Panel Mounting	0.35
¼in Chassis Mounting	0.342
Carline 1¼in Mounting	0.10

Terminal Blocks

2 amp 12 way	0.19
5 amp 12 way	0.20
15amp 12 way	0.46
32amp 12 way	0.92

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

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 BITS	0.95
ANTEX STANDS	1.90
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, 20ml body dia, Shaft 2' long

4K7–2M2 Single Gang Log	.32	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
PLUGS	Solder	.52	.65	.88	1.45
	Lug R. Angle	.89	1.34	1.98	3.48
SOCKETS	Solder	.78	.98	1.33	2.48
	Lug R. Angle	1.18	1.78	2.70	4.15
COVERS		.95	.95	.98	1.00

4000	0.24
4001	0.24
4002	0.25
4007	0.25
4011	0.24
4012	0.24
4013	0.56
4014	0.60
4015	0.60
4016	0.40
4017	0.60
4018	0.60
4020	0.85
4021	0.58
4022	0.96
4023	0.35
4024	0.50
4025	0.24
4027	0.45
4028	0.45
4029	0.75
4030	0.35
4031	1.30
4033	1.25
4034	1.46
4035	0.70
4036A	2.75
4038	0.75
4039A	2.80
4040	0.60

4042	0.50
4043	0.42
4044	0.50
4046	0.60
4049	0.38
4050	0.36
4051	0.70
4052	0.60
4053	0.60
4066	0.45
4067	2.45
4068	0.24
4069	0.24
4070	0.25
4071	0.24
4072	0.25
4073	0.25
4075	0.25
4076	0.68
4077	0.25
4078	0.25
4081	0.25
4082	0.25
4085	0.58
4086	0.58
4089	1.25
4093	0.37
4094	0.95
4095	0.95
4096	0.99

4097	2.65
4098	0.80
4099	1.05
4161	0.96
4162	0.96
4163	0.96
4174	0.96
4175	1.00
4194	0.99
4501	0.38
4502	0.38
4503	0.40
4507	0.48
4508	1.30
4510	0.55
4511	0.55
4512	0.55
4514	1.15
4515	1.15
4516	0.55
4517	2.70
4518	0.48
4520	0.53
4521	1.15
4522	1.25
4526	0.60
4527	0.65
4528	0.68
4531	1.30
4532	0.65
4536	2.65
4538	0.80
4539	0.90
4541	0.90
4543	1.25
4549	4.00
4553	2.45
4554	1.92
4555	0.35
4556	0.55
4557	2.50
4558	1.20
4559	3.25
4560	1.80

IC SOCKETS

Dil to Dil

8	pin	0.08	0.70/10
14	pin	0.10	0.95/10
16	pin	0.11	1.00/10
18	pin	0.14	1.60/10
22	pin	0.21	1.95/10
24	pin	0.25	2.25/10
28	pin	0.30	2.75/10
40	pin	0.34	3.10/10

TELEPHONE SPECIAL

BT App Tel Plug & 4-core Lead	1.50
BT App Secondary Socket	2.50
BT App Master Socket	3.50
BT App Plug only	0.50
BT 4-core Cable 15pm, 100m	12.00

B.T. Telephones now available

MICRO

2764-250n/s	5.80
Z80A-CPU	3.70
Z80A-CTC	3.30
Z80-ADNA	9.00
Z80-AP10	3.40
Z80-AS10/0	8.75
Z80-AS10/2	8.99

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WEM
SHROPSHIRE SY4 5TT TEL: 0939 32689
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VISA

Access

ORDERING: All components are brand new and to full specification. Please add 45p postage/packing (unless otherwise specified) to all orders and then add 15% VAT to the total. Either send cheque/cash/postal order or send/telephone your Access or Visa number. Official orders from schools, universaties, colleges etc most welcome.
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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 – Microwave Modules MML144/200-S (courtesy of Microwave Modules (p4)
Bottom – M J Instruments 102 Oscilloscope (p10)

SPECIAL FEATURES

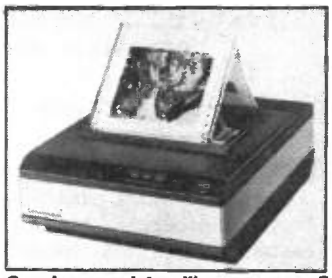
REGULARS

READER SERVICES

NEXT MONTH

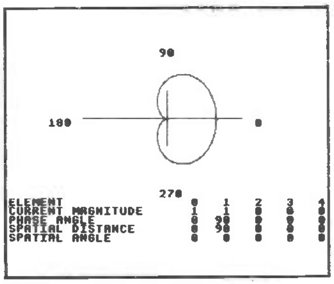
☐ **Next Issue**
Cover date February 1985 on sale Thursday, 10 January

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



One day my prints will come – page 5

TV des grenouilles – page 15



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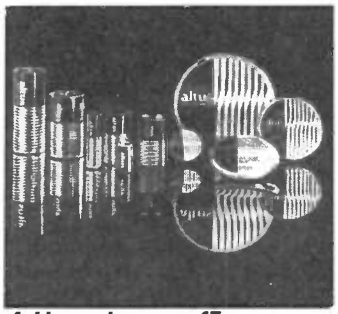


Acid remarks – page 47

Retail mania – 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

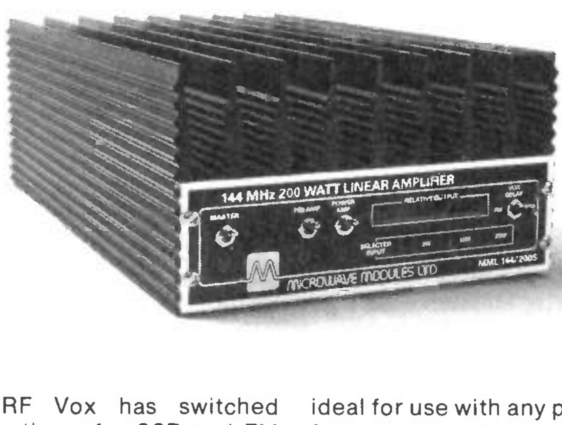
200 WATT LINEAR

The new MML 144/200-S from Microwave Modules, featured on this month's cover, has been introduced to cater for the growing requirement for a high power 144MHz solid state linear amplifier.

The amplifier provides an output power of 200 watts and is fully compatible with transceivers of 3, 10 and 25 watts output. Input power level is manually selected, so the unit is suitable for use with mobile, portable or base station equipment.

Front panel mounted switches allow the linear power amplifier and the GaAsFET receive preamplifier to be independently switched in and out of circuit.

By means of an RF Vox circuit the linear will automatically switch onto transmit when 144MHz drive is applied to the input socket. This facility can be over-ridden by the connection of an earth to the phono socket on the rear panel.



he RF Vox has switched delay times for SSB and FM modes. Design of the PA stage ensures highly reliable and ultra-linear performance, making the unit ideal for all modes of communication (SSB, FM, AM & CW).

The receive pre-amp design, employing dual-gate GaAsFETs in a noise-matched configuration, is ideal for use with any popular 2 metre transceiver and gives an excellent overall system noise figure.

Construction is to the usual high standard, and all necessary plugs are supplied.

Microwave Modules,
Brookfield Drive,
Liverpool L9 7AN.
Tel: (051) 523 4011.

SPLITTER/COMBINERS

W & G Instruments have added to their range of British manufactured signal processing components with the introduction of the 4-way splitter/combiner type 3352 and the 6-way splitter/combiner type 3354.

Both units cover the frequency range 5 to 150MHz, with isolation (mid-band) of 25dB and insertion loss of 0.75dB.

Amplitude balance is 0.3dB and phase balance 4.0 °.

The operating temperature Prange is -20°C to + 85°C.

These high performance reactive components are designed for dividing or combining RF signals with minimum insertion loss and high isolation.

W & G Instruments Ltd,
Hatfield Components Division,
Burrington Way,
Plymouth,
Devon PL5 3LZ.
Tel: (0752) 772773.

A/D CONVERTER

The DTR1580 is the newest instrument in the CIL Microsystems range. It fulfils a demand for a very accurate high speed, large storage data recorder with intelligent programs to analyse data and transfer the results either to a terminal or computer via IEEE or RS232.

Up to now this type of instrument was only available at very high cost because of the expensive way of producing 16-bit accuracy at high speed. CIL Microsystems, in conjunction with various universities, have developed a method of producing this type of conversion at low cost.

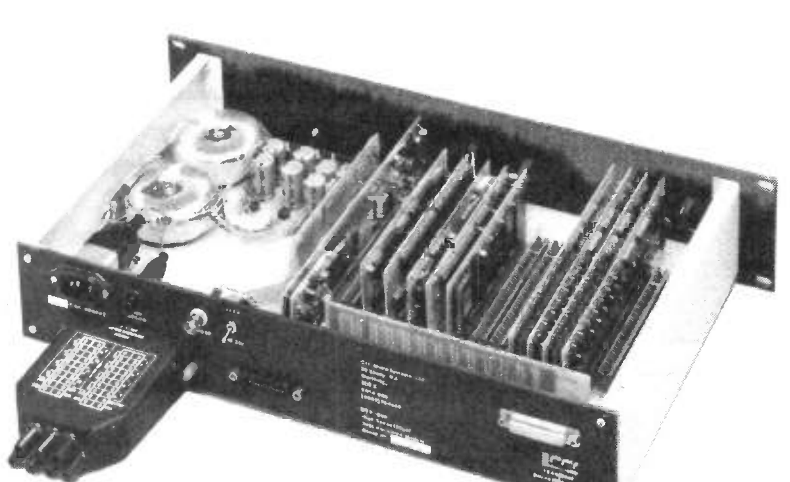
As already stated, the DTR1580 is a 16 channel 16-bit 20μS high speed A/D converter for use with the IEEE-488 BUS and RS232 link.

Recordings can be initiated by an external trigger (Schmitt input) which has programmable delay and gain (± 100mV to ± 10V).

Although the micro-processor used is the Z80, special programming and circuit techniques enable the gathering of information from the A/D converter at a maximum rate of 50KHz. The standard model has 128K memory with options of up to 512K in steps of 64K. The standard 19in 2U rack case houses a motherboard and various plug-in boards. Thus, optional increased memory is provided by inserting up to eight 64K RAM boards.

By using ASCII data transfer the unit has been made as simple as possible to operate; with the options of IEEE and RS232 it can be used with the majority of computers.

CIL Microsystems Ltd,
Decoy Road,
Worthing,
Sussex BN14 8ND.
Tel: (0903) 210474.



16-BIT MICRO

Epson America has announced a new personal computer called the QX-16, which embodies both 16-bit 8088 and 8-bit Z80 processors. European price and specification will be announced early in 1985.

The QX-16, which will go on sale initially in the United States, runs MS-DOS and CP/M, and is IBM-compatible through an optional emulator board.

Standard features of the QX-16 include 156K RAM, expandable to 512K, and dual 5.25 inch disk drives. The disk drives provide 360K of storage per disk on double-density format in the MS-DOS mode, and 720K per disk on quad-density format in the CP/M mode, twice the storage capacity, says Epson, of its major competitors.

The QX-16's specially-designed keyboard simplifies the use of differing operating systems and applications programs. An upper row of function keys can be defined for either MS-DOS or CP/M applications simply by inserting an underlay. When used with Valdocs 2 software, key commands such as PRINT and CALC can be activated with a single stroke.

Epson (UK) Ltd,
Dorland House,
388 High Road,
Wembley,
Middlesex HA9 6UH.
Tel: (01) 902 8892.

COLOUR VIDEO PRINTER

Mitsubishi Electric Corporation, who commercialised the world's first printer for instantaneous printout of pictures on a television screen last year, have recently succeeded in developing technology for a colour version.

The colour printer consists of five major blocks: a block where input National Television System Committee (NTSC) composite video signals are demodulated to obtain red, green and blue (RGB) signals, a block where each colour signal is converted into a colour digital signal by an analog-digital converter, a field memory for storing digital colour signals for a frame of picture, a block where the colour signals read from the field memory are converted into the three primary colours – yellow, magenta and cyan – of the subtractive colour process to obtain gradation colour signals, and a block where a colour print is obtained by a thermal transfer system.

When the print button is pressed, digital colour signals for one frame are stored in the field memory consisting of 12 chips of 64K dynamic random access memory (DRAM).

A full-colour print of 16 gradations is made by transferring heat-soluble ink of the three colours to plain paper by the thermal transfer system.

One print can be made in about a minute and ink sheets can be changed in cassettes each holding sheets for 100 pictures.

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

LOW-COST MULTIMETERS

Five new low-cost digital multimeters have been introduced by Beckman Industrial under the Circuitmate name. The range comprises two full-size handheld meters, the DM40 and DM45, and three pocket-size meters, the DM15, DM20 and DM25. All are 3½ digit models and incorporate the proven Beckman Industrial design concept of a single rotary centre switch operation.

The robust DM40 and DM45, ideal instruments for either field service applications or bench use, have accuracies of 0.8% and 0.5% Vdc respectively.

Features include five ranges each for ac and dc volts and current (six on the DM45 which has a 10A input) and six different resistance ranges.

Display and input sockets are recessed for maximum safety and a tilt bail and antiskid pads facilitate bench use.

The DM45 also incorporates a buzzer for fast continuity testing and circuit tracing, and both instruments have a separate range or diode testing. The price of the DM40 is £49.00, and that of the DM45 £65.00.

The DM15, DM20 and DM25, which measure only 15.0 x 8.2 x 2.5cm, are full-function meters with extras not found on most larger instruments, allowing measurement problems even outside traditional multimeter applications to be solved.

Each model has its own special dedication. Depending on the most frequent needs it is therefore possible to choose between additional capacitance measurement on the DM25 or additional transistor testing on the DM20. Model DM15 is the lowest priced version but, like the other two, also has a separate range for diode testing as well as a direct 10A input. All three instruments have a Vdc accuracy of 0.8%.

Both the DM20 and DM25 measure conductance, which is very convenient when faced with very high resistances (up to 10000Mohm). They also offer switch selection of high or low power on resistance ranges, the low power allowing convenient in-circuit measurements in sensitive electronic circuits. The top-of-the-range DM25 also incorporates a buzzer for continuity testing.

The prices for the DM15, DM20 and DM25 are £42.00, £47.00, and £58.00 respectively.

A full range of Beckman Industrial accessories is available for the Circuitmate meters.

All are covered by a comprehensive three-month warranty and are obtainable through Beckman Industrial's UK distributor network.

Beckman Industrial Ltd,
Electronic Technologies Division,
Mylen House,
11 Wagon Lane,
Sheldon,
Birmingham B26 3DU.
Tel: (021) 742 7921.

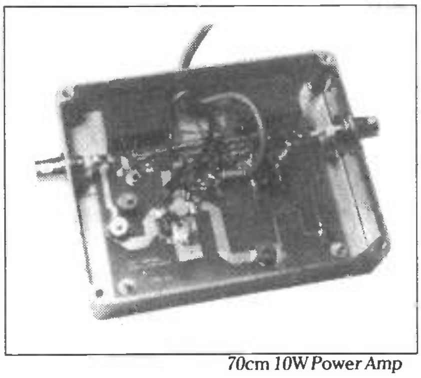
fectly loud and clear.

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

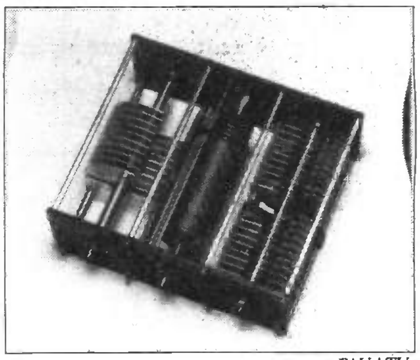
CABINET - custom-made for STU 5K ATU 41-50510 62.50

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

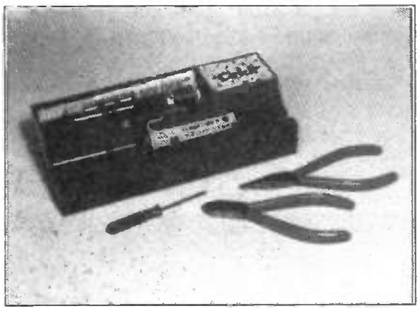
ROLLER COASTER
To complement existing equipment, covers 1-30MHz, 28uH inductance, tapered pitch for 10 and 15 meters.
Roller Coaster 41-50540 46.00



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
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TTL Cookbook	02-10358	11.00
TV Antennas and Signal Distribution Systems	02-21584	10.15

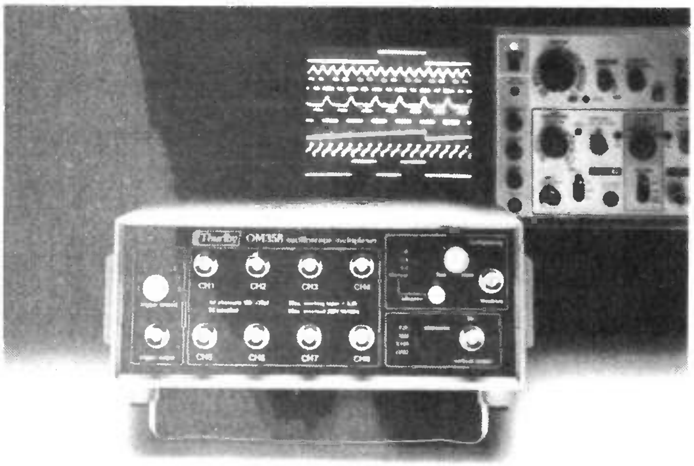
MULTIPLEXER

Levell Electronics have announced the release of a new oscilloscope multiplexer. The type OM358 expands any oscilloscope to 8 channels.

The multiplexer has a bandwidth of 35MHz and a calibration accuracy of 3%. Input impedance is 1Mohm/20pF and the attenuator has four positions of x100, x50, x20 and ground. The trigger signal can be selected to come from any of the 8 input channels. A variable multiplex rate control ensures flicker free operation at any timebase speed, and facilitates high speed multiplexed capture of multichannel single shot events.

Typical application areas include microprocessor based products, data transmission systems, analogue to digital converters, phase locked loops and frequency dividers.

Levell Electronics Ltd,
Moxon Street,
Barnet,
Herts EN5 5SD.
Tel: (01) 440 5028.



INSTRUMENT HOUSINGS

The H9 'Proto-Pac' series has now been added to the range of standard instrument housings made by PMH Inc.

Versatile and economical, Proto-Pac series housings are particularly suitable for prototyping needs and are formed from extruded aluminium tubing. Front and back panel fixing is by way of 0-80 holes tapped directly into the housing sidewalls giving the user more interior space, access to both sides, and providing excellent shielding.

The Proto-Pac series are available in a large range of sizes and with options which include covers with mounting flanges, connector holes and chemical film or nickel plating.

Aspen Electronics Ltd,
2/3 Kildare Close,
Eastcote, Ruislip,
Middlesex HA4 9UR.
Tel: (01) 868 1188.

VOLTAGE TESTERS

A range of inexpensive, reliable and safe voltage testers, ideally suited to DIY and hobby applications, is available from Steinel (UK) Ltd. The testers are simple to use and provide a wide range of voltage indication enabling the rapid and safe testing of batteries, power supplies and mains voltages.

Using a simple LED and/or neon indicator system built into one of the two shock-protected probes, ac and dc voltages of up to 415V can be detected, depending on the model chosen. A major feature of their design is their foolproof operation in all conditions likely to be encountered by the average DIY user.

Volt Check is simplicity itself to operate. It has just two LEDs indicating the presence of voltages either ac or dc in the range 4.5 to 415V, with polarity indication. This is ideal for fault-finding applications, testing whether mains sockets/terminals are live etc.

Power Check is designed specifically for the indication of ac mains voltages, and using three neons indicates voltages of up to 110, 240 and 415V.

Hobby Check provides the same three-step voltage indication as the Power Check but with the added advantage of dc measurement covering the same voltage ranges and with polarity indication.

Steinel (UK) Ltd,
17 Reddicap Trading Estate,
Sutton Coldfield,
West Midlands B75 7BU.
Tel: (021) 378 2820.

CAPACITANCE METER

GSC has introduced the Model 3000 digital capacitance meter, a precision test instrument designed for handheld battery operation.

Features include a 3½ digit resolution, accuracy to 0.2% of reading, capacitance measurements of 1pF to 2000 μF, and switch selection of capacitance range.

The instrument has a 0.5 inch high numeric liquid-crystal display with annunciators to indicate low battery and excessive compensation of stray capacitance.

Designed to operate with a 9V battery, the Model 3000 also has a front-panel zero 'adjust' control to permit nulling of stray and incidental capacitance, and a tilt stand for easy and convenient positioning.

Applications include quality control, inspection, production, design, calibration, field service and systems installation.

Available accessories include a pair of test leads, fuses, battery, and an instruction manual.

Global Specialties Corporation,
Shire Hill Industrial Estate,
Saffron Walden,
Essex CB11 3AQ.

FREQUENCY METER

The TF600 is a battery or mains (ac adaptor) operated portable frequency meter with a large 0.5in 8-digit LED display.

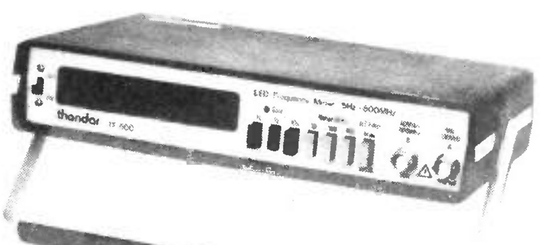
The frequency range is 5Hz to 600MHz with a sensitivity of better than 10mV RMS across the entire range.

There are two inputs. Input A is a high impedance input (1MΩ) for the 10MHz and 100MHz ranges; a low pass filter (40KHz) is provided. Input B is a 50Ω nominal input for the 40MHz to 600MHz range.

The display reads out directly in KHz and also has indicators for overflow, gate and low battery.

The decimal point is positioned automatically on all of the ranges.

Thandar Electronics Ltd,
London Road,
St Ives,
Huntingdon,
Cambridgeshire PE17 4HJ.
Tel: (0480) 64646.



THE ULTIMATE BATTERY?

AllBatteries have introduced to the UK the latest 'state of the art' battery.

Developed by the Altus Corporation, one of America's foremost battery manufacturers, the new high power Lithium Thionyl Chloride cells incorporate several unique features which make them superior to any other battery for many applications. Weight for weight and size for size, Altus cells contain more power than any other commercial cell.

Among the many special features are a number which make these new cells probably the safest battery available. Tests conducted by the UL prove that the cells can be subjected to heat, short circuit, crushing and even penetration by a metal object without any dangerous consequences.

Other patented features allow the cells to deliver high currents; the larger sizes can deliver up to 15A continuous and 30A pulse. All cells are rated at 3.6V nominal and will operate over a wide temperature range.

AllBatteries stock a wide range of Altus disc and cylindrical cells with capacities from 0.23 to 18AH. They can advise on the best choice of battery and can construct special packs if required. Custom built cells with capacities up to 8000AH are also possible.

Full details together with copies of the UL report are available from the AllBatteries sales office on (0923) 770044.

AllBatteries,
Tolpits Industrial Estate,
Tolpits Lane,
Watford,
Hertfordshire WD1 8QY.
Tel: (0923) 779297.

PROTOCARD

Protocard is a professionally designed British product for the easy construction of prototypes or the development of new circuits.

Six 16-pin DIL sockets have their pins brought out to large area solder pads on the PCB, which is also provided with transistor pads and supply and signal tracks which run the full length of the board.

Protocard can be re-used as often as required, providing a useful aid to circuit designers.

Also supplied with the board are a pack of Protocard Plancards (which are used to plan component layout), instrument wire in a selection of colours, and solder.

This product is invaluable to those constructing prototypes and test circuits, and does not suffer the problem of bad contacts sometimes encountered with push-in type boards.

E & H Electronics,
33 North Street,
Keighley,
West Yorkshire BD20 3SL.
Tel: (0535) 44103.

MULTI-STANDARD TERMINAL

PNP Communications have announced the availability of a new 'matched-filter' type RTTY/CW receive-only terminal unit.

Primarily aimed at the serious short wave listener, the unit is suitable for interfacing a communications receiver to a home computer. The matched filter-rectifier-integrator design also makes it suitable for demodulating Morse code transmissions for CW reading programs.

The terminal unit comprises two active filter chains. One is fixed at 1275Hz for space and the other is electronically switched to 1445Hz for 170Hz shift, 1700Hz for 425Hz shift or 2125Hz for 850Hz shift mark signals. This channel is used for Morse reception.

The TU also has the PNP ALC system to cater for a wide range of input signals and to compensate for signal fading. A bar-graph tuning indicator is provided to ensure accurate tuning, which is necessary for the reception of RTTY.

The TU is suitable for the reception of signals in excess of 200 baud and for the reception of AMTOR etc. TTL level outputs are provided for 'normal' and 'inverted' signals and power is available for a transmit tones generator.

All connections are by plug and socket and the TU has on-board rectifiers and power regulators. It is supplied as a built and aligned PCB complete with mains transformer, and measures 155mm x 107mm. The price is £32.50 + VAT inc p&p.

Kit versions will be available shortly.

PNP Communications,
62 Lawes Avenue,
Newhaven,
East Sussex BN9 9SB.
Tel: (0273) 514465.

INSERTION GUIDES

A new line of insertion guides, ready loaded with collet pins for speedy and accurate collet pin insertion, are available from Aries Electronics.

Both single and double row insertion guides on 0.1 inch spacings are available, the single row versions having from 3 to 40 pins and the double row versions having 6 to 48 pins on 0.3 or 0.6 inch centres. After wave-soldering the pins to the board, the disposable insertion guide is simply removed.

Aries collet pins are available in 3 styles. All styles have a two-piece contact assembly, consisting of a machined four leaf (gold plated) closed entry contact within a screw machined outer sleeve. Collet contacts provide high reliability and accept .015 to .020 round leads and flat IC leads.

Aries Electronics (Europe),
Alfred House,
127a Oatlands Drive,
Weybridge,
Surrey KT13 9LB.
Tel: (0932) 57377.

BROADBAND TRIPLEXER

Time Microwave, Santa Clara, California, have announced the Model TPF 143 triplexer, which is designed to operate from dc to 18.0GHz and provides passband channel bandwidths of dc to 2GHz, 2 to 8GHz, and 8 to 18GHz.

The triplexer exhibits 1.0dB maximum insertion loss (to within 5% of crossover), a crossover insertion loss of 4.5dB maximum, a 2:1 maximum VSWR, and rejection of 55dB to within 15% of crossover. The low profile triplexer is 3.7 x 2.0 x 0.5 inches and uses SMA female connectors.

The triplexer is an integration of Suspended Substrate MIC (SSMIC) diplexers with crossover frequencies of 2 and 8GHz. A series of SSMIC diplexers with crossover frequencies from 2.0 to 14.0GHz have been designed on RT/Duriod.

These diplexers can be integrated to form many multiplexing functions.

Time Microwave,
398 Martin Avenue,
Santa Clara, CA 95050
408/970-8463.

PRODUCT NEWS

IN-CAMERA RECORDER

The Ferguson Videostar C 3V41, the latest concept in electronic photography which combines a video camera and recorder in one compact, lightweight unit, is the latest addition to the Ferguson Videostar range.

The new Ferguson Videostar C package includes a single unit camera and recorder, slimline rechargeable battery, battery charger, RF converter, detachable microphone, carrying handle, VHS C EC30 video cassette and instruction book. Supplied in an executive style custom fitted carrying case, the Videostar C is a truly portable home video system that includes everything needed to make home video recordings in colour and with sound, and to immediately replay them on a television receiver or in the electronic viewfinder provided.

Developed from VHS technology, the Ferguson Videostar C system is completely compatible with all VHS video cassette recorders. Designed for high performance with effortless operation, this camcorder is supported by a comprehensive range of accessories offering the opportunity to exploit and enjoy the full scope of video recording techniques, making it the ideal system for domestic and business use.

It weighs just 4½lb and is only 13.5cm high, 34cm long and 20cm wide, and is therefore very convenient for one handed use.

The Videostar C has high sensitivity in low light levels (down to 15 lux), which allows it to make excellent colour recordings under almost any lighting conditions. Varying light values are compensated for by the automatic iris control, but this can also be operated manually for creative effects.

Other features include an electronic viewfinder which can be mounted at various angles and incorporates 8 recorder/camera mode indicators; instant playback through the electronic viewfinder; colour picture search (forward and reverse); back space edit; automatic quick review of each recording; LCD tape counter, including memory stop; and 6x power zoom with manual over-ride.

The Videostar C is supported by a full range of accessories which allows the video enthusiast to gain full scope and more professional results from the system.

Thorn EMI Ferguson Ltd,
Cambridge House,
Great Cambridge Road,
Enfield,
Middlesex EN1 1UL.
Tel: (01) 363 5353.

SPECIAL READERS' OFFER — THE MJI 102

Here's your chance to obtain the M J Instruments' 102 oscilloscope at a £5 discount

This simple to operate unit features fully automatic triggering, 100mV to 50V/div sensitivity, and 10mS to 1μS/div sweepspeed.
The 'scope is available to *R&EW* readers for £5 less than the already low retail price of £129.95 by enclosing the voucher below with your order, which should be sent to:

M J Instruments, Hilltop House, Thingoe Hill, Bury St Edmunds, Suffolk IP32 6BE

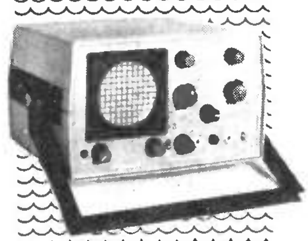
But be quick! This offer ends 31 January 1985

£5

R&EW

This voucher is worth five pounds off the purchase price of the MJI 102 oscilloscope

M J INSTRUMENTS



NEWS DESK

Gallium arsenide plan

Plessey Research (Caswell) Limited announced recently that it has reached the first major milestone in a £50M investment programme to establish a production facility for gallium arsenide integrated circuits.

Parts of the research centre have been completely refurbished to provide an additional 2000 square feet of advanced clean wafer fabrication facility and associated services. Plessey now has a total floor space of over 7000 square feet for clean gallium arsenide wafer fabrication.

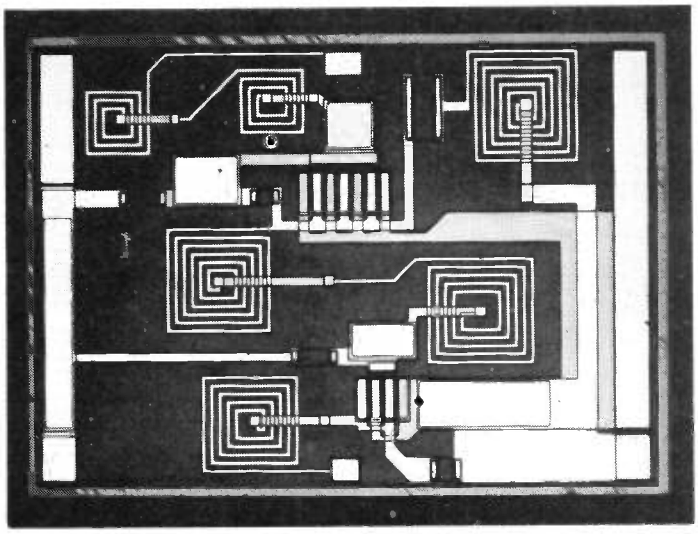
The latest addition to the company's GaAs facilities will be dedicated to the engineering and pilot production of ICs prior to their transfer to full production at the Plessey Three-Five Group Limited in Towcester.

Plans are well established to add further clean facilities for assembly and testing early in 1985. The total cost of this new facility, its equipment and commissioning is £3M. Equipment installation, including the dedicated ion-implantation facility, is now nearly complete.

Plessey has all the technology in its Caswell Laboratory to commercialise the first generation of integrated circuits and has been supplying small quantities to customers at home and abroad for some years. However, Plessey's £50M investment objective is to be a leading world producer of circuits in volume manufacture and has a plan before DTI to do this.

Gallium arsenide exhibits higher electron mobility and saturated drift-velocity than silicon, giving speed advantages of up to 4:1 over silicon for digital circuits. Analogue circuits operating up to 20GHz can be designed and fabricated at the present time. Silicon circuits have difficulty in achieving analogue bandwidths greater than a few GHz in IC form.

Applications of gallium arsenide ICs include satellite communications, phased-array radars, navigation receivers, cellular-radio systems and high-speed computers.



In order to reduce testing time, increase yield and reduce packaged chip costs, an RF on-wafer testing capability prior to chip separation has been developed at Plessey Research. This equipment will be installed in the new wafer-fabrication facility during 1985.

Currently over 30 different gallium arsenide IC designs are in advanced phases of development, including chips to perform functions such as multiway switches, mixers, multipliers and oscillators for first generation MMICs.

RFI protective screening

A new zinc coating process which eliminates radio frequency interference (RFI) has been developed by Deccospray, part of the Eltron group of companies.

The process, called Deccoscreening, consists of the homogeneous application of molten zinc to the internal surfaces of plastic enclosures without deforming, discolouring, or weakening the base material.

Electromagnetic energy is absorbed by the coating, and external radio frequency interference is subsequently reflected. This interference can be caused by such mundane things as vehicle ignitions, fluorescent lights, radio transmitters, or welding equipment.

The problem of RFI has arisen where metals have been replaced by modern plastics to house electronic components. Although more aesthetically acceptable, cheaper, and lighter, plastics are transparent to radio waves, and so protective screening becomes essential to prevent damage or malfunctioning.

The Deccospray patented process has the added advantages of being quickly and permanently attached, avoiding short circuits, and is non-combustible. The process has been effective in solving interference problems in the computer, VDU, telecommunications, security, medical, and defence industries. The process can be applied to almost any plastic housing.

DIY graphics processors

The Camberley-based systems engineering company, EASAMS Limited, unveiled two new graphics processor packages at the International Test & Measurement Exhibition held recently. These will spearhead the company's drive to strengthen its position in the fast-growing industrial market for low-cost computer graphics.

For manufacturers and others with limited CAD capability, the dedicated software packages, known as FLOW GEN and CD GEN, respectively offer generators for flowchart and circuit diagram graphics. Both 12K machine code programs take full advantage of the high resolution graphics and memory-mapped screen possibilities of Apple II micros, with hard copy output provided by a Hewlett Packard plotter.

Flowcharts and circuits are to technical publications standard, and are produced with fine-line drawing office pens of sufficient quality for immediate reproduction-for-print. Complete hardware/software packages can be supplied by EASAMS to satisfy users' needs for a low-cost automated drawing office capability.

Second generation mobile telephones

The Nordic market for mobile telephones has expanded at record speed since it first got under way in 1981. The rate of development has exceeded almost all expectations.

During the three years the NMT (Nordic Mobile Telephone) system has been in existence it has attracted more than 100000 subscribers. Of these, approximately 40000 are located in Sweden. The Nordic area is already the most active mobile telephone region in the world.

The second generation of mobile telephones is now being launched by Ericsson, one of 11 suppliers to the Scandinavian market, with their PT range.

These telephones are well equipped for future communications requirements. They are characterised by a drastic reduction in size – they are almost half the size of previous models. One station unit therefore weighs only a couple of kilos and the control unit only 340g. The small dimensions and negligible weight provide increased mounting possibilities.

The Ericsson PT telephones are already adapted and equipped for future data communications. In the future it will be possible to receive or transmit information from a mobile telephone computer terminal installed, for example, in a car.

Radar recorder

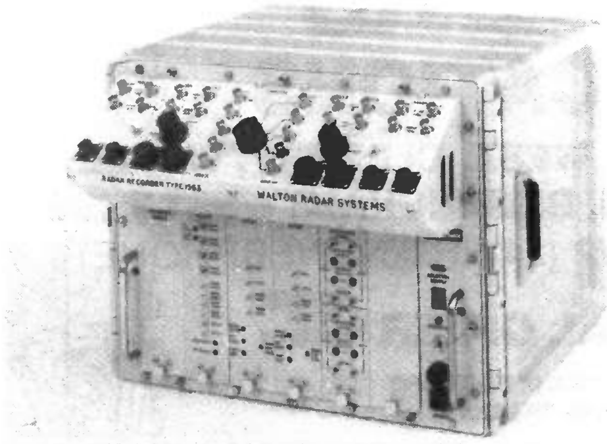
Originally developed for and currently in use with the Royal Navy, the commercial variant of Walton's Radar Recorder is now in full production.

Seen to have many applications in the defence, maritime and civil aviation fields, the system means that instead of radar information being lost as the screen is updated, there can now be a permanent record. This is useful not only for post-incident analysis but in, say, air traffic control applications, as a valuable tool when planning preventative measures.

On the training front the radar recorder has been enthusiastically received because it enables operators to work with real radar. A whole library of tapes can be built up to give trainees the experience of a wide variety of situations, so they no longer have to wait for the appropriate conditions to arise.

The Walton Radar Recorder Interface can record radar synchronising pulse, radar video and antenna azimuth data onto ¾in magnetic cassettes, as well as other data such as log, compass/gyro, secondary plot data, depth readings, voice and time code signals.

Record and replay are the basic modules of the system, but several options can be provided to suit individual requirements, such as video store, sequencer and tape copying modules.



Data processing equipment

Computerisation of British industry has now gained an unstoppable momentum, but penetration is still low and there is still a long way to go before replacement is the major determinant of demand, according to a new report on data processing equipment published by *Market Assessment*, which estimates that the market has grown from £1103M at MSP in 1978 to £2866M in 1983.

UK production in the electronic computer industry is one of the few manufacturing sectors to have ridden the recession and actually expanded, even though some UK production reflects assembly of imported parts rather than manufacture. Yet UK manufacturers' sales of data processing equipment is valued at £1,962M out of the total £2,866M market in 1983.

Advertising has increased phenomenally, reflecting both market growth and the proliferation of manufacturers. In 1978, media advertising of computers and calculators alone accounted for £2.10M. By 1983, this had grown to £26.45M and this excludes trade exhibitions and direct mail. IBM and ICL are by far the largest advertisers, followed by DEC, ACT Apple, Hewlett Packard and Honeywell.

The report examines the performance and prospects of calculators, mainframe computers, small business computers, computer peripherals, encoders, disc drives, printers and tapedecks.

Data Processing Equipment: Market Assessment Product Group Report is published by Market Assessment Publications, 2 Duncan Terrace, London N1 8BZ. Tel: 278 9527/8/9.

Computer repairs

The looming nightmare of repairing hundreds of thousands of cheap home computers after their warranties expire has been solved by a new British company, Computer-fix Ltd of Camberley, Surrey.

Computer-fix has set up a national network, initially of 500 dealers, offering cheap, guaranteed repairs in only 48 hours plus postage time from the dealer to Camberley and back.

The network is based on a revolutionary British diagnostic computer which can reveal a fault in any of the top ten brands of home micros in just seconds. The machine does not even need to be told the make or model of micro it is testing.

ACUMEN – Advanced Computer Memory Tester – is British designed and manufactured and if Computer-fix decided to sell it would cost around £5000 (somewhat less than existing advanced test equipment!).

Most home computers sold in Britain are still covered by their manufacturers' warranties, as sales started to boom only the Christmas before last. According to managing director Ray Johnson, the first hundreds of thousands of repairs out of warranty are just starting to explode on the market.

With his combination of revolutionary test equipment and a national network of dealers, Mr Johnson believes he can corner the British market for home micro repairs, especially when people see just how low his prices are (a 90-day guarantee on parts and labour is included).

Plans are under way to extend the principle, possibly on franchise, throughout Western Europe.

PCB-based product lines

RIFA have announced the introduction of a completely new line of products designed to simplify the design and production of PCB-based systems and modules.

At the centre of this new range of products is the unloaded PCB, which incorporates a full matrix of holes on 0.1in centres. This may be mated at right-angles with a front panel which itself contains a PCB, and the resulting assembly fitted into an industry-standard 19in rack.

A variety of components, such as LED holders, fuse holders, switches, trimmers and test jacks etc, may be plugged or soldered directly into the host board or front panel, thus dramatically simplifying the assembly of both prototype and production board-based modules.

Third generation MosFETs

Motorola is using significantly improved process technology in its new 'A' series of MosFET devices now in production. Utilisation of this new TMOS III technology results in significant cost savings to customers, making MosFET devices an even more attractive and cost-effective alternative to bipolar transistors in many applications.

The state-of-the-art design of TMOS III devices, accomplished through fine line geometry and spacing of source sites, increases the packing density to more than one million cells per square inch.

This smaller die size is less expensive to produce and yet retains the low on-resistance ($r_{DS(on)}$) figures of previous TMOS die with larger surface areas.

As an example, the industry standard bipolar transistor, the 2N3055 (with an equivalent on-resistance of 0.3 ohms), can now be replaced economically in many uses with the advanced Motorola power MosFET, the MTP3055A. This is a 60 volt, 12 amp device with an $r_{DS(on)}$ figure of 0.15 ohms.

Motorola has also recently expanded its discrete surface-mount product lines with a full range of ½ watt and 1 watt Zener diodes in the form of the MLL34 and MLL41 leadless packages.

This company thus becomes the first US supplier of surface-mount Zeners, complementing its previously introduced lines of leadless Schottky and general-purpose rectifiers for power-supply (and circuit protection) applications. REW

CANAL PLUS

FRANCE'S NEW 'FOURTH CHANNEL' COMES ON THE AIR NIGEL CAWTHORNE G3TXF EXPLAINS ALL

Canal Plus started full time programme transmissions in early November 1984, just three years after the company was formed as France's first film channel TV.

Before *Canal Plus*

France, up until the arrival of *Canal Plus,* had three TV channels: TF1, Antenne 2 and FR3. These three channels were created following the break-up of the old ORTF, and all three are government run.

The transmission of all TV programmes in France is organised by the TDF (Telediffusion de France). The TDF owns and operates all the transmitters and the programme channels each pay a transmission fee to the TDF. All three programmes are transmitted on UHF and can be received by anyone with a TV receiver, just like the BBC1, BBC2, IBA1 and C4 transmissions in the UK.

The new *Canal Plus* however uses both Band III VHF and UHF.To appreciate the implications of using Band III VHF for a new fourth channel, it is worth briefly tracing through the history of TV, this being a history of 'lines'.

Lines and bandwidth

In the days of black and white television there were many different line standards in use. These reflected to some extent the date of commencing TV transmissions in each country. The UK was the first and selected the then technically feasible 405 line system. The USA selected 525 lines. Many European countries went for 625 lines. France however went even further in the 'lines' race and chose 819 lines for its VHF service.

Choosing more 'lines' meant that the bandwidth required to transmit the TV programme was that much greater. The UK black and white 405 line signal required 3.5MHz of bandwidth between the vision and sound carriers, but as the number of lines increased, so did the RF bandwidth required to transmit the signal. At 525 lines the vision-sound spacing was 4.5MHz, at 625 lines 6MHz, and the French 819 line system required 11MHz. This meant that within a given frequency range (Band I was 41-68MHz and Band III was 174-225MHz), fewer channels could be accommodated as the number of lines was increased. In the UK, Band I represented 5 channels, whereas across in France there was room for only 2 TV channels in the same bandwidth.

Colour: more standards – more chaos!

The arrival of colour TV transmissions in Europe standardized the number of lines at 625, but introduced international disagreement concerning the colour coding method to be used. France went one way with her SECAM system and Germany and the UK went another way, with PAL.

Even though the number of lines had been standardized to 625, pictures were still not interchangeable across borders because the colour standards were different (also the sound-vision carrier spacing was a little different, as was the modulation system used for the sound). International TV standards were still in chaos, so that the interchange of programmes between one broadcaster and another was made impossible without the use of expensive and quality degrading standard-convertors.

The arrival of *Canal Plus* in France comes at a time of some major changes in frequency spectrum uses, both within the UK and to some extent in Europe as well.

UHF planning

When the UHF four-channel network was planned in the UK, the basic objective was that a full four programme interference-free service on UHF would eventually be available almost everywhere in the UK.

The introduction of Channel 4 TV in the UK has been the final check on the accuracy with which the original UHF TV network was planned. A full four channel service will soon be available in the UK for a very high percentage of the population. In France though things are different!

The planning of the French UHF transmissions did not envisage providing four UHF channels to the majority of the population. Three channels can be provided, but not the fourth.

The main problem to be overcome when planning a TV network that re-uses the same frequencies in different parts of the country is that of co-channel interference.

If a transmitter at one side of the country is on say, channel 26 at 511.25MHz (vision carrier), can this frequency/channel be re-used at the other side of the country without an unacceptable level of interference? As an example, channel 26 is used by the 1,000KW ERP transmitter at Crystal Palace in London for BBC1. The same channel is also used by the 250KW ERP TV transmitting station at Stockland Hill for BBC2 in the south-west of England. Detailed network planning had to be undertaken to ensure that for an adequately high percentage of the time there would be interference-free reception for the large majority of viewers.

DX curse

During times of the year when there is anomalous propagation at UHF (joyous DX openings to the amateur, but a curse to the TV network designer!), can a satisfactory signal be received from the local TV transmitter without undue interference from the other transmitter on the same frequency? The task of the network planner is to prepare an optimum frequency plan for the whole country.

Network planning techniques include the use of sophisticated computer models as well as detailed field strength measurements and analysis. Techniques such as frequency off-set, where the

Region	Main transmitter site Channel			Power	Relays VHF	Relays UHF	Total sites
Paris: Eiffel Tower	06	H	VHF	20KW	4	5	10
North: Lille	05	H	VHF	20KW	3	1	5
Rhône-Alpes: Lyons	10	H	VHF	20KW	11	4	16
Clermont	05	H	VHF	10KW	3	1	5
Gex	05	V	VHF	4KW	3	1	5
South: Marseilles	05	H	VHF	20KW	3	5	9
St Raphael	10	V	VHF	4KW	–	–	1
Nice-St Alban	66	H	UHF	5KW	1	1	3
Nice-La Madeleine	32	H	UHF	1KW	2	–	3

Canal Plus has 57 transmitters: 9 main stations (>1KW), 30 VHF relays and 18 UHF relays. The network will be extended in 1985 to cover Normandy, Brittany and South-West France

carrier frequency of one transmitter is moved slightly relative to another co-channel transmitter, are used to reduce co-channel interference problems.

In the UK, the UHF TV network was planned on the basis that there would be four programme channels. Not so in France!

VHF and UHF

This is the background to why the new *Canal Plus* TV channel in France is obliged to use a mixture of VHF and UHF transmitters in order to reach its audience. Total coverage of France on a UHF only basis for the new fourth channel has proved to be impossible, so the possible complications of a new VHF Band III transmitter network start to set in.

Canal Plus' new transmitter network is a mixture of VHF and UHF transmitters. Of the 57 transmitters that are in service at the start of broadcasting in November 1984, 37 are on VHF and 20 on UHF (see table).

819 lines phased out

French black/white transmissions on VHF used to use 819 lines. All the 819 line transmitters on VHF have been closed down over the past few years, in the same way that in the UK the BBC and IBA have been phasing out their 405 line transmissions. But in France, things will be different again!

Whereas the UK is liberating both Band I and Band III for other services, in France the *Canal Plus* transmitters on VHF Band III will be a new service using 625 line transmissions in colour on VHF for the first time in France. In the UK, VHF transmissions were only ever on black/white. The opening of *Canal Plus* in France means that VHF Band III is being used for a new French TV service, replacing the now defunct 819 line system, whereas in the UK, Band III is to be used for entirely different services after the 405 line VHF TV transmitters close down.

Subscription TV

Unlike the three other TV programme channels in France, *Canal Plus* will not be getting its income from the licence fee and advertising revenues. Its income will be derived entirely from subscriptions and programme sponsoring.

Subscriptions will be on a monthly basis, with discounts being available for subscriptions taken out over long periods. The current subscription is 120 Francs per month (about £10).

In addition the *Canal Plus* viewer also has to pay a once and for all deposit on a decoder unit which is supplied through local TV dealers. The decoder is an essential part of the system, because transmissions are encoded so that viewers without a decoder will be unable to see the picture or hear the sound. The deposit on the decoder is 420 Francs (£37).

Canal Plus will not carry advertisements, but some programmes will be sponsored. A sponsoring company or organisation will pay to have its name, logo, jingle and slogans connected with a particular programme or series of programmes. This is similar to the sponsoring of sporting events that is now common in the UK. Sponsoring revenues will be *Canal Plus'* second source of income after viewers' subscriptions.

Encryption

A special decoder has to be plugged into the TV set in order to receive *Canal Plus*. Without a decoder the viewer will still be able to watch the three other channels (TF1, A2 and FR3), but will not have access to the *Canal Plus* programmes on the fourth channel.

Subscribers are given an 8 figure code for each of the months for which they have paid their subscription. The code has to be changed on the decoder unit each month by the subscriber, and one month's code will not work during the following month. The subscriber receives from *Canal Plus* a list of the codes for all the months for which the subscription has been paid. The code for each individual subscriber is different.

The decoder unit can be taken with the subscriber when he goes on holiday. With his own decoder he will be able to watch *Canal Plus* on other TV sets which are not normally used for receiving the fourth channel.

VHF Antennae live again!

As French 819 line VHF transmissions have been phased out, French TV viewers have become 'all UHF', in the same way as it is now rare to find a VHF TV receiver being used in homes in the UK. Both in the UK and France VHF TV antennae have been left to rust away and eventually be blown down by gales!

Many would-be *Canal Plus* subscribers in France will have to re-install a VHF TV antenna in order to receive the new transmissions. In Paris for instance, there is a 20KW VHF TV *Canal Plus* transmitter in the Eiffel Tower operating on French TV channel 06. Most Parisians have been receiving UHF-only signals for years. *Canal Plus* viewers have to buy and have installed a VHF antenna. This is a further cost to the subscriber.

Round-the-clock TV

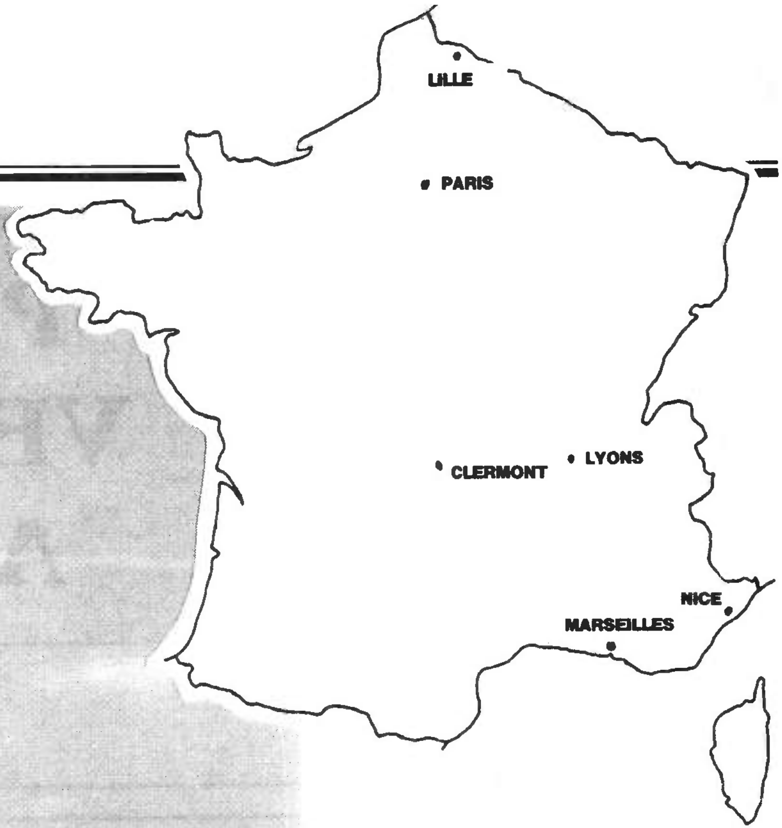
The planners behind *Canal Plus* believe that there is a round-the-clock market for television in France. Monday to Thursday, *Canal Plus* will be on the air from 7am to 3am, but from Friday to Monday it will be on the air for 24 hours a day. Such a high concentration of programming will make the UK's 'breakfast television' look very tame in comparison!

Although it will be broadcasting for long hours there will be a large amount of 'repeat' material. The scheduling of the programme material, which will for the most part be films, has been done on the basis that viewers generally watch television in a regular pattern. Night-shift workers will be able to see films during the day that will be repeated for other viewers in the evenings and at other times of day.

From a transmission viewpoint, the arrival of *Canal Plus* will mean that the VHF Band III TV channels used will be on the air virtually all the time without a break in transmission. The table shows the location, channels and powers of the

French VHF Band III TV channels used by Canal Plus for 625 line colour transmissions

Channel	Vision carrier	Sound carrier
05	176.0	182.5
06	184.0	190.5
07	192.0	198.5
08	200.0	206.5
09	208.0	214.5
10	216.0	222.5



Canal Plus' high power TV transmitters in the first phase will cover the large population areas around Lille, Paris, Clermont, Lyons, Marseilles and Nice. The Eiffel Tower in Paris houses many transmitters including the new fourth channel Canal Plus

higher powered VHF Band III transmitters that were brought into service at the beginning of *Canal Plus* programming in November. But what is happening to these VHF Band III frequencies in the UK?

UK VHF Band III closes

As described in the November issue of ***R&EW,*** the old VHF Band III TV frequencies in the UK are being given over to the land mobile service. This is where things start to get interesting from a spectrum usage viewpoint!

On one side of the Channel, there will be a number of high-power VHF TV transmitters on a round-the-clock schedule, whereas on this side there will be the new relatively low-power land mobile services. A formula for mutual interference problems!

Canal Plus will not be the only user of VHF Band III in France either. The French PTT is also putting land mobile radio services into parts of Band III. In the Paris region, the Radiocom 200 network is operating in the range 193-207MHz which straddles the French Band III TV channels of 07 and 08. These TV channels will be put into service in other parts of France to carry *Canal Plus*. There may be interference problems in France too.

Only experience and a few days of good 'VHF lift' in the summer will tell whether or not the network planning has been sufficient to avoid mutual interference both within France and across the Channel, caused by using the same frequencies in adjacent countries for two very different types of service.

Vive la difference!

The French and English hardly ever agree on anything! Lamb, long-life milk, TV transmission standards and frequency spectrum management included!

On one side of the Channel VHF TV transmitters are being silenced forever, whereas just a few kilometres away on the other side, new VHF Band III transmitters are being switched on.

To be fair to both *Canal Plus* and France, it is the UK that is the odd one out! Most European countries still use Band III for TV as well as in some cases Band I. Not all Band III services are fully duplicated on UHF, so that closing down VHF transmitters is not yet a practical possibility in many countries.

France's *Canal Plus* is the first TV programme channel to introduce subscription TV using direct VHF/UHF transmissions. *Canal Plus* is thus using on-the-air transmissions in the same way that the cable operator uses his cable, except that *Canal Plus* can only ever offer one programme. The viewer becomes a subscriber, with the power to cancel his subscription if he is not satisfied with what he receives.

Audience projections

Canal Plus is being shy in saying exactly how many subscribers have joined up, but their original target was to have 200,000 subscribers at the beginning of full-time programming in November 1984 and to grow to about 1,500,000 subscribers by November 1987. Daily measurements of audience levels will be taken so as to track closely the audience response to this new type of TV programming for the French viewer. Subscribers will receive material through the post to encourage them to keep up their subscription.

The new fourth channel TV service in France, *Canal Plus,* can claim a number of firsts for France, for both programming style (subscription TV with non-stop films) and television transmission techniques (mixed VHF and UHF).

COMPUTER MODELLING OF PHASED VERTICAL ARRAYS

F HOUGHTON G3VZM
& C A SWIFT

Phased vertical arrays have been used for many years by amateurs and professionals alike and are referred to in many publications. The amateur press, however, is usually very limited in its cover, often restricted to two element arrays with 90 degree phase shift. Just occasionally articles have touched on the versatility of these antennae.

Tedium

In one of these articles, in *Ham Radio* magazine, May 1977, K1AON described a method of calculating the relative field strengths around a phased vertical system using a programmable calculator. This was a great improvement on the 'cut and see' approach, but still required the tedium of hand plotting the results.

This program takes the next step by using a home computer to calculate the relevant field strengths and construct a horizontal polar diagram on the monitor screen.

The program has been written to deal with an array of up to five elements which may be arranged in any configuration, not just straight lines. The polar diagram is backed up with a numerical output, allowing accurate comparison between arrays as well as the overall impression of performance given pictorially.

Although the program was written using a BBC Model B computer it has been run successfully on an Acorn Electron. It is intended that enough guidance on the vital parts of the program have been included to help transposition to any other machine.

The model

The strength of the field at any point about an array of driven elements will be the phasor sum of the strengths due to each element. By phasor sum we mean that the relative phase angles are important as well as the magnitudes. Quantities in phase will result in a simple addition of the magnitudes, while a phase shift of 180 degrees leads to cancellation of part, or all (if the magnitudes are equal). Intermediate phase differences yield an intermediate result. A more detailed explanation can be found in any textbook on ac electricity if required.

The magnitude and phase angle of the relative field strength of each element is calculated and the results combined to give the total for a given array by the equation:

$$P_I = \left| 1 + \sum_{n=1}^{N-1} K_n . e^{jB_n \cos(S_n - I) - A_n} \right|$$

where:
P_I = relative field strength at angle I
K_n = relative current amplitude, element n
N = total number of elements

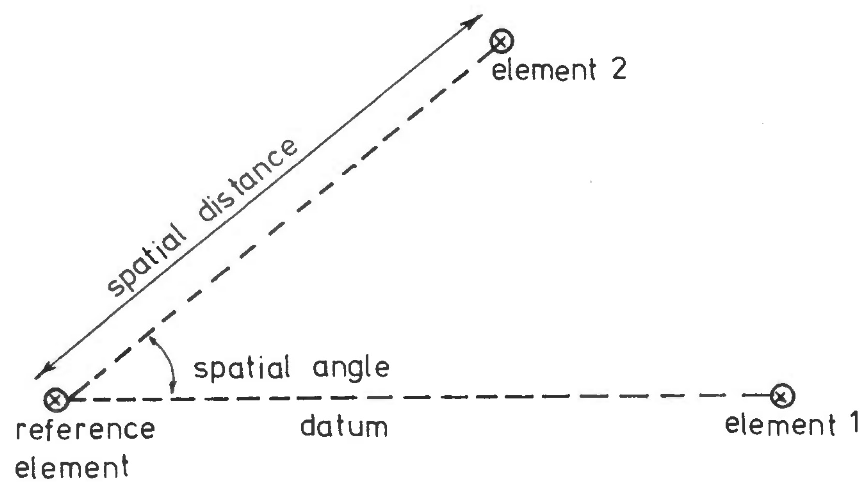


Fig 1 *The basic model of a phased array, illustrating the various terms used*

B_n = distance between element n and reference
S_n = spatial angle of element n
A_n = phase angle of current in element n
I = angle relative to centre of array

The program

A full analysis of the construction of and thinking behind the program is not really appropriate to this article. However some notes may be of help if it becomes necessary to debug the program after entry.

The arrays used to hold values entered and calculated results are dimensioned in line 120.

The purpose of each procedure (subroutine) should be evident from the titles, eg PROCpolar which produces the polar diagram.

The first of the important procedures is PROCenter, located at line 250. This asks for the number of elements in the array and continues with a call to PROCinput, at line 270. PROCinput is in the form of a loop, repetition of which is controlled by the number of elements.

As the title suggests, this procedure controls the entry of the parameters of each element.

PROCcorr, line 690, allows the correction of any errors in input and also allows the easy alteration of the parameters from within the program. The initial entry at first appears clumsy, but with practice this becomes second nature.

PROCresults, line 380, displays the numerical results.

These results are derived from PROCcalc, line 410, which is also used for the polar diagram. It is important to note the use of RAD to obtain functions of angles. The ABS function in line 520 is also essential to avoid system crashes.

PROCpolar, line 550, uses the results of PROCcalc at one degree intervals to plot the polar diagram. At line 590 the relative field strength is converted to rectangular form, providing X and Y co-ordinates for this display.

Using the program

When the program is run a menu is displayed which offers entry of data, numerical display of results, horizontal polar diagram, or an opportunity to leave the program.

On selecting 'Enter values' the program will respond with a series of prompts requesting numerical data for the calculations. It will start by requesting the total number of elements in the array, which may be 2, 3, 4 or 5. The number entered is used to set the limits on a loop which presents the following prompts:

'Current Magnitude' which, in this instance, is the ratio of the current magnitude in the given element to that in the reference element (E0). For most amateur purposes this will be 1, ie equal current, but it has not been preset so that the effect of varying the ratio can be investigated at least in theory. Perhaps the design of current splitting networks could be a future subject.

Angular phase shift

'Current Phase Angle' is the angular phase shift between the element and E0. This is due to the length of the interconnecting feeder and is fundamental to the operation of this type of antenna. The phase angle can easily be varied by switching between feeders of different lengths and is likely to be the most readily altered parameter of a given array. The angle may be either positive or negative, the beam being 'rotated' through 180 degrees by switching from one to the other.

'Spatial Distance' is the linear distance separating the given element from E0. This must be entered in electrical degrees (one wavelength equals 360 degrees).

'Spatial Angle' is the angle between a datum line and the line between the given element and E0. If all the elements are in a straight line then the spatial angle will be zero. If they are arranged in any other shape then a datum must be defined, preferably a line through two or more elements.

On completion of data entry a press on the space bar will return to the menu for selection of the next operation.

'Display Numerical Results' will require one further data input. The Angular Increment of Plot can be any angle and is used to define the number of intervals around the circle at which the relative field strength will be calculated for display. When a full screen of output has been displayed the computer will wait until the SHIFT key is pressed, allowing time for note taking.

On completion of this operation, a press of the SPACE bar will return to the menu.

'Display Polar Diagram' instructs the

THE PROGRAM

```
>>L.

   10 REM *****************************
   20 REM *   PHASED VERTICAL ARRAYS  *
   30 REM *                           *
   40 REM *  by    FRED HOUGHTON      *
   50 REM *              &            *
   60 REM *         TONY SWIFT        *
   70 REM *                           *
   80 REM *      August 1984 (c)      *
   90 REM *****************************
  100 *TV255
  110 MODE1
  120 DIMA(5),B(5),C(5),D(5),K(5),P(5),R(5),S(5):K(0)=1:N%=0
  130 PROCmenu
  140 DEFPROCmenu:PROCtitle
  150 PRINTTAB(7,13)"1......Enter values"
  160 PRINTTAB(7,15)"2......Display Numerical Results"
  170 PRINTTAB(7,17)"3......Display Polar Diagram"
  180 PRINTTAB(7,19)"4......Next/End"
  190 PROCchoice(5)
  200 IFG%=1ANDN%=0PROCenter ELSEIFG%=1ANDN%<>0PROCinput
  210 IFG%=2PROCresults
  220 IFG%=3PROCpolar
```

```
230 IFG%=4PROCend
240 PROCmenu:ENDPROC
250 DEFPROCenter:PROCtitle
260 REPEATPRINTTAB(4,9)"HOW MANY ELEMENTS DO YOU WISH TO"''"CONSIDER? ";:INPUT
""N%:UNTILN%>1ANDN%<6:PROCinput:ENDPROC
270 DEFPROCinput
280 L%=0:REPEAT:L%=L%+1
290 PROCtitle
300 PRINTTAB(1,3)"  ENTER VALUES RELATIVE TO REFERENCE"''"   ELEMENT (E0)"
310 PRINTTAB(13,8)"ELEMENT ";L%
320 PRINTTAB(0,10)"1.CURRENT MAGNITUDE...............";K(L%)
330 PRINTTAB(0,12)"2.CURRENT PHASE ANGLE.............";A(L%)
340 PRINTTAB(0,14)"3.SPATIAL DISTANCE,(Degs.Elect.)..";B(L%)
350 PRINTTAB(0,16)"4.SPATIAL ANGLE...................";S(L%)
360 REPEATPROCcorr:UNTILG%=89:UNTILL%=N%-1
370 PROCkey(31):ENDPROC
380 DEFPROCresults:PROCtitle
390 PRINTTAB(1,4)"ANGULAR INCREMENT OF PLOT     DEGREES":INPUTTAB(27,4)AI%:PRO
Ckey2
400 I=0:VDU28,0,29,39,6,14:FORY=1TO(360/AI%):PROCcalc:PRINTTAB(3)"ANGLE  ";I;T
AB(20)"STRENGTH  ";INT(O*100)/100:I=I+AI%:NEXT:VDU15,26:PROCkey(31):ENDPROC
410 DEFPROCcalc
420 L%=0:REPEAT:L%=L%+1
430 E=B(L%)*COS(RAD(S(L%)-I))-A(L%)
440 C(L%)=COS(RAD(E))
450 D(L%)=SIN(RAD(E))
460 R(L%)=K(L%)*C(L%)
470 P(L%)=K(L%)*D(L%)
480 UNTILL%=N%-1
490 T1=1:T2=0
500 L%=0:REPEAT:L%=L%+1
510 T1=T1+R(L%):T2=T2+P(L%)
520 O=SQR(ABST1^2+ABST2^2)
530 UNTILL%=N%-1
540 ENDPROC
550 DEFPROCpolar:PROCtitle
560 MOVE300,512:DRAW940,512
570 MOVE640,412:DRAW640,612
580 FORI=0TO360:PROCcalc:MOVE640,512
590 PLOT69,640+(O*COS(RAD(I)))*100,512+(O*SIN(RAD(I)))*100:NEXT
600 MOVE0,0
610 PRINTTAB(31,16)"0";TAB(19,7)"90";TAB(5,16)"180";TAB(19,24)"270"
620 @%=4
```

```
630 PRINTTAB(0,25)"ELEMENT               0   1   2   3   4"
640 PRINTTAB(0,26)"CURRENT MAGNITUDE",K(0),K(1),K(2),K(3),K(4)
650 PRINTTAB(0,27)"PHASE ANGLE      ",A(0),A(1),A(2),A(3),A(4)
660 PRINTTAB(0,28)"SPATIAL DISTANCE ",B(0),B(1),B(2),B(3),B(4)
670 PRINTTAB(0,29)"SPATIAL ANGLE    ",S(0),S(1),S(2),S(3),S(4)
680 @%=10:PROCkey(31):ENDPROC
690 DEFPROCcorr
700 COLOUR2:REPEATPRINTTAB(4,31)"Are these figures correct (Y/N)? ";:*FX15,0
710 G%=GET:UNTILG%=78ORG%=89
720 IFG%=89ENDPROC
730 REPEATPRINTTAB(2,31)"Type in No.of the value to be altered";:COLOUR3
740 G%=GET:UNTILG%>48ANDG%<53
750 G%=G%-48:X%=34
760 IFG%=1Y%=10:PROCalter:INPUTTAB(X%,Y%)K(L%)
770 IFG%=2Y%=12:PROCalter:INPUTTAB(X%,Y%)A(L%)
780 IFG%=3Y%=14:PROCalter:INPUTTAB(X%,Y%)B(L%)
790 IFG%=4Y%=16:PROCalter:INPUTTAB(X%,Y%)S(L%)
800 ENDPROC
810 DEFPROCalter:COLOUR2:PRINTTAB(0,31)SPC(39);TAB(X%,Y%);SPC(3);TAB(9,31);"En
ter the correct value";:COLOUR3:ENDPROC
820 DEFPROCchoice(C%)
830 COLOUR2:REPEATPRINTTAB(8,31)"Enter the appropriate number";:G%=GET:G%=G%-4
8:UNTILG%>0ANDG%<C%:COLOUR3
840 ENDPROC
850 DEFPROCkey(Y%)
860 COLOUR2:REPEATPRINTTAB(0,Y%);SPC(39);TAB(6,Y%)"Press SPACE bar to continue
";:*FX15,0
870 G%=GET:UNTILG%=32:COLOUR3:CLS
880 ENDPROC
890 DEFPROCkey2:COLOUR2:PRINTTAB(3,31)"Press SHIFT to scroll the screen";:COLO
UR3:ENDPROC
900 DEFPROCtitle
910 CLS:COLOUR2:PRINTTAB(10,1)"VERTICAL AERIAL ARRAYS":COLOUR3
920 ENDPROC
930 DEFPROCend:PROCtitle
940 PRINTTAB(7,13)"1......Continue with this Array"
950 PRINTTAB(7,15)"2......For New Array"
960 PRINTTAB(7,17)"3......Finish with the Program"
970 PROCchoice(4)
980 IFG%=1PROCinput:PROCmenu
990 IFG%=2CLEAR:RUN
1000 IFG%=3CLEAR:CLS:END
1010 PROCend:ENDPROC
```

program to calculate the values of relative field strength at intervals of 1 degree and to plot the results in graphic form. The horizontal axis of the display corresponds to the datum line mentioned earlier.

Scaling down

There may be occasions, especially when using the larger arrays, when the polar diagram is too large for the screen. The scaling may be reduced by substituting a smaller number for the multiplier 100 in line 590.

NB this multiplier is used twice in the line and must be changed at each location to preserve symmetry.

The fourth menu option, 'Next/End', selects a secondary menu which has three options:

'Continue with this Array' provides a safeguard against unintentional selection of the Next/End choice.

'For New Array' is the quickest way of changing to a completely different array as it causes the program to RUN again, clearing all resident data on array parameters.

'Finish with Program' is self-evident in its operation.

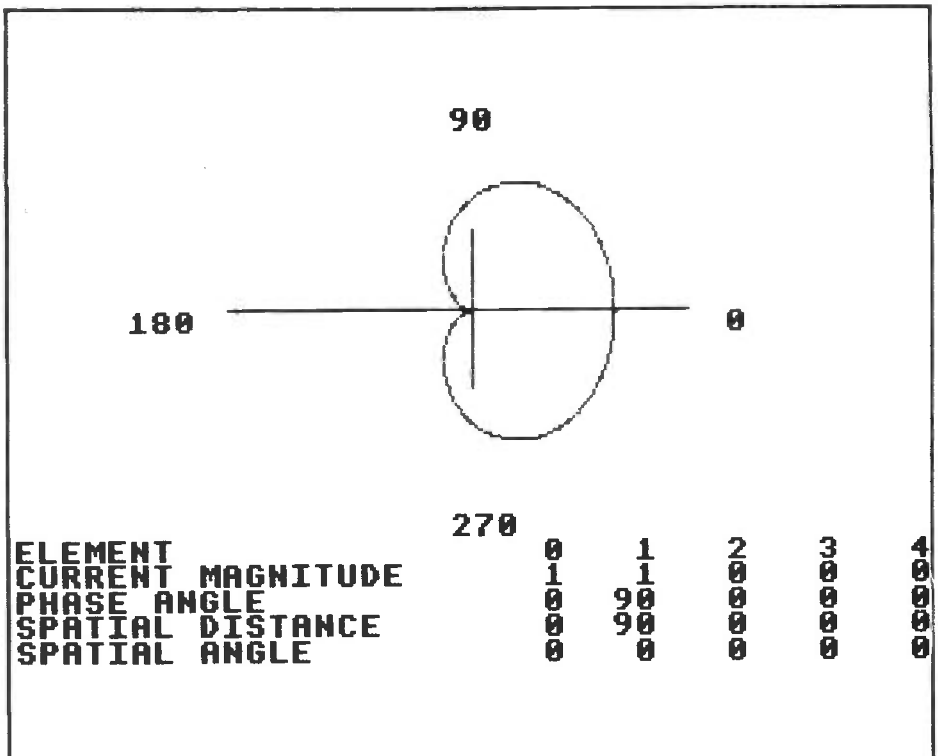


Fig 2 *2 elements spaced a quarter wavelength and fed 90° out of phase*

Testing the program

None of us are infallible in avoiding errors between page and keyboard, so the following two examples are given to check the program.

1 An array of two elements with equal current in each and a current phase shift of 90 degrees. The two elements are spaced one quarter of a wavelength apart. (This is a common textbook example.)

Remember that one element is the reference, represented in the equation by adding 1, so that only one set of element data is entered.

On request enter the following:

Number of elements . . . 2

and for element 1,

Current magnitude . . . 1

Current phase angle . . . 90

Spatial distance . . . 90

Spatial angle . . . 0

The polar diagram should be as shown in *Figure 2*.

Try a phase angle of -90, which should rotate the polar diagram through 180 degrees.

2 A three element array set out in the form of an equilateral triangle of side one quarter of a wavelength. Each element is fed in phase with the reference, with equal current magnitudes.

Two sets of element data will be requested. Enter the following:

Number of elements . . . 3

For element 1,

Current magnitude . . . 1

Current phase angle . . . 0

Spatial distance . . . 90

Spatial angle . . . 0

and for element 2,

Current magnitude . . . 1

Current phase angle . . . 0

Spatial distance . . . 90

Spatial angle . . . 60

This time the polar diagram should be as in *Figure 3* (although there is some flattening of the circle on the printout, most likely due to the deficiencies of the printer used). REW

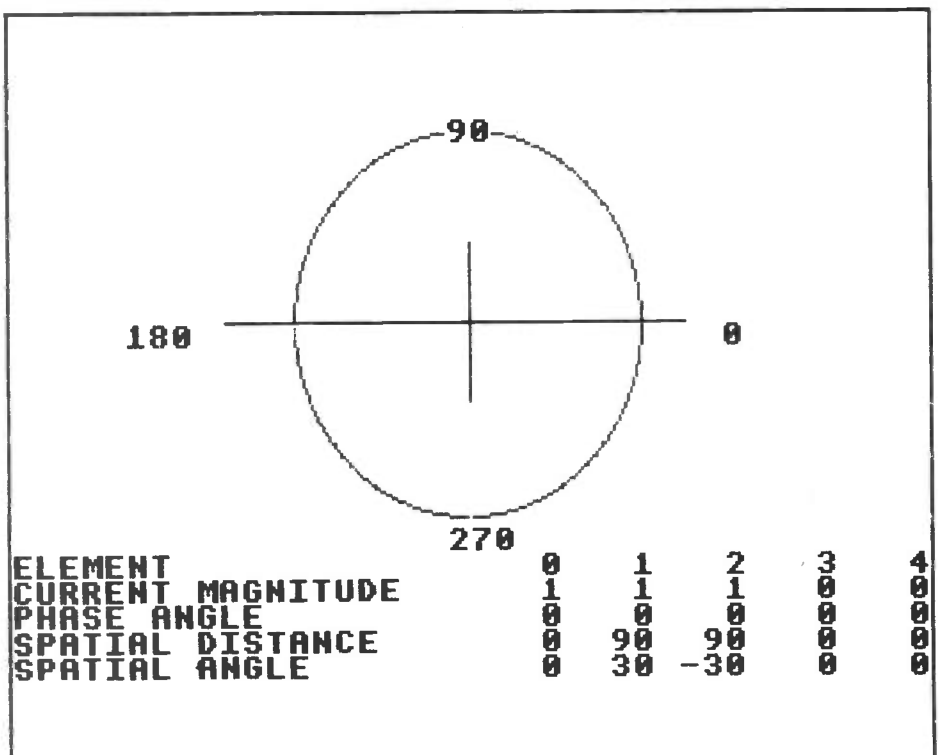
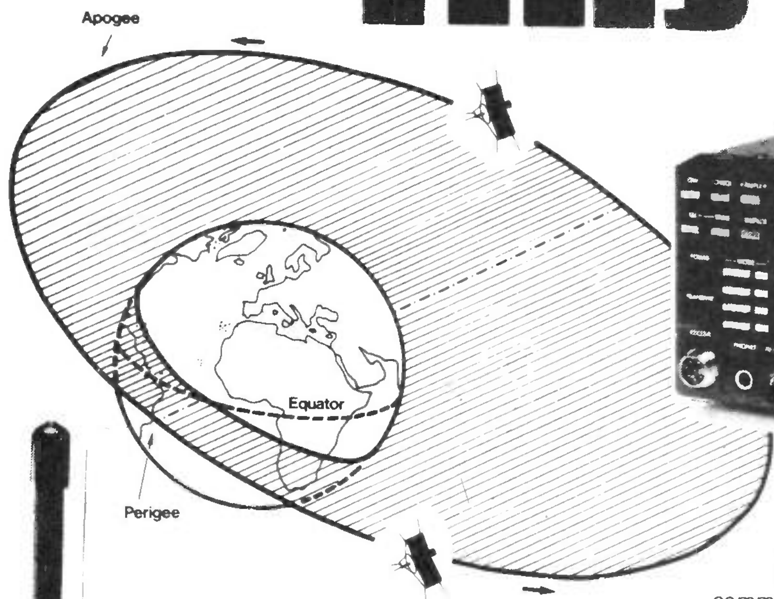


Fig 3 *3 elements in an equilateral triangle of side one quarter wavelength, all fed in phase*

ICOM IS OUT OF THIS WORLD.



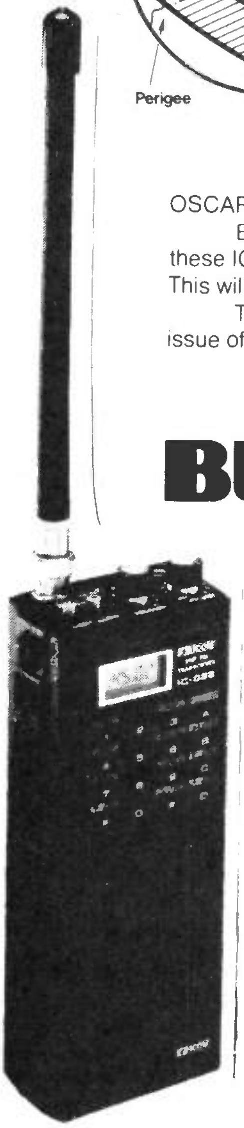
IC-271 & 471

ICOM can introduce you to a whole new world via the world communications satellite OSCAR. Did you know that you can Tx to OSCAR on the 430-440MHz IC-471 and Rx on the 2m. IC-271.

By making simple modifications, you can track the VFO's of the Rx and Tx either normally or reverse. This is unique to these ICOM rigs and therefore very useful for OSCAR 10 communications. Digital A.F.C. can also be provided for UOSAT etc. This will give automatic tracking of the receiver with digital readout of the doppler shift.

The easy modifications needed to give you this unique communications opportunity are published in the December '84 issue of OSCAR NEWS. Back issues of OSCAR NEWS can be obtained from AMSAT (UK), LONDON, E12 5EQ.

BUT, ON THE OTHER HAND...



IC-02E
IC-04E, (70cm).

The new direct entry microprocessor controlled IC-02E is a 2 meter handheld jam packed with excellent features.

Some of these 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 of course 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 continues to be available.

Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM

ICOM PRICES ARE DOWN TO EARTH.

(Please contact us or your local Icom dealer for current prices)

IC-745

ICOM's IC-745 is the all-in-one transceiver featuring an HF all band SSB, CW, RTTY, AM (receive only) ham transceiver, plus a general coverage receiver. Options for FM transceive and an internal power supply make the IC-745 the complete transceiver in an all-in-one package.

The receiver section features a 100KHz to 30MHz general coverage receiver, this allows access to all HF bands plus all the frequencies in between. The IC-745 has an adjustable AGC circuit and DFM (Direct Feed Mixer) giving a wide dynamic range of 103dB with an intercept point at + 18dBm. Exceptionally clean reception is achieved with a low noise PLL circuit and a 70MHz first IF.

The IC-745's features include IF shift, 16 programmable memories with lithium battery back-up, passband tuning, a noise blanker both wide and narrow, threshold level control, notch filter, receive audio tone control and an all mode squelch. Also available is a front end switchable receiver preamp providing 12dB gain. RIT has a ±1KHz range.

We could go on all day about the 745, get in touch with us and we will send you the full story.

IC-290D

290D is the state of the art 2 meter mobile, it has 5 memories and VFO's to store your favourite repeaters and a priority channel to check your most important frequency automatically. Programmable offsets are included for odd repeater splits, tuning is 5KHz or 1KHz.

The squelch on SSB silently scans for signals, while 2 VFO's with equalising capability mark your signal frequency with the touch of a button. Other features include: RIT, 1KHz or 100Hz tuning/CW sidetone, AGC slow or fast in SSB and CW, Noise blanker to suppress pulse type noises on SSB/CW.

You can scan the whole band between VFO's/scan memories and VFO's. Adjustable scan rate 144 to 146 MHz, remote tuning with optional IC-HM1 microphone. Digital frequency display, Hi/Low power switch. Optional Nicad battery system allows retention of memory.

Agent: Gordon G3LEQ, or telephone Knutsford (0565) 4040. Please telephone first, anytime between 0900 – 2200 hrs.
Gordon also sells Yaesu products.

Special Offer as from 15th January '84 IC-290D reduced to £469 and the IC-290E to £399. Also 70cm version IC-490E, £529. Take advantage of this money saving offer.

You can get what you want just by picking up the telephone. Our mail-order dept. offers you: free, same-day despatch whenever possible, instant credit, interest-free H.P., telephone Barclaycard and Access facility and a 24 hour answering service.

Please note that we now have a new retail branch at 95, Mortimer Street, Herne Bay, Kent. tel:69464. Give it a visit, BCNU.

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Tel:(0227/3) 63859/63850

MICROWAVE MODULES LTD

2 METRE MULTIMODE TRANSVERTER MMT144/28-R

NEW RELEASE

FEATURES

★ 25 watts Tx output
★ GaAsFET RF stage
★ Transmit ALC circuit
★ 13.8V DC operated
★ Repeater shift (normal, simplex, reverse)
★ High level DBM mixer
★ LED Bargraph Power Meter
★ RF Vox – Adjustable delay & manual override

SPECIFICATION

General

Input freq range	: 28-30MHz
Output freq range	: 144-146MHz
Repeater shift	: Simplex, normal, reverse
DC requirements	: 13.8V DC & 6 Amps

Transmit Section

Output power	: 25 watts +/- 1dB
Input level range	: ¼ to 300mW
ALC range	: 20dB
Modes of operation	: SSB, FM, CW, AM
Spuribus outputs	: -65dB or better

Receive Section

Gain	: 20dB min
N.F.	: 2dB or better
3rd order intercept	: +19dBm (output)

DESCRIPTION

This new transverter has been designed to allow users of existing HF band transceivers to establish a first-class transceive facility on the 144MHz band.
The MMT144/28-R incorporates many new and exciting features which combine to make this product simply superb.

Receive Section
An NEC GaAsFET is employed in a noise-matched configuration feeding a high level double balanced mixer via a bandpass filter. IF gain is achieved by a JFET post amplifier. This combination produces a good signal to noise ratio, excellent immunity to overload and cross modulation, resulting in a rugged receive system having a third order output intercept point of +19dBm.
Two separate low-noise oscillators, operating at 116.00 and 115.40MHz are included, running from a regulated 8.2 volt supply. Selection of the wanted oscillator is achieved by a quad op-amp circuit, controlled by the front panel mounted 'MODE' switch. This provides simplex, repeater and reverse repeater operation. The output of each oscillator feeds a JFET buffer amplifier via the quartz crystal which acts as a filtering element to reduce amplitude noise and reciprocal mixing products. The resultant high level injection is extremely pure and free from harmonics.

Transmit Section
The incoming 28MHz signal, in the range ¼ to 300mW, is initially fed to the RF VOX circuit, ALC control circuit and the input level control. This signal is then fed into a pair of MOSFETs in a balanced mixer configuration, together with the local oscillator injection, to produce the wanted signal in the range 144-146MHz.
This signal is then amplified by several linear stages up to the specified output power of 25 watts. A visual indication of relative output power is provided by a front panel mounted LED bargraph display.
A rear panel mounted level control allows the user to adjust the sensitivity of the transverter to suit the transceiver in use, and a front panel mounted RF VOX delay control allows adjustment to suit SSB/FM modes.
The ALC circuit has a 20dB dynamic range and has been incorporated to ensure that a totally clean signal is produced by the transverter. This is a particularly useful feature which will virtually eliminate compressed signals and the resultant problems caused to local stations.

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AMATEUR RADIO WORLD

Compiled by Arthur C Gee G2UK

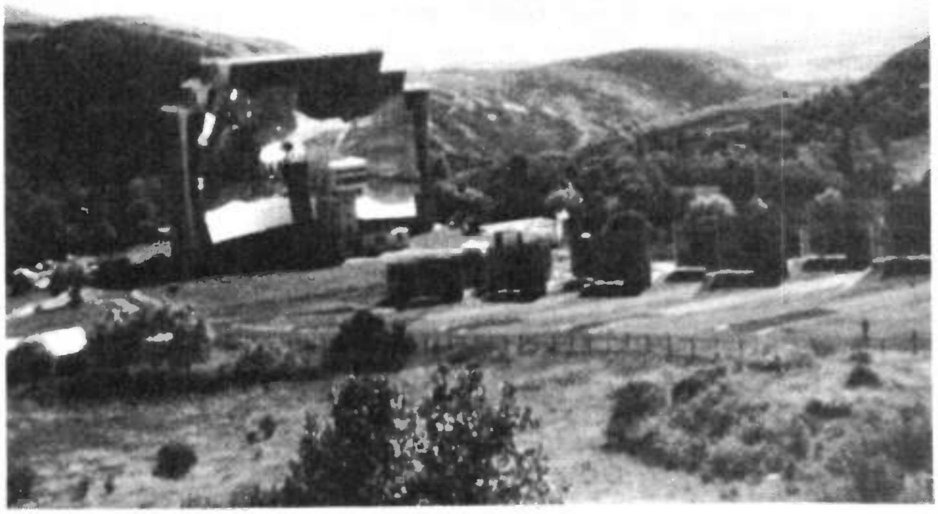
One hears a lot these days about alternative sources of energy. One of the most plausible of these, which is already in widespread use, is of course solar energy.

Solar heating is now well past the experimental stage, and its use for heating swimming pools and as a supplementary source of house heating is well established even in this country. Additionally of course, practically all satellites use solar radiation for their power source.

A very interesting variation of the use of solar energy is to be found as a research project up in the mountains of southern France.

Here, near Fontromue in the Pyrenees Mountains, a solar furnace has been established. By means of myriads of small mirrors an intense beam of solar rays is focused on a small crucible, into which materials can be placed and the effect of the intense heat generated can be determined.

Our illustration this month is of this solar furnace and its environs, and shows the huge mirror made up of thousands of small mirrors with a total surface area of 10000 square metres. Things are so arranged that these mirrors can be kept focused on the crucible as the sun crosses the sky. The photo was taken by a friend of your scribe, during a holiday in the Pyrenees last summer.



An interesting 'reverse use' of the solar mirrors was carried out recently by some French radio amateurs.

The French electricity authorities gave them permission to use the mirror for an attempt to moonbounce TV signals on 1255MHz. The crucible was replaced by a dipole antenna and the controlling computer reprogrammed to direct the mirrors towards the moon instead of towards the sun. FM modulated vision signals with a transmitter power of 140 watts were used.

It will be very interesting to hear what was achieved when the results of these tests come to hand.

New locator system

Beginning 1 January 1985, a new system of indicating the location of one's QTH comes into operation. There are of course numerous ways in which one can do this. The simplest is to give the nearest town. Or if you want to be more accurate and have a suitable atlas, you can give your longitude and latitude.

Your scribe recently heard a Brazilian Beacon station on 28.300MHz, PY2AMI, giving his QTH in this manner, *viz*, 22.45 degrees south and 47.16 degrees west. The signal gave the additional information that the power was 10 watts into a ground plane antenna.

However, radio amateurs have adopted a system better suited to their specific needs.

The first such system, which was commonly known as the QRA System, was introduced in Europe. Its main purpose was to enable accurate distances to be measured, which it would do down to a few kilometres between amateur radio stations, so that results of VHF contests and so on could be accurately measured. It became the custom for contests to actually require the QTH Locator, as it came to be known, to be given to the contacts made so that results could be easily determined.

The QTH Locator system was very much a local distance indicator however, and was not applicable for use over the whole of the world. To overcome this difficulty various proposals have been made over the years to produce a more versatile system and, after much discussion and debate, a system has been devised which has met with the approval of most radio amateur authorities. All three regions in the International Amateur Radio Union have agreed to adopt it.

New system

In the new system the world is divided along lines of latitude and longitude into areas known as 'fields'. Each field covers 20 degrees of longitude from west to east and 10 degrees of latitude from south to north.

The surface of the world is thus divided into 324 fields. These are labelled by two letters in the range A to R. The first letter gives the longitude of the field, starting from 180 degrees west and working eastwards. The second letter gives the latitude of the field, starting from 90 degrees south and working northwards. It is interesting to note that the squares of the new system coincide with those of the old QRA squares.

Finally, each of these squares is divided into a 24x24 grid of 'subsquares'. Each subdivision covers 5 minutes of longitude and 2.5 minutes of latitude, and is indicated by two letters, each in the range A to X, starting from the south-west corner of the square. The first letter of the subsquare gives the longitude and the second the latitude.

It all sounds pretty complicated, but no doubt once in practice it will all fall into place. Needless to say the system is very compatible with computers, and numerous programs are already available.

Readers who would like to know more about the system should consult an excellent article in the October 1984 issue of the RSGB's *Radio Communication*, by John Morris GM4ANB, which explains all and includes three computer programs designed to aid the process of adapting to the new system. (Or see last month's **R&EW**).

RS6 satellite disappears

One of the most consistently reliable Russian amateur radio satellites quite suddenly went out of action towards the end of September last. It had been suffering from low battery voltages for some time and it was thought that these might have been nearing their end. But the demise came much sooner than expected.

It is always difficult to get specific information about the Russian satellites and this is certainly true in this case. Some mystery surrounds the rather sudden disappearance of the RS6 signals; it is reported that RS6 has 'ceased to exist' but whether this means it has disintegrated is not certain.

There have been 280 satellites launched into the same orbit as RS6 since 1970, so the sudden demise of this Russian satellite may be due to its destruction in a collision.

Quite a few problems are now appearing due to congestion on densely occupied orbits, and several satellites whose planned function has been completed, but which are still orbiting, have been moved out into higher orbits when possible to get them out of the way of satellites which are still active.

An example is that of GEOS-2. This satellite was launched into a geostationary orbit in June 1978 and completed its planned scientific mission in July 1980. In January 1984, it was moved from the densely occupied geostationary orbit into a higher and slightly asynchronous orbit, where it drifted at a rate of 3.5 degrees of longitude per day.

However, due to the wish of the scientific community to obtain data over the whole of the 11 year solar cycle and to support the Active Magnetosphere Particle Tracer Experiment project, plus the fact that it was still in good condition, Switzerland and Germany requested it be reactivated, and this has now been done.

Careless talk

The quarterly magazine of the Ipswich Radio Club highlights a matter which your scribe feels needs far more publicity than it gets. This article, 'Discretion' by G4UKL, appeared in the January 1984 edition of *The Cornish Link*, the magazine of the Cornish Radio Amateur Club, and merits wide publicity. To quote:

'At a recent club meeting, it was wisely decided not to publish the names and addresses of members since, it was argued, such a list would provide a handy guide for house-breakers. Subsequently, listening around for a familiar voice on 2 metres, I heard a QSO between two operators with new G4 callsigns which was frightening because of the manner in which confidential information was being traded.

'It would seem that operator 'A' had been to visit a well-known member's shack and was enthusiastically describing his visit to operator 'B'. This account included a list of the shack contents, how much the equipment cost, what manufacture, how old, and its various applications. Even the layout was graphically explained. Not to be outdone, operator 'B' claimed knowledge of the shack and described its location by airing his geographical knowledge and asking 'A' for confirmation of the QTH.

Worst but not first

'This is by far the worst I have heard, but by no means the first and it can serve no good purpose whatsoever. If members elect to give an inventory of their own shacks and QTH over the air that's their ego trip, but please do not invite thieves to other members' homes by careless and irresponsible gossip. Use a telephone for any confidential chat.

Naive

'No radio ham can be so naive as to believe that only 'goodies' listen to their QSOs. It is an open invitation to the criminal fraternity (a current growth industry) to detail shack and house contents on any band. Being insured does not compensate for the shock and inconvenience of a rifled and desecrated house, or replace equipment no longer available but treasured.

'Can we please have some common sense and an awareness that going 'simplex' is not the equivalent of going 'private'? However flattered your friend may be by your admiration and envy, he or she will not be quite so amiable if 'put in the frame' by what is tantamount to a breach of confidence.'

This is all very similar to your scribe's views and is reproduced here as he considers it deserves as much publicity as possible. He knows several amateurs who are very careful to avoid any reference whatsoever to a forthcoming holiday, so as not to broadcast around when their QTHs will be unoccupied.

Other news

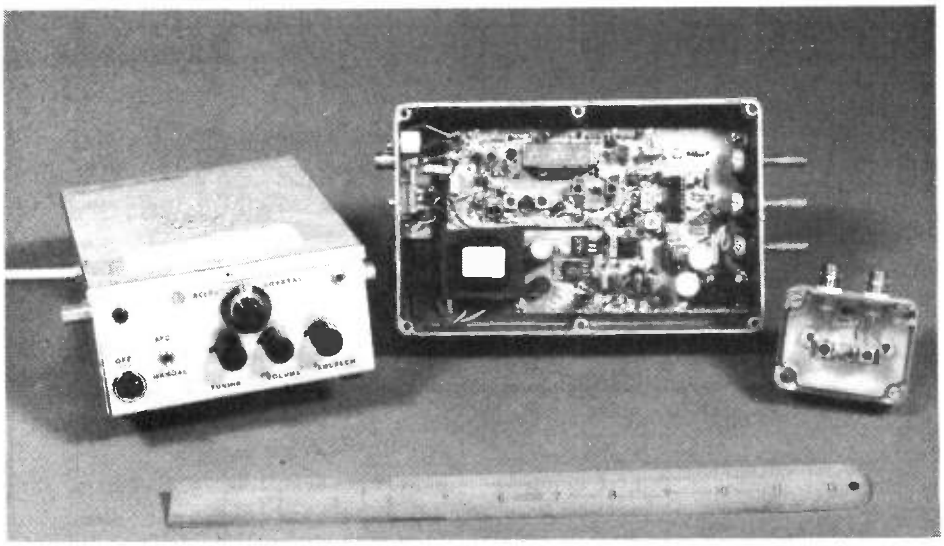
The RSGB have appointed their first lady President. Mrs Joan Heathershaw will take office on 1 January 1985. She holds the callsign G4CCH and was formerly zonal representative on the RSGB Council for Zone A.

The ARRL has appointed an international Program Manager, JA8VRO. The idea is to encourage international contacts and friendship through travel, exchange holidays, etc. Those interested should write to JA8VRO, International Program Manager, ARRL, 225 Main Street, Connecticut 06111, USA giving their name, callsign if any, address and the languages they can speak.

The Yaesu Owners Club has a new address, viz, PO Box 47, York YO1GA. Send an SAE to Freda for full details of membership of the club. R&EW

RUSSIAN ☆ SATELLITES

A guide to the reception and decoding of VHF signals from the USSR's navigation satellites, with full details of hardware, software and signal formatting



P Daly, D Bell and M Leybourne
Department of Electrical and Electronic Engineering
University of Leeds
and
PA Pitts
University Television Service
University of Leeds

PART ONE: GENERAL DESCRIPTION AND SIGNAL FORMATTING

Reception of signals at VHF frequencies from the low-orbiting navigational satellites belonging to the USSR is discussed in terms of circuit implementation and decoding of the 50 baud data. An interface with a minicomputer is described which allows automatic data logging followed by processing stages whose output defines the positions of the satellites in a group. This orbital data forms the basis for navigational computations enabling the observer to fix his position.

It is the purpose of this paper to describe receiving and processing equipment used to decode signals from all the satellites in the system, and to identify the different transmit frequencies in use.

1. INTRODUCTION

For the purposes of providing navigational position fixes by satellite the USSR and the USA operate systems giving worldwide coverage by means of low polar-orbiting satellites.

Both the USSR system[1] – sometimes called 'Cicada' – and the USA system[2] 'Transit', transmit very stable carrier frequencies at 400 and 150MHz. Dual frequencies are used to provide enhanced accuracy by accounting for ionospheric effects, although many receivers attempt to provide fixes by means of one frequency only.

Data from the satellite is transmitted in both systems at 50 baud, but whereas the Transit satellites send data at both transmit frequencies, the Soviet satellites only transmit data at the lower frequency. The data modulation schemes used differ considerably between the two systems, the Transit system operating a PSK modulation with data encoded in doublet form, and the 'Cicada' satellites using audio tones for both data and synchronisation purposes.

At present the USSR's VHF navigation satellites orbit the earth with a period close to 105 minutes, with an orbital inclination of around 83° and a height of 1000Km.

The satellites are divided into two groups, one with USSR identification numbers 1-8 and the other with numbers 11-14. The orbital planes of neighbouring satellites in each group are spaced by either 30° (group 1-8) or 45° (group 11-14) with the result that worldwide reception of one or other satellite is possible, on average, every hour or so.

Soviet identification numbers together with Cosmos number and international designation for all satellites in orbit in September 1983 are given in *Table1.*

The longest period between passes is naturally experienced by observers at the equator, whereas those at either pole will receive from one or other satellite every few minutes.

Each satellite transmits a signal near 150MHz towards earth, with a 50 baud data sequence AM modulated onto the main carrier. The information is encoded by means of three tones at 3 and 5KHz

Table 1

Soviet number	Cosmos number	International designation
01	1448	1983-023A
02	1386	1982-069A
03	1428	1983-001A
04	1459	1983-042A
05	1464	1983-048A
06	1417	1982-102A
07	1338	1982-003A
08	1181	1980-039A
11	1383	1982-066A
12	1304	1981-087A
13	1447	1983-021A
14	1339	1982-012A

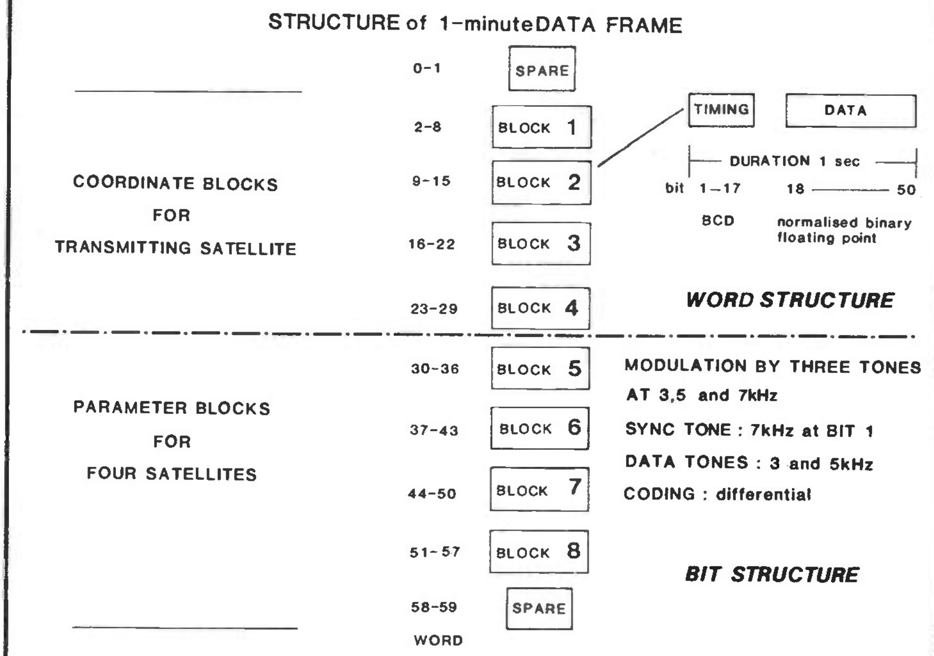


Fig 1a *Frame format of 60-word message*

(data differentially encoded) and 7KHz (synchronisation pulse at the beginning of every second).

1. 1 Time

One word of information lasts one second and contains 50 bits, commencing with the local (Moscow) time and followed by 32 data bits. A block of data contains 7 words and there are 8 blocks per frame of one minute, leaving 2 empty words at the beginning and end of each minute.

The blocks contain information relating to the orbital position of the satellites in normalised floating point notation.

This information, together with additional measurements by the observer of range rate from the satellite, forms the basic data required by a hyperbolic navigation system to fix the observer's own position in three dimensions.

2. GENERAL DESCRIPTION

The overall function of the satellite receiver on the ground is to demodulate the VHF carrier, to separate out and identify the data and synchronisation tones, to implement in software the computer interface and to process the binary information into meaningful output parameters.

Since the signal format holds the key to the understanding of all the receiving sub-systems, this is first explained in some detail with examples of typical data streams. With an understanding of the message content, the reader is then in a position to follow the details of the hardware and software implementation which come after.

3. SIGNAL FORMATTING AND MODULATION

3.1 Modulation scheme

As mentioned briefly in the introduction, the VHF carrier is amplitude modulated by one of three audio tones at 3, 5 and 7KHz. Each tone lasts 20mS and there are 50 tone bursts in one second. A transition between the 3 and 5KHz tones indicates a binary 'one', and no change indicates a binary 'zero'.

At the beginning of each second the 7KHz synchronising pulse, which remains on until the first non-zero data bit, is sent. The synchronising pulse may last a minimum of 1 bit (20mS) just before local midnight, to 18 bits (360mS) at local midnight – see the next section on data format.

3.2 Frame format

The data format employed by the Cosmos navigation satellites uses one minute frames divided into 60 words, each word lasting 1 second and containing 50 bits.

The 60 words of a frame are split into 8 blocks of 7 words each, with two empty words at the beginning and at the end of each frame. The word number then corresponds to the current second, with the first block starting at second 2 and the last block ending at second 58.

The frame format is shown in *Figure 1(a)* together with word and bit structure.

Each word of 50 bits contains information concerning the time of transmission and one of the satellite parameters. The first bit of each word is left empty to allow the sync pulse to last for at least one bit.

The sync pulse terminates as soon as the first non-zero data bit after bit 1 is met. The time then occupies bits 2-18 and is encoded BCD into hours (bits 2-6), minutes (bits 7-12) and seconds (bits 13-18) local Moscow time (MST – MST in summer is 3 hours ahead of GMT and 2 hours ahead of BST).

It follows that the sync pulse is shortest (1 bit long) when the hour number reaches 16 and that the sync pulse is longest (18 bits long) at midnight.

The binary data in each word from bit 19 to bit 50 contains information which, apart from some integer exceptions which are dealt with later, is encoded in the normalised binary floating point notation as follows:

bits 19-23: exponent E, with sign digit at bit 19;

Table 2

Word	Parameter	Parity bit number
1	ascending node longitude (east) in radians	50
2	inclination, i in radians	24
3	satellite ID semi-major axis in Kms	
4	constant 1, a + e x sin (ω)	19
5	constant 2, b + e x cos (ω) where e = eccentricity, ω = argument of the perigee and a and b are very small offsets from the centre of a circle obtained by plotting word 4 against word 5	19
6	orbital period (minutes)	19
7	time of ascending node with bits 20-23 month bits 24-28 day bits 29-33 hour bits 34-39 minute bits 40-50 part of minute	19

The signs of words 1, 2, 3 and 6 are always positive, of course, and the signs of words 4 and 5 are always to be taken as negative.

bit	19	27	35	43 50		
00.50.00	00000000	00000000	00000000	00000000		
00.50.01	00000000	00000000	00000000	00000000		
00.50.02	01101010	01001011	10011111	10100000	← X (km)	
00.50.03	01011011	00111100	01011011	00111100		
00.50.04	01101010	10100101	00100010	11111000		
00.50.05	00011110	10101111	01101100	01100101	← $\dot{X}$ (km/s)	Block 1
00.50.06	00000111	01111010	00010001	11001110		
00.50.07	00011010	01101110	11001010	00001110		
00.50.08	00010001	00000110	00000100	11111111		
00.50.09	01100011	10010011	01111011	00101100		
00.50.10	01011010	11100111	11101001	00100101	← Y (km)	
00.50.11	01101011	00000111	00010011	10101000		
00.50.12	10011111	00010010	11000000	00100001		Block 2
00.50.13	00000111	11111111	00000101	00101010	← $\dot{Y}$ (km/s)	
00.50.14	00010011	11010000	11111010	10111000		
00.50.15	01000111	00000110	01111101	11011111		
00.50.16	01101010	01001011	10011111	10100000		
00.50.17	01011011	00111100	01011011	00111100		
00.50.18	01101010	10100101	00100010	11111000	← Z (km)	
00.50.19	00011110	10101111	01101100	01100101		Block 3
00.50.20	00000111	01111010	00010001	11001110		
00.50.21	00011010	01101110	11001010	00001110	← $\dot{Z}$ (km/s)	
00.50.22	00010001	00000110	00000100	11111111		
00.50.23	01100011	10010011	01111011	00101100		
00.50.24	01011010	11100111	11101001	00100101	bits 27-37	
00.50.25	01101011	00000111	00010011	10101000	minute of day	
00.50.26	00011111	00010010	10000000	00100001	bits 19-26	Block 4
00.50.27	00000111	11111111	00000101	00101010	code word 1	
00.50.28	00010011	11010000	11111010	10111000	bits 38-50	
00.50.29	01000111	00000110	01111101	11011111	← code word 2	
00.50.30	00010111	11111001	11110011	00100011	← ascending node (rads)	
00.50.31	00001110	11100101	00111111	01000011		
00.10.32	00101111	10011001	10000010	00100010	← id, bits 19-23	
00.50.33	01001010	01001001	01011011	10010110		Block 5
00.50.34	01000110	10100000	11111010	00100011		
00.50.35	00111011	01000111	01011111	11000110		
00.50.36	00110111	01011000	11101110	11100101	sma, bits 25-50	
00.50.37	00001111	11100011	01010111	01110101		
00.50.38	00001110	11100101	01110111	10101000	← inclination (rads)	
00.50.39	00110011	10011001	00101111	11011010		
00.50.40	01001111	11001010	10100000	10000001	← a + e sin ω	Block 6
00.50.41	11000010	01011011	00110011	10111111	← b + e cos ω	
00.50.42	00111011	01000110	11101001	10101001		
00.50.43	00110111	01101100	10010011	10111110		
00.50.44	00011110	00110101	11000010	10110001		
00.50.45	00001110	11100101	00111101	10011001		
00.50.46	00111011	10011010	00001111	01101010		
00.50.47	11001111	11001001	10000111	11100111	orbital period	Block 7
00.50.48	01010111	01110111	11011100	00111000	(minutes)	
00.50.49	00111011	01001000	00011111	00111110	←	
00.50.50	10110111	01001101	10101000	11111010		
00.50.51	00001011	11101000	10000010	11100010		
00.50.52	00001110	11100101	01000001	10001111	bits 20-23, month	
00.50.53	01000111	10011001	10110110	00111010	bits 24-28, day	
00.50.54	11000010	01000101	10111001	00011110	bits 29-33, hour	Block 8
00.50.55	11000010	00110001	10000010	01111111	bits 34-39, minute	
00.50.56	00111011	01000111	10100010	00101111	bits 40-50, part	
00.50.57	10110111	01101000	10011110	01101101	←	
00.50.58	00000000	00000000	10000000	00000000		
00.50.59	00000000	00000000	10000000	00000000		

***Fig 1b** Binary and timing data for one Cosmos frame*

USSR Time 00:50:00

0 0 0 0

0 0 0 0

Block 1		Block 2	
X COORD. (KM)	4700.98828	X COORD (KM)	3661.92456
Y COORD. (KM)	1656.71277	Y COORD. (KM)	1487.82144
Z COORD. (KM)	5417.09277	Z COORD. (KM)	6200.61426
DX/DT (KM/S)	-5.37049544	*DX/DT (KM/S)	-.0960388798
DY/DT (KM/S)	-.869208544	DY/DT (KM/S)	-.999043137
DZ/DT (KM/S)	4.86554122	DZ/DT (KM/S)	3.81632567
CODEWORD #1	17	CODEWORD #1	71
CODEWORD #2	1279	CODEWORD #2	7647
MINUTE OF DAY	48	MINUTE OF DAY	51

Block 3		Block 4	
X COORD. (KM)	4700.98828	X COORD. (KM)	3661.92456
Y COORD. (KM)	1656.71277	Y COORD. (KM)	1487.82144
Z COORD. (KM)	5417.09277	Z COORD. (KM)	6200.61426
DX/DT (KM/S)	-5.37049544	*DX/DT (KM/S)	-6.14453519
DY/DT (KM/S)	-.869208544	DY/DT (KM/S)	-.999043137
DZ/DT (KM/S)	4.86554122	DZ/DT (KM/S)	3.81632567
CODEWORD #1	17	CODEWORD #1	71
CODEWORD #2	1279	CODEWORD #2	7647
MINUTE OF DAY	48	MINUTE OF DAY	51

Block 5		Block 6	
A.N.LONG (RAD)	3.97636622	A.N.LONG (RAD)	1.94402662
ORBIT INC(RAD)	1.44774827	ORBIT INC(RAD)	1.44817853
IDENTITY NUMBER	5	IDENTITY NUMBER	6
S.M.A (KM)	7372.06665	S.M.A (KM)	7369.49536
CONSTANT 1	1.11648132E-03	CONSTANT 1	-1.85132402E-03
CONSTANT 2	-2.56720389E-03	CONSTANT 2	2.30103353E-03
ORBITAL TIME (MIN)	104.921764	ORBITAL TIME (MIN)	104.864092
TIME OF NODE JUN 29	12.29.51.7089844	TIME OF NODE JUN 29	22.18.28.0664063

Block 7		Block 8	
A.N.LONGITUDE (RAD)	4.42000401	A.N.LONGITUDE (RAD)	1.95412356
ORBIT INC (RAD)	1.44773558	ORBIT INC (RAD)	1.4477658
IDENTITY NUMBER	7	IDENTITY NUMBER	8
S.M.A (KM)	7376.48169	S.M.A (KM)	7373.69458
CONSTANT 1	-1.84923338E-03	CONSTANT 1	2.21909757E-03
CONSTANT 2	-8.4672949E-04	CONSTANT 2	2.141989717E-03
ORBITAL TIME (MIN)	105.015255	ORBITAL TIME (MIN)	104.954191
TIME OF NODE JUN 29	6.53.7.32421875	TIME OF NODE JUN 29	20.19.48.1933594

0 0 128 0

0 0 128 0

*Note the decoding error in DX/DT owing to errors in bits 19 and 36

***Fig 1c** Processed data for one Cosmos frame*

bits 24-50: mantissa M, with sign digit at bit 24;

bit 25 is always 'one' and the binary point occurs between bits 24 and 25.

The decimal equivalent is simply:

$$M \times 2^E$$

where the binary digits from 25-50 have been converted into a decimal fraction.

For example, the binary sequence 10101011 01011001 01101101 00100110 is converted to:

E = 10101 (binary) = −5
M = 0.11011001.....= +.83733043
Decimal = $+0.83733043 \times 10^{-5}$

The only data not so coded are some integer values, for example satellite identification number and timing data, which are simply decoded as BCD numbers. Clearly bit 25 need not be 'one' for integer data values.

3.3 Block structure

A one minute data frame has 8 blocks of 7 words each, split into two groups; blocks 1-4 contain positional data on the transmitting satellite, and blocks 5-8 contain parameters of the Keplerian orbit of up to 4 satellites. The first and last two words in each frame are spare.

Details of the block structure are given in *Figure 1(b)*, which illustrates the precise layout of both co-ordinate and parameter blocks.

Blocks 1-4 of each one minute frame are redundant co-ordinate blocks of the transmitting satellite's position at three-minute intervals. Redundancy is incorporated by repeating blocks 1 and 2 in blocks 3 and 4.

Blocks 5-8 contain orbital parameters for up to 4 satellites, and the same blocks of the following frame are reserved for data concerning an additional 4 satellites. Thereafter this data is repeated every two minutes.

3.3.1 Co-ordinate blocks

The first two blocks give position x,y,z (words 1-3) and velocity x,y,z (words 4-6) of the transmitting satellite at two consecutive three-minute intervals. Word 7 contains the relevant minute of the day encoded in bits 27-37. Bits 19-26 and bits 38-50 of word 7 are not understood and merely decoded (codewords 1 and 2) as if they were integers. This data is repeated to give a total of 4 blocks.

3.3.2 Parameter blocks

The parameter blocks give details of the elliptic orbits of up to 4 satellites in the group (any others are given in the next frame). These parameters are as shown in *Table 2*.

This description of the frame format is derived from the original data first published by Wood and Perry[1]. It is repeated and extended here to assist the reader in translating the binary data shown in *Figure 1(b)*.

Figure 1(c) shows the decoded version of the binary data given in *Figure 1(b)*, as the interested reader may verify.

NEXT MONTH

The receive chain hardware is described, with an outline of the requirements and the techniques adopted

RF — SMALL SIGNAL AMPLIFIERS

A guide to overcoming the pitfalls of circuit design and construction

by James Dick

Frustration is a common feeling to newcomers in any hobby. Electronics is no exception and, indeed, is full of potential pitfalls not only for beginners but also for the more experienced. Frequently, a project is started with great enthusiasm but, when the moment of 'switch-on' arrives, this changes to disappointment. There are many causes of circuit malfunction, and simple wiring errors account for a significant fraction. However, electronics has other weapons in its armoury with which to baffle constructors.

Once the relatively safe ground of low frequency analogue and digital circuits is left behind and radio frequencies loom on the horizon, there are many hidden obstacles. Some, like stray capacitances, are purely a matter of careful constructional practice. Others lie deeper in the art of circuit design and the physics of the components themselves. One such area is the small-signal RF amplifier. Let us look at this useful species of circuit and discover some of the science behind the art.

The simple amplifier

Perhaps the simplest single-transistor amplifier can be designed in the common-emitter configuration. *Figure 1* shows the transistor and its dc bias components which ensure that the transistor is in its correct mode for amplification.

Let us, arbitrarily, decide on a supply voltage of 12 volts and a collector current of 1mA. The emitter resistor is chosen to give a voltage of 1.5 volts at the transistor's emitter, so that changes in the voltage drop from the base to the emitter due to temperature variations do not *significantly* change the emitter voltage. The bias resistors are chosen so that 100 microamperes flows in the bias chain (Rb1, Rb2) and the voltage at the base is 700mV above that at the emitter. The collector voltage is set by Rc to be mid-way between the emitter and supply voltages.

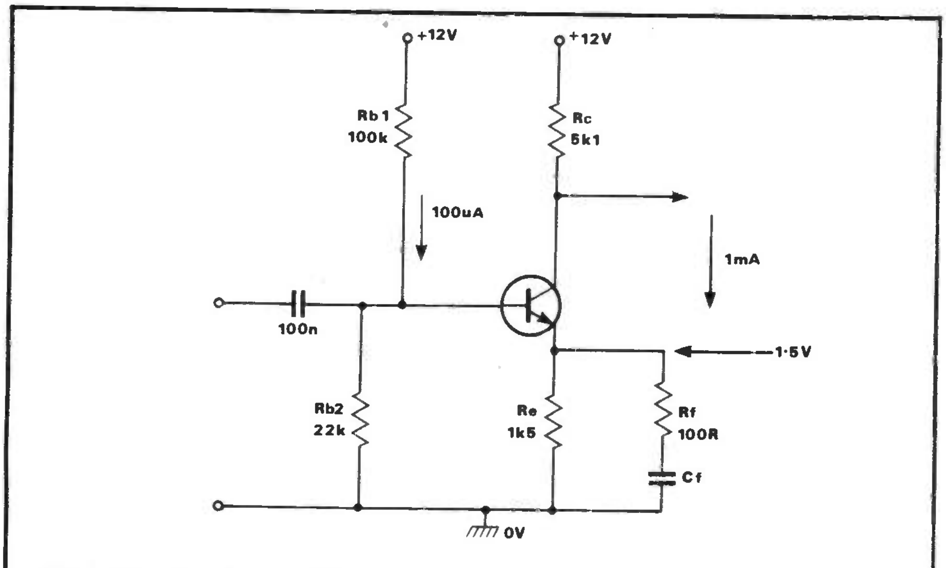


Fig 1 *Simple transistor amplifier*

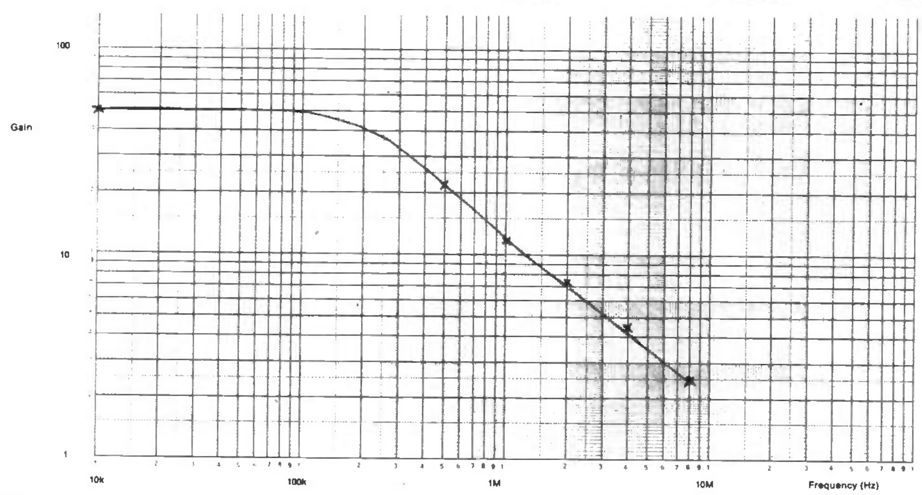


Fig 2 *Frequency response of simple amplifier*

ac signals

So far, the dc operating conditions have been set. To couple ac signals into and out of the circuit, Ci and Co are chosen to have a small impedance at the lowest frequency of interest.

Because of the negative feedback provided by Re, the circuit would only have a gain of about 3; Rf and Cf are inserted to reduce this feedback: Cf prevents Rf shunting Re at dc and so ruining the dc bias. Now the gain, Av, is approximately Rc divided by Rf, or nearly 50. Indeed, connecting a small 1KHz signal to the input, and an oscilloscope to the output shows that this is the case. Pass *'Go'*, collect £200. However, *Figure 2* illustrates what happens to the gain as the input frequency is increased. *Anybody for jail?*

Why does the circuit not function at higher frequencies? After all, the design is simple and often used. The reasons are fairly straightforward. *Figure 3* shows the model of the transistor that we used to calculate the circuit values for *Figure 1.* 'rb' and re represent resistances within the transistor, while Rc and Re are the component values of *Figure 1;* Rf (via Cf) has been absorbed into Re. By tracing

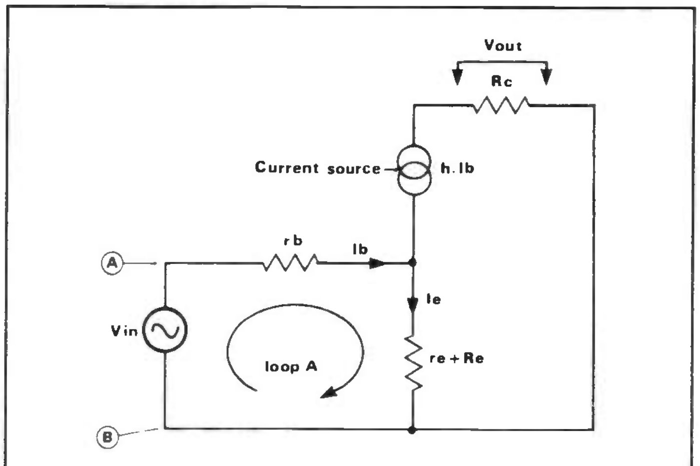


Fig 3 Basic transistor model

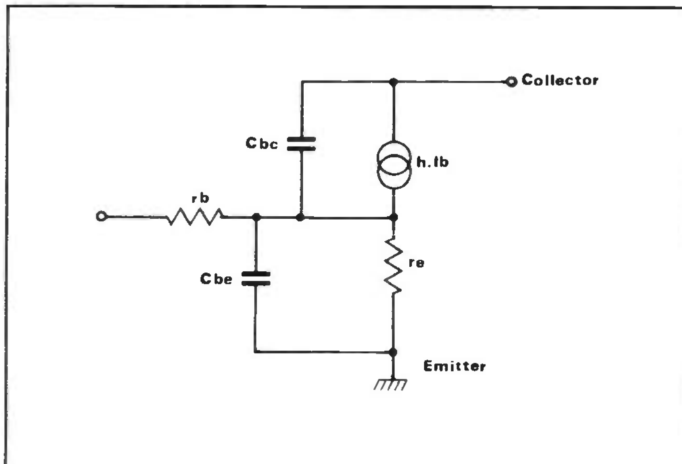


Fig 4 Capacitances in the transistor

round loop A from point A to point B, we see that the input voltage is equivalent to that developed across rb by Ib and that of (re + Re) by Ie, the emitter current:

$$V_{IN} = rb.Ib + (re + Re).Ie$$

Since Ie is the sum of the base current, Ib, and the amplified base current in the collector (shown as the current source) we can then write:

$$Ie = Ib + h.Ib$$

where h is the small signal gain of the transistor specified by the maker. The output voltage, seen across Rc, is simply (by Ohms Law):

$$V_{OUT} = h.Ib.Rc$$

so the gain is:

$$\frac{V_{OUT}}{V_{IN}} = \frac{h.Rc}{rb + (h + 1)(re + Re)}$$

Since rb is small compared to (h + 1) (re + Re), it may be ignored. 're' is near 25ohms and, on substituting in the other values, a gain of 50 is indeed obtained.

However, *Figure 3* has totally ignored the capacitances present within the transistor (let alone those of stray wiring, etc). *Figure 4* shows an improved model with two capacitances added: Cbc, between the base and the collector, and Cbe, between the base and the emitter. The former is caused by the varactor-like properties of the reverse-biased base-collector junction, and more will be said about it later. The latter is created by the charge transfer process within the semiconductor and it parallels re.

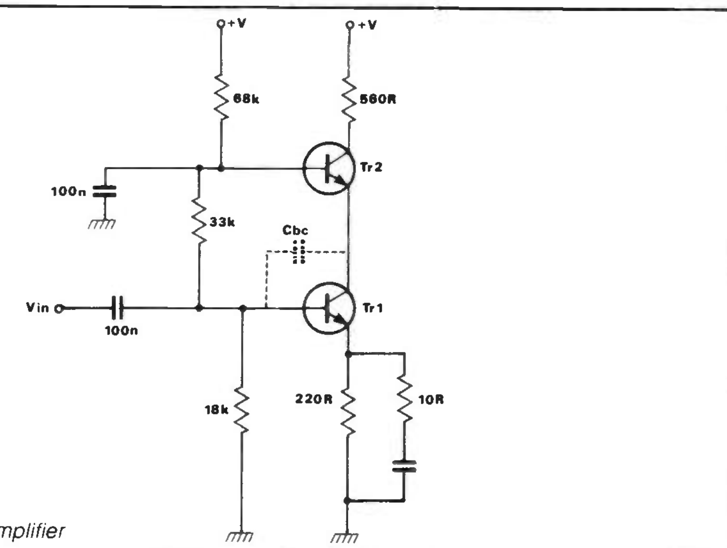


Fig 5 Cascode amplifier

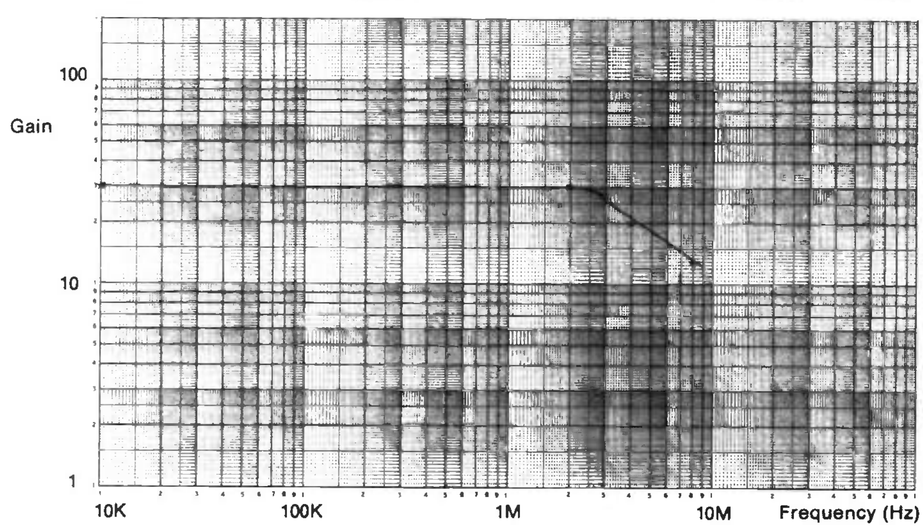


Fig 6 Cascode frequency response

Split

At high frequencies, the current flowing in through rb splits: some goes through re while the remainder goes through Cbe and effectively robs the transistor of current. At high enough frequencies, the current gain falls to unity.

The frequency at which this happens is quoted by the maker in the transistor's specification under the name of f_T. There is a wide range in the values of f_T. High-power, germanium transistors can be given values as low as a few hundred kilohertz, while a modern RF device may have an f_T in excess of a gigahertz.

Because Cbe increases as the emitter current in the transistor increases, its value has to be calculated from a simple equation:

$$Cbe = \frac{Ie\ (mA)}{2\pi f_T.25}$$

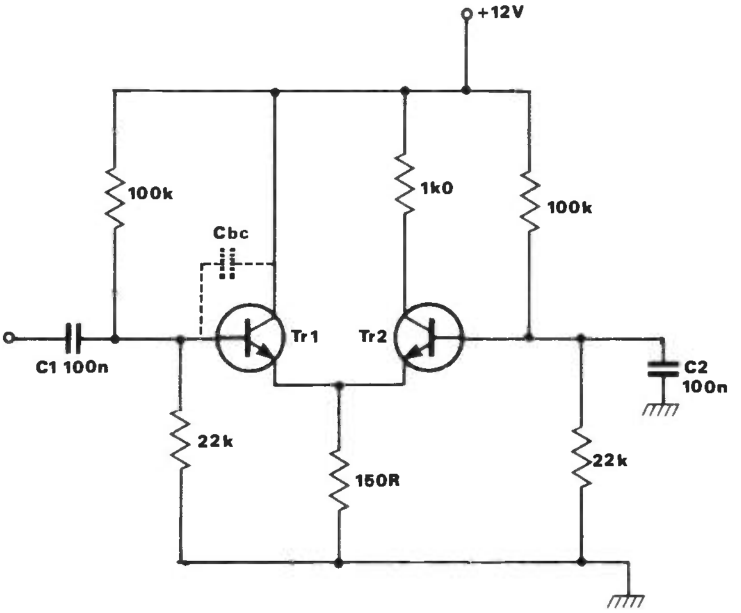


Fig 7 Long tailed pair configuration

So for Ie at 2mA, f_T at 300MHz, Cbe is 42pF – quite significant at even low RF.

Miller effect

The effect of the collector-base capacitance is even more significant. Because one end of Cbe is on an input-signal line and the other end is on the output point (transistor end of Re), the effect of Cbc on circuit operation is equivalent to a capacitor whose value is the product of Cbc and the low-frequency voltage gain. Hence, even a small capacitance (4pF, say) as Cbc when multiplied by the low frequency gain (x 100) becomes significant (400pF!). This is known as the *Miller effect.*

Another capacitor which limits the amplifier's frequency response is the load capacitance C_L. The effect of C_L is easily understood because each time the voltage on the transistor's collector changes, the charge difference on the capacitor has to be made up by current flowing through the collector resistance. Thus C_L tries to act like a small reservoir capacitor on a power supply and prevents high frequency operation.

Let us apply the capacitances to the circuit in *Figure 1.* The output frequency response is:

$$f = \frac{1}{R_L C_L}$$

So, when R_L = 5.1K and C_L = 20pF, f = 10MHz, which is not too serious a problem. The capacitance between the emitter and collector is so small (a few pF) that it has been ignored here; however, it *does* become important in the higher HF and VHF regions.

The main response degradation comes from the effects of Cbe and Cbc. The resistance seen by an input signal is the small-signal gain, h, multiplied by the sum of re and Rf. 're' is the intrinsic emitter resistance (within the transistor), and is 25ohms at 1mA (scales reciprocally with Ie). The capacitance is Cbe, as calculated above, and Cbc multiplied by the low frequency gain. So, with Cbe at 42pF, Cbc at 6pF, and h at 200:

$$f = \frac{1}{h(25 + 100)(42\text{pF} + 6\text{pF x}50)}$$

we obtain f = 120KHz. This will be dependent on exact transistor parameters and the variation of Cbc with the magnitude of the collector-base voltage, but it certainly gives us a ball-park figure for the start of the roll-off of the gain. Turning again to *Figure 2,* we see that the actual 3dB point is near 150KHz.

The cures

There are various cures for the capacitance problem. Transistor types should be carefully chosen to be designed for RF amplifiers – capacitances are then minimised. The transistors' operating current can be increased: this decreases re and so improves the frequency response. The circuit configuration may also be changed and, as this is the most interesting solution, we shall examine three designs which improve the HF response.

Earlier, we noted that the Miller effect – which multiplied the capacitance of Cbc by the low-frequency gain of the circuit – was caused by the large, asymmetric voltage variation across Cbc. The fact that one end sees an amplified voltage relative to the other end causes a 'feedback current' to flow through Cbc. This can be reduced by the use of two circuit designs.

The first, shown in *Figure 5,* is the cascode circuit (not to be confused with cascade). When a signal is injected into the base of Tr1, the transistor's collector voltage changes by the same amplitude – but with an opposite polarity. Hence, Cbc only sees a voltage variation of twice the input signal. The capacitance is therefore not multiplied by the low-frequency gain and so remains a few picofarads in value.

Secret

But how does this circuit produce gain? The secret lies in passing the variation in current through Tr1 onto a second transistor: Tr2. The variation in current through its collector resistor creates the output voltage signal – such a buffer-type of action is possible by tying Tr2's base to a fixed voltage considerably higher than Tr1's collector voltage. Because a transistor behaves as a current source, and current sources have very high impedances, there is very little coupling of the output voltage to Tr1's collector and thence to its base – so the Miller effect is greatly reduced. *Figure 6* shows the frequence response of the cascode circuit in *Figure 5.*

Although the cascode circuit is shown here with two bipolar transistors, Tr1 may be replaced by a FET (leaving Tr2 bipolar), or both may be replaced with FET types. The biasing arrangements change, of course, but the input resistance *rises,* and this is important in some applications where the signal source is of high impedance.

Another circuit design which avoids the Miller effect is the long-tailed pair – as illustrated in *Figure 7.* Here, Tr1 is used as an emitter follower. Tr1's base-collector capacitance only sees the input signal variations across it because the collector is tied directly to the positive supply. Gain is obtained by transferring the variation in Tr1's current to Tr2 – this assumes that the resistor attached to the emitters of both Tr1 and Tr2 behaves like a constant current sink.

The variation in the collector current of Tr2 causes the output voltage variation available at Tr2's collector. Note that Tr2 is really a version of the rarely-seen common-base amplifier, so called because the base of the transistor is 'common' to both input and output signals.

In this version of the long-tailed pair, the base of Tr2 is coupled to ground (for ac signals) by C2. The frequency response of this amplifier is similar to the cascode discussed above; the drop in gain around 3MHz is caused by the capacitance Cbe, which may be minimised by careful choice of transistor.

The poor f_T used here is merely for illustration.

The circuit in *Figure 7* may be changed to allow the gain to be voltage-controlled. By inserting a voltage-controlled current sink in the tail of the 'pair', the gain becomes variable – and lends itself to use in systems with AGC.

The last technique we shall look at is the tuned amplifier. Intended for amplifying a limited range of frequencies, a tuned circuit is inserted as the collector's ac load.

This has several advantages. The inductor/capacitor in the tuned load effectively nulls out troublesome circuit capacitances, while the near-zero dc resistance of the coil allows an arbitrary collector current to be set by the designer. The ac signal can be transferred between stages of the amplifier by transformers, with each 'side' acting as a tuned circuit. The most obvious application of this configuration is in intermediate frequency amplifiers where a broadband response is not required and the selectivity obtained by the successive tuned sections is an advantage.

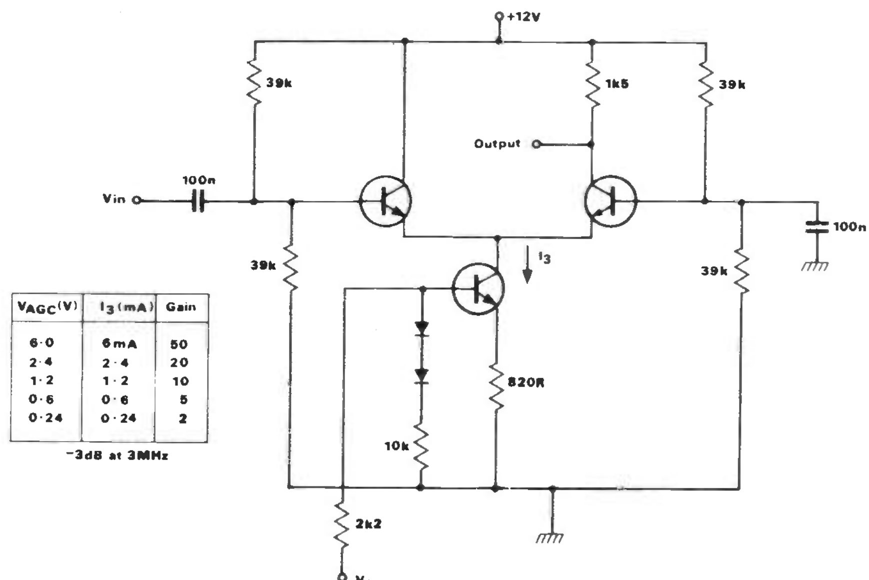
However, despite the science introduced into HF amplifier design, the subject is still an art. The circuits depend so much on capacitance values that transistor types have to be carefully chosen – even then, the values are variable with circuit bias voltages and currents! With care, simple amplifiers may be built which give useful gain into the VHF region.

Other fields

While circuits with good HF responses are obviously required as RF signal amplifiers, there are other areas which have similar needs. In order to amplify pulses with sharp edges, the amplifier used must have gain up to ten times the pulse repetition frequency – to faithfully copy a 1MHz square wave, constant gain to 10MHz (at least) is required.

Such pulses are common when dealing with the output from Geiger-Muller tubes (used to detect nuclear radiation) and photo-multiplier devices in science. As fabrication techniques have improved, digital electronics have increased in speed – microprocessors with clock rates of 10MHz and more are now in everyday use.

Because transistors in digital circuits are operated outside their linear region, other effects must be taken into account. The base of a saturated transistor stores charge and, when the base signal changes, the surplus charge delays the transistor's response. Delays of several hundred nanoseconds are not uncommon with general purpose transistors – such delays can be the equivalent of a few processor cycles. The simplest way of preventing this performance degradation is to keep the transistor in its linear region – the penalty is paid in signifi-



V_{AGC}(V)	I_3(mA)	Gain
6·0	6mA	50
2·4	2·4	20
1·2	1·2	10
0·6	0·6	5
0·24	0·24	2

−3dB at 3MHz

Fig 8 *AGC amplifier*

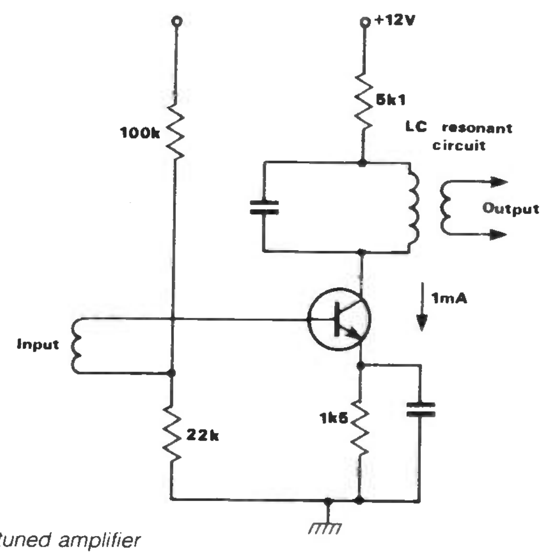


Fig 9 *Typical tuned amplifier*

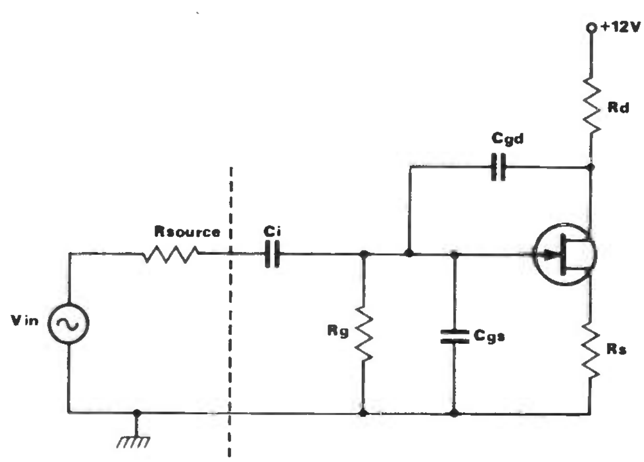


Fig 10 *Capacitances in the FET amplifier*

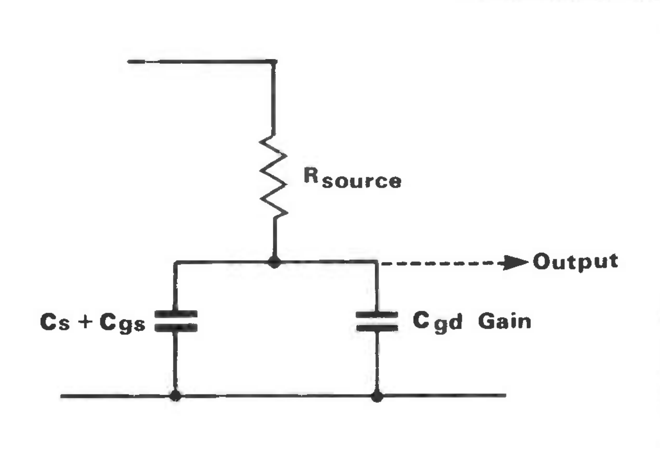


Fig 11 *Equivalent input stage*

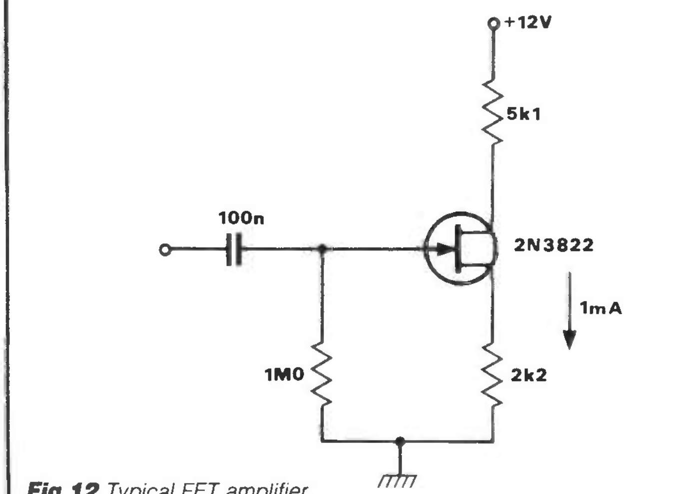


Fig 12 *Typical FET amplifier*

cantly higher power consumption.

FET capacitances

Just like their bipolar cousins, FET devices suffer from capacitive effects which degrade their performance as RF amplifiers. The model of the FET, with all capacitances shown, is illustrated in *Figure 10.* C1 is the dc-decoupling capacitor while C_{gd} and C_{gs} are internal capacitors within the device. Although both are specified for some devices with the above titles, manufacturers sometimes quote C_{gss} (also called C_{iss}) and C_{dss} (also called C_{oss}). However, C_{gd} and C_{gs} are both easily found from C_{gss} and C_{dss} by the following formulae:

$$(C_{gs} = C_{gss} - C_{dss})$$

and:

$$(C_{gd} = C_{dss} = \text{(approx) } C_{rss})$$

Note that C_{rss} is also occasionally used. This is the algebraic sum of C_{gd} and C_{ds}. The latter is an extremely small capacitance between the drain and source. It may be ignored in most instances. Typically, C_{gs} is around 4pF and C_{gd} around 2pF for JFETS intended for amplifiers; devices designed for analogue switches may have C_{gs} near 20pF.

Following on from the description of the bipolar circuitry, C_{gd} is amplified by the Miller effect in simple configurations. Of course, the cascode design will always reduce the effect of C_{gd} multiplication. The -3dB point is found by treating R_{source}, the combined input capacitances (ie any signal-source capacitance and C_{gs}), and C_{gd} (multiplied by the low-frequency gain) as a simple serial RC circuit *(Figure 11)*. Then:

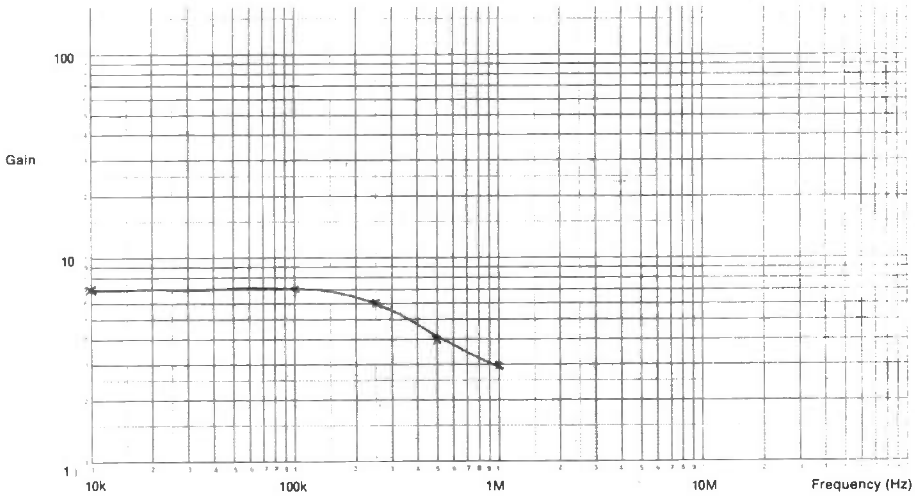


Fig 13 *FET amplifier frequency response*

$$f = \frac{1}{2\pi R_{source}\left[C_{gs} + C_{source} + (1 + \text{gain})C_{gd}\right]}$$

A simple amplifier is shown in *Figure 12.* The source resistance was 10kilohms and 20pF, C_{gd} was 2pF and C_{gs} 4pF. The gain (measured at 1KHz) was 7. From the formula, the -3dB point should be 400KHz; the actual frequency response is shown in *Figure 13.* REW

DATA FILE . . .

Ray Marston continues his survey of opto-electronics principles and systems with an in-depth look at practical LED 'chaser' and 'bar-graph' circuits.

In last month's edition of *Data File* we gave a basic introduction to the general subject of opto-electronics, and went on to take a detailed look at LED (light-emitting diode) principles and at a number of practical LED 'flasher' circuits. In the present edition of 'The File' we'll look at a number of practical LED 'chaser', 'dot-' and 'bar-graph' display circuits.

'Chaser' principles & the 4017B

One of the most popular types of LED display circuit is the so-called 'chaser' or 'sequencer', in which an IC (or other electronic device) is arranged to drive an array of LEDs in such a way that individual LEDs (or small groups of LEDs) turn on and off in a pre-determined and repeating sequence, thereby producing a visually attractive display in which a ripple of light seems to run along a chain.

Probably the most popular IC used in 'chaser' applications is the 4017B CMOS chip. This device is actually a decade counter/divider IC with ten decoded outputs, each of which can be used to directly drive an LED display. If desired, outputs can be coupled back to the IC control terminals to make the device count to, or divide by, any number from 2 to 9 and then either stop or re-cycle.

Numbers of 4017B ICs can easily be cascaded to give either multi-decade division, or to make counters with any desired number of decoded outputs. The 4017B is thus an exceptionally versatile device that can easily be used to 'chase' or 'sequence' an LED display of virtually any desired length.

Figure 1 shows the outline, pin designations, and the functional diagram of the 4017B, and *Figure 2* shows the basic timing diagram of the device, which incorporates a 5-stage Johnson counter and features CLOCK, RESET, and CLOCK INHIBIT input terminals.

The internal counters are advanced one count at each positive transition of the input clock signal when the CLOCK INHIBIT and RESET terminals are low. Nine of the ten decoded outputs are low, with the remaining output high, at any given time. The outputs go high sequentially, in step with the clock signal, with the selected output remaining high for one full clock cycle.

An additional CARRY OUT signal completes one cycle for every ten clock input cycles, and can be used to ripple-clock additional 4017B ICs in multi-decade counting applications.

The 4017B counting cycle can be inhibited by setting the CLOCK INHIBIT terminal high. A high signal on the RESET terminal clears the counter to zero and sets the decoded '0' output terminal high.

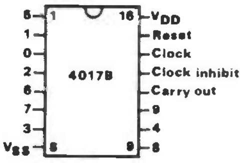


Fig 1a *Outline and pin designations of 4017B*

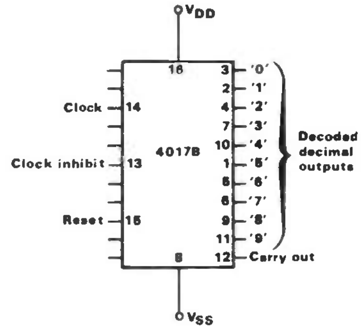


Fig 1b *Diagram and data for the 4017B*

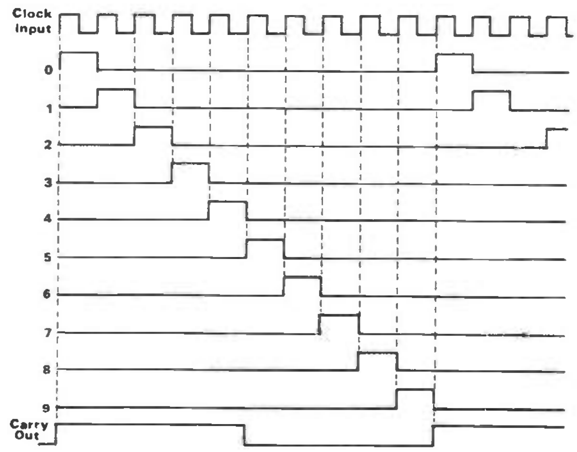


Fig 2 *Waveform timing diagram of the 4017B*

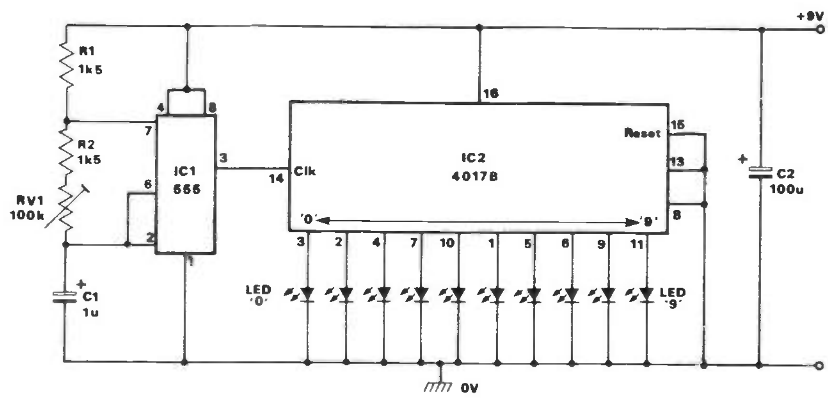


Fig 3 *10-LED chaser or sequencer can be used with <9V supply*

4017B chaser/sequencer circuits

Figure 3 shows the practical circuit of a 4017B 10-LED chaser, in which ICl (a 555 timer chip connected in the astable mode) is used as a variable-speed (via RV1) clock generator, and the 4017B is wired into the 'decade counter' mode by grounding its CLOCK INHIBIT (pin 13) and RESET (pin 15) control terminals.

The action of the *Figure 3* circuit is such that the visual display appears as a moving 'dot' which repeatedly sweeps from the left (LED '0') to right (LED '9') in ten discrete steps as the 4017B outputs sequentially go high and turn the LEDs on. The LEDs do not, of course, have to be arranged in a straight line: they can, for example, be arranged as a circle, in which case the 'dot' will seem to rotate.

Note that the LEDs in the *Figure 3* circuit are not provided with current-limiting resistors, and that the circuit can safely be used only with supply voltages up to 9 volts. The decoded outputs of the 4017B provide inherent current-limiting under short circuit conditions.

The manufacturers do not quote a maximum short-circuit current value, but practical experience indicates that currents of 10 – 15mA are commonly available from the device. The maximum device dissipation-per-output-stage figure of 100mW is quoted on some data sheets, indicating that a voltage drop up to about 7 volts can safely be developed across a 4017B output stage under maximum-current conditions.

Thus, the LED chaser circuit of *Figure 3,* which has each LED connected directly between an output and ground, can safely be used up to maximum supply values of 9 volts (allowing for a 2 volt drop across each 'on' LED).

Greater

At voltages greater than 9 volts, the circuit of *Figure 4,* which has a current-limiting resistor wired in series with each LED, should be used. Note that the main purpose of these resistors is that of reducing the power dissipation of the 4017B.

A variant that is sometimes used is shown in *Figure 5,* and can be used with reasonable confidence at supply values up to 12 volts maximum.

Figure 6 shows a possible equivalent of this circuit when it is powered from a 15 volt supply, and illustrates the defect of the design. The action of the 4017B is such that, when a given LED is on, the anodes of all other LEDs are effectively grounded: R1 thus causes the 'off' LEDs to be reverse biased.

Because of the low reverse-voltage ratings of LEDs, it will often be found that one of the 'off' LEDs will zener at about 5 volts, giving the results shown in the diagram and possibly causing a destructive power overload in one of the 4017B output stages.

Thus, when the 4017B is used to drive LED displays in the 'moving dot' mode, the LEDs can be connected directly to the IC outputs if supply values are limited to 9 volts maximum. At supply values greater than 9 volts, the LEDs must be connected to the IC outputs via current-limiting resistors.

A variety of display circuits are shown in *Figures 7* to *14.*

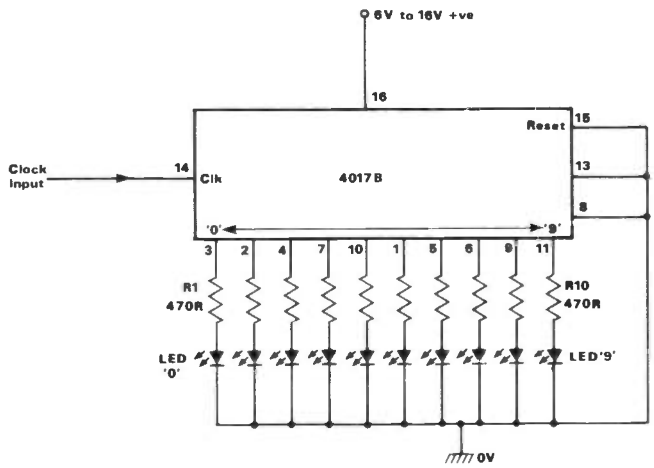


Fig 4 *This version of the 10-LED chaser can be used with supplies ≤15V*

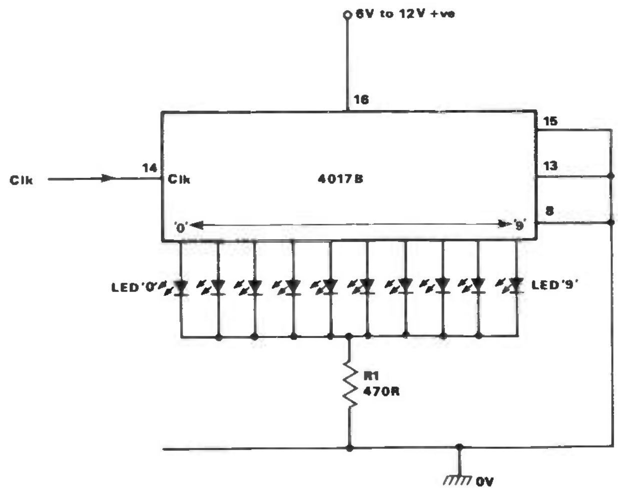


Fig 5 *This version of the chaser can be used with supplies ≤12V*

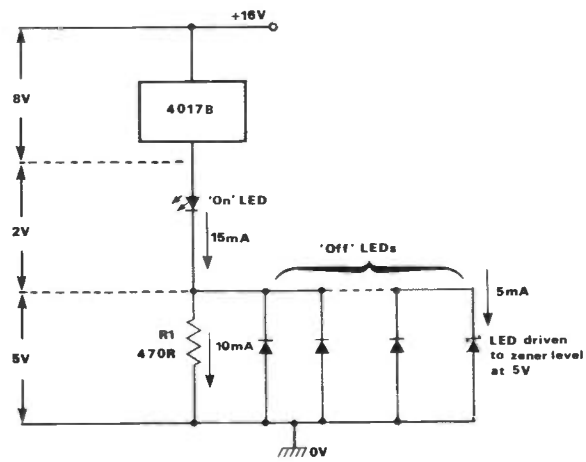


Fig 6 *Possible equivalent of the Fig 5 circuit with a 15V supply*

Alternative LED displays

The output stages of the 4017B can source or sink currents with equal ease.

Figure 7 shows how the IC can be used in the 'sink' mode to make a 'moving hole' LED display, in which nine of the ten LEDs are on at any given time, with single LEDs turning off sequentially. If the LEDs are arranged in the form of a circle, the circle will seem to rotate.

Note in this circuit that, since all LEDs except one are on at any given time, they must all be provided with current-limiting resistors to keep the IC power dissipation within reasonable limits.

Moving dot displays are, in practice, far

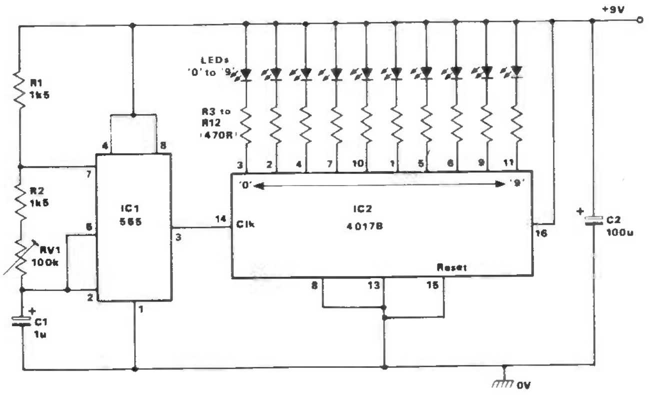


Fig 7 10-LED 'moving hole' display

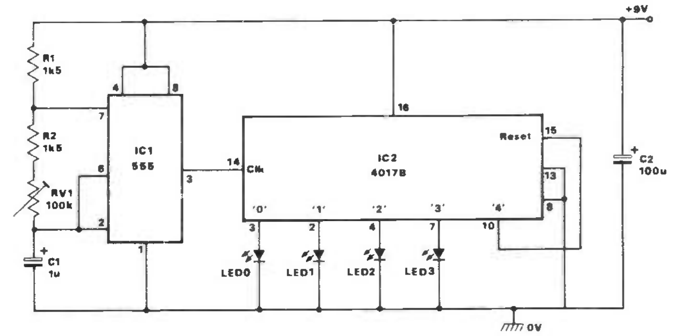


Fig 8 4-LED continuous 'moving dot' display

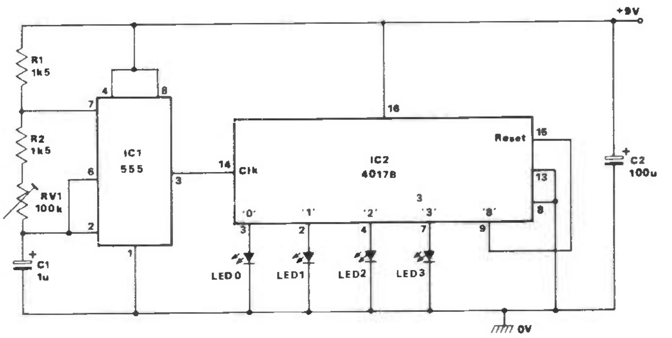


Fig 9 4-LED intermittent 'moving dot' display with 50% 'blank' period

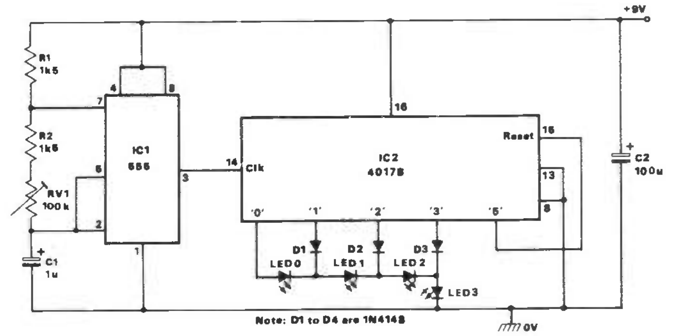


Fig 10 Circuit of a 4-LED 5-step sequential turn-off display

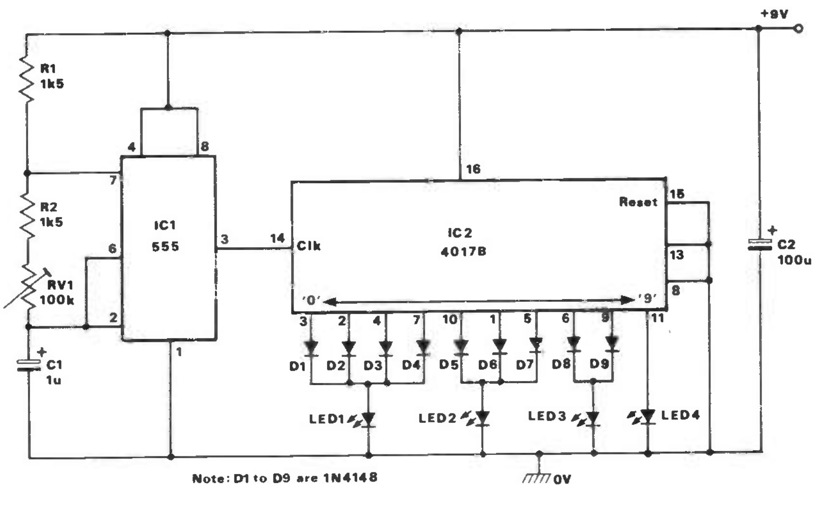


Fig 11 4-LED continuous 'accelerator' display

more popular than the moving hole types. Moving dot displays of the *Figure 3* type can be used with fewer than ten LEDs by simply omitting the unwanted LEDs, but in this case the dot will seem to move intermittently, or to 'scan', since the IC takes ten clock steps to completely sequence and all LEDs will thus be off during the 'unwanted' steps.

If a continuously-moving less-than-10-LED display is required, this action can be obtained by connecting the first 'unused' output terminal of the 4017B to its pin-15 RESET terminal, as shown (for example) in the 4-LED circuit of *Figure 8*.

Alternatively, the circuit can be made to give an intermittent display with a controlled number of 'off' steps by simply taking the appropriate one of the 'unwanted' outputs to the pin-15 RESET terminal. In *Figure 9*, for example, the LEDs 'display' for four steps and then 'blank' for four steps, after which the sequence repeats.

Figure 10 shows a rather unusual and very attractive 4-LED 5-step sequencer, in which all four LEDs are initially on but then turn off one at a time until eventually (in the 5th step) all four LEDs are off.

Note in this circuit that the LEDs are effectively wired in series and that the basic circuit cannot be used to drive more than four LEDs.

Figure 11 shows another unusual and attractive LED display. In this case the 4017B runs through a 10-step sequence, with LED1 on for steps '0' to '3', LED2 on for steps '4' to '6', LED3 for steps '7' to '8', and LED4 on for step '9'.

The consequence of this action is that the visual display seems to accelerate from LED1 to LED4, rather than sweep smoothly from one LED to the next. The acceleration action repeats *ad infinitum*.

Figure 12 shows how the above circuit can be modified to give an intermittent display, in which the visual 'acceleration' action occurs for 10 clock cycles but all LEDs then blank for the next 20 cycles,

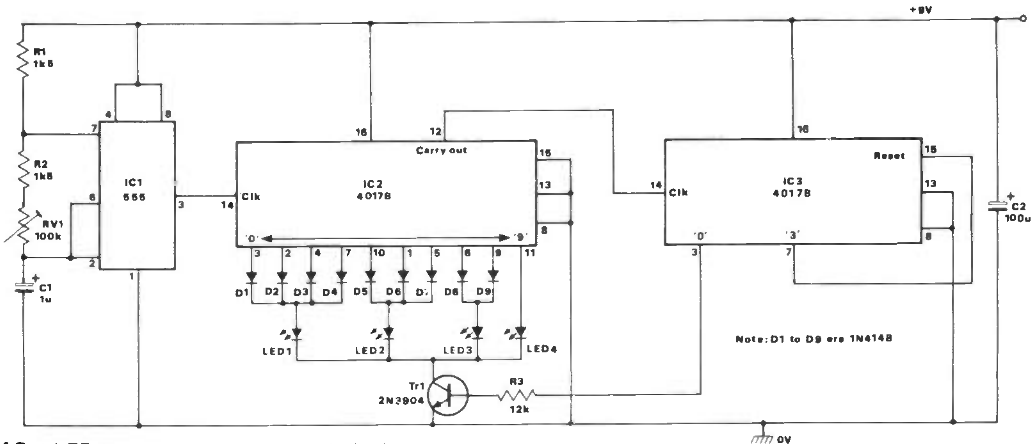


Fig 12 4-LED intermittent 'accelerator' display

Fig 15 Bar-graph indi

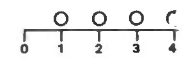
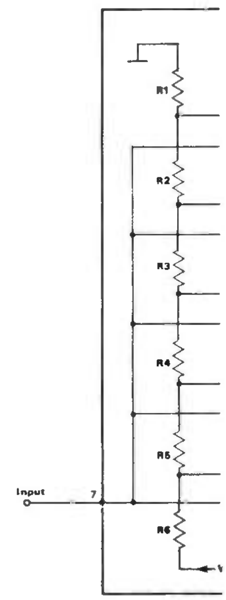


Fig 16 'Dot' indication



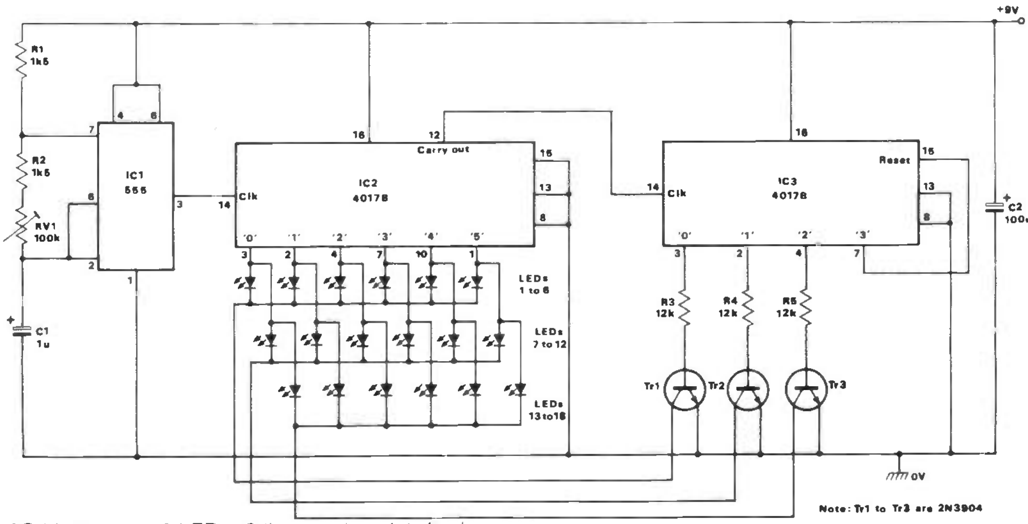


Fig 13 Multiplexed 6-LED x 3-line moving dot display

Fig 17 Block diagram

after which the action repeats. The action of this circuit is as follows:

The 4017B has a CARRY OUT terminal at pin 12. When the IC is used in the divide-by-10 mode, as in *Figures 11* and *12*, this terminal produces one output cycle each time the IC completes a decade count.

In *Figure 12*, this signal is used to clock a second 4017B (IC3), which is connected in the divide-by-3 mode, with its '0' output fed to gating transistor Tr1. Consequently, for the first ten cycles of a sequence the '0' output of IC3 is high and Tr1 is biased on, so IC2 acts in the manner already described for *Figure 11*, with its LEDs turning on sequentially and passing current to ground via Tr1. After the 10th clock pulse however, the '0' output of IC3 goes low and turns Tr1 off, so the LEDs no longer illuminate, even though IC2 continues to sequence.

Eventually, after the 30th clock pulse, the '0' output of IC3 again goes high and turns Tr1 on, enabling the display action to re-occur.

Figure 12 is a simple example of display 'multi-plexing', in which IC3 and Tr3 are used to enable or disable a bank of LEDs. *Figure 13* shows a further example of a multiplexing circuit, in which three lines of six intermittently-sequenced LEDs are sequentially enabled via IC3 and individual gating transistors, with only one line enabled at any one time. This basic circuit can in fact be expanded to control a ten line (100 LEDs) matrix display.

Finally, to complete this look at 'sequencer' circuits, *Figure 14* shows the circuit of a 4-bank 5-step 20-LED chaser. Note here that a bank of four LEDs is wired in series in each of the five used outputs of the 4017B, so that four LEDs are illuminated at any given time.

In practice, roughly 2 volts are dropped across each 'on' LED, giving a total drop of about 8 volts across each 'on' bank, so

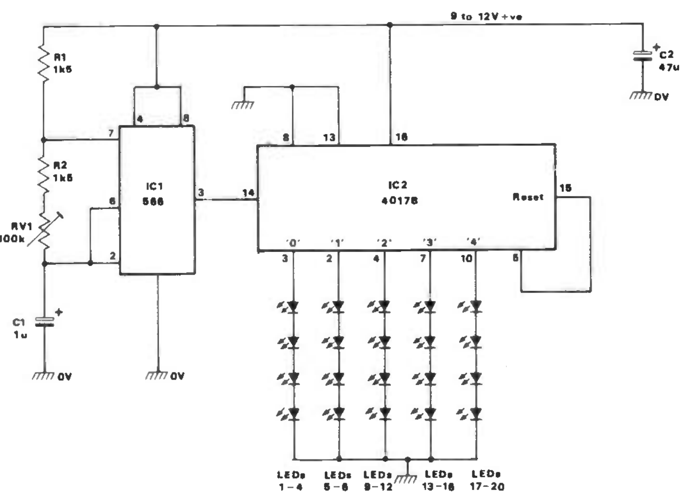
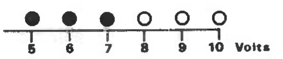
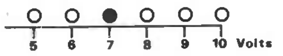


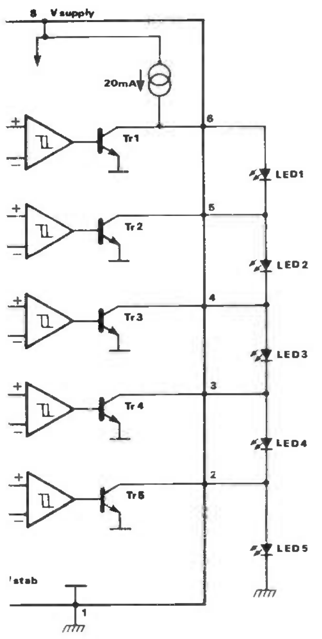
Fig 14 This 4-bank 5-step 20-LED chaser must be used with a supply >9V



cation of 7V on a 10V 10-LED scale



of 7V on a 10V 10-LED scale



of the U237B -type bar-graph driver

VIN	1	2	3	4	5
1.0V	OFF	OFF	OFF	OFF	OFF
0.8V	OFF	OFF	OFF	OFF	ON
0.6V	OFF	OFF	OFF	ON	ON
0.4V	OFF	OFF	ON	ON	ON
0.2V	OFF	ON	ON	ON	ON
0V	ON	ON	ON	ON	ON

Fig 18 *States of the U237B internal transistors at various input voltages*

the circuit supply voltage must be greater than this value for the circuit to operate. A greater number of LEDs can be used in each bank if the supply voltage value is suitably increased.

'Bar-graph' displays

Another type of multi-LED indicator circuit is the so-called 'analogue-value' indicator, which is designed to drive a chain of linearly-spaced LEDs in such a way that the length of chain that is illuminated is proportional to the analogue value of a voltage applied to the input of the LED-driver circuit, ie so that the circuit acts like an analogue voltmeter. These circuits may be designed to produce either a 'bar-graph' display, as shown in *Figure 15,* or a 'dot' display, as in *Figure 16.* In a 'bar-graph' display, the input value is indicated by the total number of LEDs that are illuminated. In the 'dot' display, the input value is indicated by the relative position of a single illuminated LED.

Special ICs are available for operating LED analogue-value display systems. The most useful of these are the U237 family from AEG, and the LM3914 family from National Semiconductor.

The U237 family are simple 'dedicated' devices which can usefully be cascaded to drive a maximum of 10 LEDs in 'bar' mode only. The LM3914 family are more complex and highly versatile devices, which can easily be cascaded to drive as many as 100 LEDs, and can drive them in either 'bar' or 'dot' mode. Both types are listed as 'bar-graph driver ICs'.

IC-driven bar-graph displays make inexpensive and superior alternatives to analogue-indicating moving-coil meters. They are immune to 'sticking' problems, are fast acting, and are unaffected by vibration or attitude. Their scales can easily be given any desired shape.

In a given display, individual LED colours can be mixed to emphasise particular sections of the display, and 'over-range' detectors can easily be activated from the driver ICs and used to sound an alarm and/or flash the entire display under the over-range condition. They also have better linearity than conventional moving-coil meters, typical linear accuracies being 0.5%. Scale definition depends on the number of LEDs used; a 10-LED display gives adequate resolution for most practical purposes.

We'll look at a range of practical U237-based bar-graph display circuits in the remaining section of this edition of *Data File*, and go on to look at some LM3914-based designs next month.

U237 basics

The AEG U237 family of bar-graph driver ICs are simple, dedicated devices, housed in 8-pin DIL packages and each capable of directly driving up to five LEDs.

The family comprises four individual devices. The U237B and U247B produce a linear-scaled display and are intended to be used as a 'pair', driving a total of ten LEDs. The U257B and U267B produce a log-scaled display, and are also meant to be used as a 'pair' driving a total of ten LEDs.

All ICs of the U237 family use the same basic internal circuitry, which is shown in block diagram form (together with external connections) in *Figure 17.*

The IC houses five complete sets of Schmitt voltage-comparator/transistor-switches, each of which has its threshold switching or 'step' voltage individually determined by a tapping point on the R1 to R6 voltage divider, which is powered from a built-in voltage regulator: the input of each comparator is connected to the pin-7 input terminal of the IC. The IC also houses a constant-current generator (20mA nominal), and the five external LEDs are wired in series between this generator and ground (pin 1), as shown in the diagram.

The basic circuit action is such that groups of LEDs are turned on or off by activating individual switching transistors within the IC. Thus, if Tr3 is turned on it sinks the 20mA constant-current via LEDs 1 and 2, so LEDs 1 and 2 turn on and LEDs 3 to 5 turn off.

The U237B has step voltages spaced at 200mV intervals, and *Figure 18* shows the states of its five internal transistors at various values of input voltage. Thus, at zero volts input, all five transistors are switched on, so Tr1 sinks the full 20mA of constant current, and all five LEDs are off. At 200mV input, Tr1 turns off but all other transistors are on, so Tr2 sinks the 20mA via LED1, driving LED1 on and causing all other LEDs to turn off, and so on.

Eventually, at 1.0 volt input, all transistors are off and the 20mA flows to ground via all LEDs, so all five LEDs are on. Note that the operating current of the circuit is virtually independent of the number of LEDs turned on, so the IC generates negligible RFI as it switches transistors/LEDs.

The four ICs in the U237 family differ only in their values of 'step' voltages,

DEVICE	STEP 1	STEP 2	STEP 3	STEP 4	STEP 5
U237B	200mV	400mV	600mV	800mV	1.00V
U247B	100mV	300mV	500mV	700mV	900mV
U257B	0.18V/-15dB	0.53V/-6dB	0.84V/-1.5dB	1.19V/+1.5dB	2.0V/+6dB
U267B	0.1V/-20dB	0.32V/-10dB	0.71V/-3dB	1.0V/0dB	1.41V/+3dB

Fig 19 *Step-voltage values of the U237 family of bar-graph driver ICs*

PARAMETER	MIN	TYP	MAX
Supply voltage	8V	12V	25V
Input voltage			5V
Input current			0.5mA
Max supply current		25mA	30mA
Power dissipation (at 60°C)			690mW
Step tolerance	-30mV		+30mV
Step hysteresis		5mV	10mV
Input resistance		100K	
Output saturation voltage			1V0

Fig 20 *General specification of the U237 family of ICs*

which are determined by the R1 to R6 potential divider values. The table of *Figure 19* shows the step values of the four ICs. Note that the U237B and U247B are linearly scaled, and can be coupled together to make a 10-LED linear meter with a basic full-scale value of 1 volt. The U257B and U267B are log scaled, and can be coupled together to make a 10-LED log meter with a basic full-scale value of 2.0 volts or+6dB.

Figure 20 shows the basic specification of the U237 family of ICs. Note that the supply voltage range is specified as 8 to 25 volts. In practice, the minimum supply voltage is one of the few design points that must be considered when using these ICs, and must be at least equal to the sum of the 'on' voltages of the five LEDs, plus a couple of volts to allow correct operation of the internal circuitry. Thus, when driving five red LEDs, each with a forward voltage drop of 2V0, the supply value must be at least 12 volts. Different-coloured LEDs (with different forward voltage drops) can be used together in the circuit, provided that the supply voltage is adequate.

Another 'usage' point concerns the input impedance of the IC. Although the input impedance is typically 100K, the IC in fact tends to become unstable if fed from a source impedance greater than about 20K. Ideally, the signal feeding the input should have a source impedance less than 10K; if the source impedance is greater than this, stability can be enhanced by wiring a 10n capacitor between pins 7 and 1.

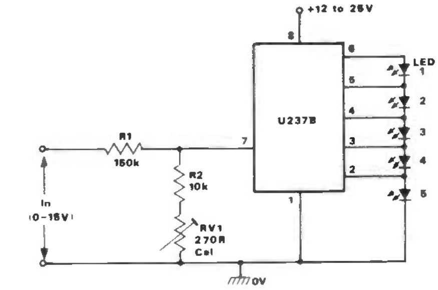


Fig 23 *The Figure 21 circuit modified to O-15V*

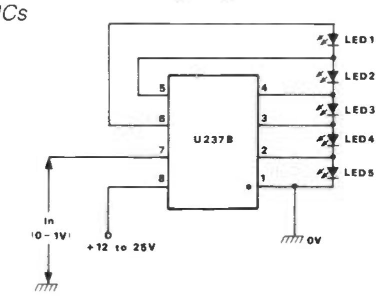


Fig 21 *Connection for a O-1V 5-LED meter*

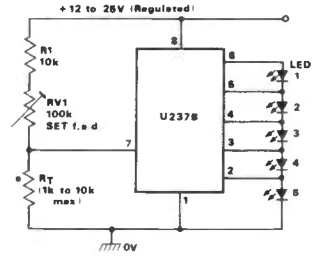


Fig 24 *Indicating heat, light etc using a transducer sensor*

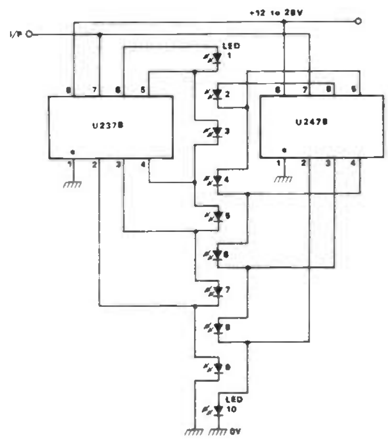


Fig 22 *Connections for a O-1V 10-LED meter*

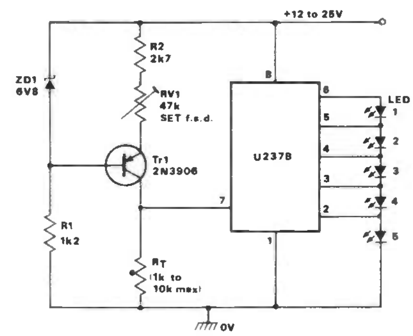


Fig 25 *Alternative to the Figure 24 circuit*

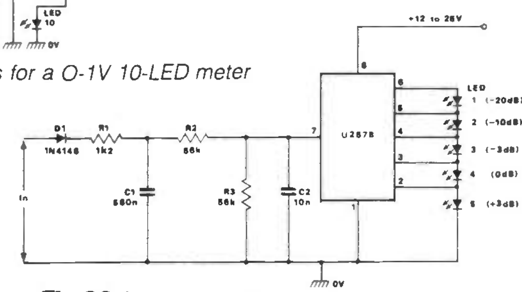


Fig 26 *A 5-LED AF-level meter.*

Practical U237 circuits

Figures 21 to *26* show some practical ways of using the U237 family of devices. In all these diagrams, we have shown the supply voltage as being '+12 to 25 volts', but the reader should keep in mind the constraints already mentioned.

Figure 21 shows the practical connections for making a 0 - 1 volt 5-LED linear-scaled meter, using a single U237B IC, and *Figure 22* shows how a U237B/U247B pair of ICs can be coupled together to make a 0 - 1 volt 10-LED linear-scaled meter.

Note in the latter case that the two ICs are operated as individual *'Figure 21'* style circuits (needing only a '5-LED' supply voltage), but have their input terminals tied together and have their LEDs *physically* alternated, to give a 10-LED display.

Figure 23 shows how the full-scale sensitivity of the basic circuit can be reduced by feeding the input signal to the IC via the R1 and R2-RV1 potential divider, which has a 15:1 ratio and thus gives a full-scale sensitivity of 15 volts.

Figures 24 and *25* show how the basic *Figure 21* circuit can be used to indicate the value of a physical parameter (such as light, heat, etc) that can be represented by the analogue resistance value of transducer R_T.

In both cases, the transducer is effectively fed from a constant-current source, so that the input voltage to the IC is directly proportional to the transducer resistance value.

In *Figure 24*, the transducer current is derived from the regulated supply line via R1-RV1, and current constancy relies on the fact that the regulated supply voltage is large relative to the 1 volt full-scale sensitivity of the meter. In *Figure 25*, current constancy is ensured by the ZD1-Tr1-etc constant-current generator.

Finally, to complete this month's edition of *Data File*, *Figure 26* shows how the U267B 'log' IC can be used to make a 5-LED audio-level meter. A 10-LED meter can be made by connecting the R1-R2-R3-C1-D1 input circuit to the input of a U257B/U267B pair of ICs connected in the *Figure 22* configuration. REW

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SWG22 ...... 95p
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En copper per 2oz
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 45p
3 core Round 3A
35p
Round 6A 50p
Round 13A 80p

Power
1 mm T&E 40p
1.5 mm T&E ... 45p
2.5 mm T&E ... 60p
6 mm T&E 150p
TV COAX 40p
Screened Single
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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 26p
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 ...... 45p
1000/63 ...... 75p
2200/10 ...... 39p
2200/16 ...... 46p
2200/25 ...... 55p
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
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18.432M 270p
26.54M 200p
26.59M 200p
26.64M 200p
26.69M 200p
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26.8M 200p
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27.045M 200p
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27.145M 200p
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27.255M 200p

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Croc clips 10p
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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 36p
Jack skt line
mono 25p
Jack skt line
stereo 30p
COAX plug 15p
COAX skt surf ... 30p
COAX skt flush ... 25p
COAX line skt ... 46p
COAX coupler ... 46p
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
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Ebow adapt. ... poa
Straight adapt. 60p
VHF T adapt. 160p
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
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D-type skt
15 W 200p
D-type skt
25 W 460p
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 P551 ...... 300p
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4W 1%
E24 ...... 7p
1W 5%
E12 ...... 10p
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3W ww
2R2 ...... 20p
7W ww 30p
10W ww 35p
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14 pin 11p
16 pin 12p
18 pin 16p
20 pin 17p
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24 pin 21p
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40 pin 35p

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pair
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198p
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262p
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314p
Elliptical 7"x5" ......
338p
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5W 386p
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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 7185p
Round 15"
200W 8735p
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3¾" 624p
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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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6V 950p
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
120VA 30V ... 1300p
160VA 35V ... 1500p
300VA 35V ... 2000p
500VA 35V ... 2650p
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AF106	0.50
AF114	1.95
AF121	0.60
AF124	0.65
AF125	0.35
AF126	0.32
AF127	0.65
AF139	0.40
AF150	0.60
AF178	1.95
AF239	0.42
AU106	4.50
AU107	3.50
AU110	2.00
AY102	2.95
BC107A	0.11
BC107B	0.11
BC108	0.10
BC108A	0.11
BC108B	0.12
BC109	0.10
BC109B	0.12
BC109C	0.12
BC114	0.11
BC116A	0.15
BC117	0.19
BC119	0.24
BC125	0.25
BC139	0.20
BC140	0.31
BC141	0.25
BC142	0.21
BC143	0.24
BC147	0.09
BC147B	0.09
BC148A	0.09
BC148B	0.09
BC149	0.09
BC153	0.30
BC157	0.12
BC158	0.09
BC159	0.09
BC160	0.28
BC161	0.28
BC170B	0.15
BC171	0.09
BC171A	0.10
BC171B	0.10
BC172	0.10
BC172B	0.10
BC172C	0.10
BC173B	0.10
BC174	0.09
BC174A	0.09
BC177	0.15
BC178	0.15
BC182	0.10
BC182LB	0.10
BC183	0.10
BC183L	0.09
BC184LB	0.09
BC204	0.10
BC207B	0.13
BC208B	0.13
BC212	0.09
BC212L	0.09
BC212LA	0.09
BC213	0.09
BC213L	0.09
BC214	0.09
BC214C	0.09
BC214L	0.09
BC237B	0.09
BC238	0.09
BC239	0.12
BC251A	0.12
BC252A	0.15
BC258	0.25
BC258A	0.39
BC284	0.30
BC300	0.30
BC301	0.30
BC303	0.26
BC307B	0.09
BC327	0.10
BC328	0.10
BC337	0.10
BC338	0.09
BC347A	0.13
BC461	0.35
BC478	0.20
BC527	0.20
BC547	0.10
BC548	0.10
BC549A	0.10
BC550	0.14
BC557	0.08
BC557B	0.08
BC558	0.10
BC639/10	0.30
BCY33A	1.60
BD115	0.30
BD116	0.60
BD124P	0.59
BD131	0.42
BD132	0.42
BD133	0.40
BD135	0.30
BD136	0.30
BD137	0.32
BD138	0.30
BD139	0.32
BD140	0.30
BD144	1.10
BD150C	0.29
BD159	0.65
BD160	1.50
BD166	0.55
BD179	0.72
BD182	0.70
BD201	0.83
BD202	0.65
BD203	0.78
BD204	0.70
BD222	0.46
BD223	0.59
BD225	0.48
BD232	0.35
BD233	0.35
BD234	0.35
BD236	0.49
BD237	0.40
BD238	0.40
BD242	0.65
BD246	0.75
BD376	0.32
BD410	0.65
BD434	0.65
BD437	0.75
BD438	0.75
BD520	0.65
BD538	0.65
BD597	0.95
BD701	1.25
BD702	1.25
BD707	0.90
BDX32	1.50
BDY57	1.65
BF115	0.35
BF119	0.65
BF127	0.39
BF154	0.20
BF158	0.22
BF160	0.27
BF167	0.29
BF173	0.22
BF177	0.38
BF178	0.26
BF179	0.34
BF180	0.29
BF181	0.29
BF182	0.29
BF183	0.29
BF184	0.28
BF185	0.28
BF194	0.11
BF195	0.11
BF196	0.11
BF197	0.11
BF198	0.16
BF199	0.14
BF200	0.40
BF241	0.15
BF245	0.30
BF257	0.28
BF258	0.28
BF259	0.28
BF271	0.26
BF273	0.18
BF336	0.34
BF337	0.29
BF338	0.32
BF355	0.37
BF362	0.38
BF363	0.65
BF371	0.25
BF394	0.19
BF422	0.32
BF423	0.25
BF457	0.32
BF458	0.36
BF467	0.68
BF595	0.23
BF597	0.25
BFR39	0.23
BFR40	0.23
BFR41	0.28
BFR81	0.25
BFR88	0.30
BFR90	1.50
BFR91	1.75
BFT42	0.35
BFT43	0.35
BFW61	0.60
BFW92	0.85
BFX29	0.30
BFX84	0.26
BFX85	0.32
BFX86	0.30
BFX88	0.25
BFY50	0.21
BFY51	0.21
BFY52	0.25
BFY90	0.77
BLY48	1.75
BR100	0.26
BR101	0.49
BR103	0.55
BR303	0.95
BRC4443	1.15
BT100A/02	0.85
BT106	1.49
BT116	1.20
BT119	3.15
BT120	1.65
BU105	1.95
BU108	1.69
BU124	1.25
BU125	1.25
BU126	1.60
BU204	1.55
BU205	1.30
BU208	1.39
BU208A	1.52
BU208D	1.85
BU326	1.20
BU326S	1.50
BU407	1.24
BU500	2.25
BU526	1.90
BU807	2.25
BUY20	2.15
BUY69B	1.70
MJ3000	1.98
MJE340	0.40
MJE350	
MJE520	0.48
MJE2955	
MPSA13	0.29
MPSA92	0.30
MRF237	3.45
MRF450A	12.50
MRF453	17.50
MRF454	23.50
MRF455	17.50
MRF475	2.50
MRF477	10.00
OC16W	1.95
OC23	1.50
OC29	2.25
OC36	2.25
OC42	0.75
OC44	0.75
OC45	0.55
OC70	0.45
OC71	0.55
OC75	0.95
OC81	0.50
OC16W	2.50
R2008B	1.45
R2010B	1.45
R2322	0.58
R2323	0.66
R2540	2.48
RCA16334	0.90
RCA16335	0.80
S2060D	0.95
SKE5F	1.45
TIP29	0.40
TIP29C	0.42
TIP30C	0.43
TIP31C	0.55
TIP32C	0.42
TIP33B	0.95
TIP34B	0.95
TIP41A	0.45
TIP41C	0.45
TIP42C	0.47
TIP47	0.65
TIP120	0.60
TIP125	0.65
TIP142	1.75
TIP146	2.75
TIP161	2.95
TIP2955	0.80
TIP3055	0.55
TIS91	0.20
TV106/2	1.50
ZRF0112	16.50
2N1100	6.50
2N1711	0.30
2N2110	4.50
2N2219	0.28
2N2905	0.40
2N3053	0.40
2N3054	0.59
2N3055	0.52
2N3702	0.12
2N3703	0.12
2N3704	0.12
2N3705	0.12
2N3706	0.12
2N3708	0.12
2N3733	9.50
2N3773	2.75
2N3792	1.35
2N4280	3.50
2N4427	1.95
2N4444	1.15
2N5294	0.42
2N5296	0.48
2N5298	0.60
2N5496	0.95
2SA329	0.95
2SA715	0.60
2SC495	0.80
2SC496	0.80
2SC931D	0.95
2SC1096	0.80
2SC1106	2.50
2SC1172Y	2.20
2SC1173	1.15
2SC1306	1.00
2SC1307	1.50
2SC1364	0.50
2SC1449	0.50
2SC1678	1.25
2SC1909	1.45
2SC1945	2.65
2SC1953	0.95
2SC1957	0.80
2SC1969	1.95
2SC2028	1.15
2SC2029	1.95
2SC2078	1.45
2SC2091	0.85
2SC2098	2.50
2SC2166	1.95
2SC2314	0.80
2SC2371	0.36
2SC931D	0.95
1SD234	0.50
2SD325E	1.65
3N211	1.95
3SK45	0.95
3SK88	0.55

DIODES

AA119	0.08
BA115	0.13
BA145	0.16
BA148	0.17
BA154	0.06
BA156	0.15
BA157	0.30
BAX13	0.04
BAX16	0.06
BB105B	0.30
BT151	0.79
BY126	0.10
BY127	0.11
BY133	0.15
BY164	0.45
BY176	1.20
BY182	0.55
BY184	0.35
BY199	0.40
BY206	0.14
BY208-800	0.33
BY210-800	0.33
BY223	0.90
BY298-400	0.22
BY299-800	0.22
BYX10	0.20
BYX36-150R	0.20
BYX38-600R	0.60
BYX55-600	0.30
BYX71-600	1.10
BZX61	0.15
BZY88	0.10
BZY95C30	0.35
CS4B	4.50
CS10B	8.45
OA47	0.09
OA90	0.05
OA91	0.06
OA95	0.06
OA202	0.10
1N21DR	5.00
1N23B	5.00
1N23C	5.00
1N23ER	5.00
1N23WE	5.00
IN4001	0.04
IN4003	0.04
IN4004	0.05
IN4005	0.05
IN4007	0.06
IN4148	0.02
IN4448	0.10
IN5401	0.12
IN5402	0.14
IN5403	0.12
IN5406	0.13
IN5407	0.16
IN5408	0.16
ITT44	0.04
ITT923	0.15
ITT2002	0.10

BASES

B5D	5.50
B7G	0.15
B7G SKTD	0.25
B8G	0.70
B8H	0.70
B9A	0.25
B9ASKTD	0.40
B9G	0.75
B10B	0.20
B13B	0.50
B14A	3.00
12 Pin CRT	0.95
Nuvistor	2.95
Octal	0.35
SK610	35.00
UX5	1.75
UX7	1.75
Valve Can	0.30
8 Pin Dil	0.14
14 Pin Dil	0.15
16 Pin Dil	0.17
18 Pin Dil	0.18

WIREWOUND RESISTORS

4 Watt 5R6-10K	0.20
7 Watt R47-22K	0.20
11 Watt 1R5-15K	0.25
17 Watt 1R-15K	0.30

ZENER DIODES
BZX61 0.15
6V2 7V5 8V2 9V1 10V 11V 12V 13V 15V 16V 18V 20V 22V 24V 27V 30V 33V 36V 39V 47V 51V 56V 68V 75V

BZY88 0.07
2V7 3V 3V3 3V6 3V9 4V3 4V7 5V1 5V6 6V2 6V8 7V5 6V2 9V1 10V 11V 12V 13V 15V 18V 20V 24V 27V 30V

THERMISTORS

VA1040	0.23
VA1056S	0.23
VA1104	0.70
VAT8650	0.46
VA1097	0.25

BATTERIES
7V Power Mike batteries TR175 £2.25 ea other prices on request

LINE OUTPUT TRANSFORMERS

DECCA 100	7.95
DECCA 1700 MONO	9.95
DECCA 1730	8.95
DECCA 2230	8.25
GEC 2040	8.95
GRUNDIG 1500	15.45
GRUNDIG 5010-6010 2222, 5011-6011	13.45
ITT CVC20	8.20
ITT CVC30	8.25
PHILIPS G8	8.50
PHILIPS C9	8.99
PHILIPS G11	13.39
PYE 725	10.95
RBM T20A	12.40
TANDBERGE 90°	11.15
TELEFUNKEN 711A	11.15
THORN 1590	9.50
THORN 8000	9.20
THORN 9000	9.95
THORN 9800	22.40
THORN MAINS TRANSFORMER 3000/3500	9.70

EHT MULTIPLIERS

ITT CVC20	6.35
ITT CVC30	6.35
PHILIPS G8550	6.96
RANK T20A	6.91
THORN 3000/3500	7.57
THORN 8500	5.50
THORN 9000	8.00
UNIVERSAL TRIPLER	5.45

REPLACEMENT ELECTROLYTIC CAPACITORS

DECCA 30 (400-400/350V)	2.65
DECCA 80/100 (400/350V)	2.99
DECCA 1700 (200-200-400-350V)	3.55
GEC 2110 (600/300V)	2.25
ITT CVC20 (220/400V)	1.80
PHILIPS G8 (600/300V)	2.25
PHILIPS G9 (2200/63V)	1.19
PHILIPS G11 (470/250V)	2.35

POTENTIOMETERS

STANDARD VERTICAL POTS	0.12
MIN. VERTICAL POTS	0.12
STANDARD HORIZONTAL POTS	0.12
MIN. HORIZONTAL POTS	0.12
CONVERGENCE PRE-SETS	0.30
SLIDERS LOG	0.48
SLIDER LINEAR	0.45

SOLDERING EQUIPMENT

25W Antex Iron	4.59
Weller Instant Heat Gun	11.30
240V Weller Marsman	4.74
1/2 Kilo Solder 60/40	6.95

SPARES & AIDS

FOAM CLEANSER	0.79
FREEZE IT	0.82
SOLDA MOP	0.64
SWITCH CLEANER	0.79
WD40	1.25
PUSH PUSH MAINS SWITCH (DECCA, GEC, RANK, THORN ETC)	1.02
PYE IF GAIN MODULE	6.99
ANODE CAP (27KV)	0.69

PUSH BUTTON UNITS

DECCA, ITT. CVC20 6WAY	7.95
ITT CVC5 7WAY	10.19
PHILIPS G8 (550) 6WAY	14.49

VARICAP TUNERS

ELC1043/05 MULLARD	8.65
ELC1043/06 MULLARD	8.65
U321	8.25
U322	8.25

20MM ANTI SURGE FUSES

100MA-800MA	15p each
1A-5AMP	12p each

20MM QUICK BLOW FUSES

100MA	8p each
200MA-5AMP	5p each

P.M. COMPONENTS LTD

PHONE 0474 813225 3 LINES

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VISA

TELEX 966371 PM COMP

A SELECTION FROM OUR STOCK OF BRANDED VALVES

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A1998 11.50
A2087 11.50
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A2293 6.50
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A2599 37.50
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A2900 11.50
A3042 24.00
A3283 24.00
AC/THI 4.00
ACT22 59.75
AC/S2 PEN 8.50
AH221 39.00
AH238 39.00
AL60 6.00
AN1 14.00
ARP12 0.70
ARP34 1.25
ARP35 2.00
ATP4 2.50
AX50 5.50
AZ11 4.50
AZ31 2.50
BL63 2.00
BS450 67.00
BS810 55.00
BS814 55.00
CIK 19.00
C3JA 21.00
C6A 9.00
C1112G 70.00
C1108 54.95
C1134 32.00
C1148A 115.00
C1149/1 130.00
C1150/1 135.00
C1534 32.00
CCA 2.60
CC3L 0.90
CL33 2.00
CV Nos Prices on request
D63 1.20
DA41 22.50
DA42 17.50
DA90 4.50
DA100 125.00
DAF91 0.45
DAF91 0.70
DAF96 1.00
DC70 1.75
DC90 1.20
DCX4-1000 12.00
DCX4-5000 25.00
DET16 28.50
DET18 28.50
DET23 35.00
DET24 39.00
DET25 22.00
DF91 0.70
DF92 0.60
DF96 0.65
DF97 1.00
DH63 1.20
DH77 0.90
DH79 0.56
DH149 2.00
DK91 0.90
DK92 1.20
DK96 2.50
DL35 2.50
DL63 1.00
DL70 2.50
DL73 2.50
DL91 1.50
DL92 0.95
DL93 1.10
DL94 2.50
DL96 2.50
DLS10 13.50
DLS16 10.00
DM70 1.95
DM160 2.75
DY51 1.50
DY86/87 0.65
DY802 0.72
E55L 42.00
E80CF 11.00
E80F 18.50
E81CC 3.15
E81L 12.00
E82CC 3.50
E83CC 3.50
E83F 5.50
E86C 9.50
E88C 7.95
E88CC 3.50
E88CC Siemans Special 5.95
E90CC 7.95
E90F 7.95
E91H 4.50
E92CC 3.95
E99F 6.99
E130L 19.95
E180CC 6.50
E182CC 9.00
E180F 6.50
E186F 8.50
E188CC 7.50
E280F 19.50
E283CC 10.00
E288CC 13.50
E55L 42.00
E810F 18.15
E1148 1.00
E1524 6.95
EA50 1.00
EA76 1.95
EA79 1.95
EAA91 0.60
EABC80 0.70
EAC91 2.50
EAF42 1.20

EAF801 3.50
EB34 1.50
EB41 3.95
EB91 0.52
EBC33 2.50
EBC41 1.95
EBC81 1.50
EBC90 0.90
EBC91 0.90
EB91 0.60
EBF80 0.65
EBF83 0.65
EBF85 0.95
EBF89 0.70
EBF93 0.95
EBL1 2.50
EBL21 2.00
EC52 0.75
EC70 1.75
EC80 9.50
EC81 7.95
EC86 1.00
EC88 1.00
EC90 1.10
EC91 5.50
EC92 1.75
EC93 1.50
EC95 7.00
EC97 1.10
EC8010 12.00
ECC32 3.50
ECC33 3.50
ECC35 3.50
ECC81 1.15
ECC81 Special quality 1.95
ECC82 0.55
ECC82 Mullard 1.50
ECC82 Philips 1.95
ECC83 0.65
ECC83 Brimar 1.35
ECC83 Philips 1.95
ECC84 0.50
ECC85 0.60
ECC86 2.75
ECC88 0.85
ECC91 2.00
ECC180 0.72
ECC189 0.78
ECC801S 3.50
ECC803S 3.50
ECC804 0.60
ECC2000 12.00
ECF80 1.15
ECF82 1.15
ECF86 2.25
ECF200 1.85
ECF202 1.85
ECF801 0.85
ECF804 6.00
ECF805 2.50
ECF806 10.25
ECH3 2.50
ECH4 3.00
ECH35 2.15
ECH42 1.00
ECH81 0.65
ECH83 0.78
ECH84 0.69
ECH2000 1.50
ECL80 0.60
ECL82 0.65
ECL83 2.50
ECL84 0.74
ECL85 0.69
ECL86 0.80
ECL805 0.69
EF22 2.50
EF37A 2.00
EF39 1.10
EF41 3.50
EF42 3.50
EF50 2.50
EF55 4.95
EF71 1.50
EF72 1.20
EF73 1.00
EF80 0.55
EF83 3.50
EF85 0.50
EF86 2.25
EF86 Special quality 3.15
EF89 0.85
EF91 1.50
EF92 2.15
EF93 0.95
EF94 0.95
EF95 1.50
EF97 0.90
EF98 0.90
EF183 0.65
EF184 0.65
EF730 1.80
EF731 3.50
EF732 3.50
EF800 11.00
EF805S 13.50
EF806S 14.50
EF812 0.65
EFL200 1.50
EH90 0.72
EK90 0.72
EL32 0.95
EL33 4.00
EL34 2.25
EL34 Mullard/Phillips 4.50
EL36 1.50
EL37 9.00
EL38 4.75
EL41 3.50
EL42 2.00
EL81 6.95
EL82 0.58
EL83 5.95
EL84 0.75

EL85 4.50
EL86 0.85
EL90 1.50
EL91 6.00
EL95 0.70
EL153 12.15
EL183E 3.50
EL183P 3.50
EL360 6.75
EL500 1.40
EL504 1.40
EL509 5.25
EL519 6.95
EL802 3.65
EL821 8.50
EL822 12.95
EM1 9.00
EM4 9.00
EM80 0.70
EM81 0.70
EM84 1.65
EM85 3.95
EM87 2.50
EN10 8.00
EN32 13.50
EN91 1.10
EN92 4.50
ESU150 14.95
ESU872 25.00
EY51 0.80
EY81 2.35
EY83 1.50
EY84 5.95
EY86/87 0.50
EY88 0.55
EY91 5.50
EY500A 1.50
EY802 0.70
EZ35 0.75
EZ40 2.75
EZ41 2.15
EZ80 0.75
EZ81 0.75
EZ90 1.50
F6064 2.95
FW4/800 2.95
G55/1K 9.00
G180/2M 9.00
G232 Mullard 3.95
G240/2D 9.00
G400/1K 14.00
GC10B 17.50
GC10D 17.50
GC10/4B 17.50
GC10/4E 17.50
GC12/4B 17.50
GD86W 6.00
GDT120M 5.00
GE10 9.00
GN4 6.00
GN10 15.00
GR10G 4.00
GS10C 16.50
GS10H 12.00
GS12D 12.00
GT1C 14.00
GT1C S/S 13.00
GTE175M 8.00
GTR150W 1.00
GU20 35.00
GXU1 13.50
GXU3 24.00
GXU50SS 14.50
GY501 1.20
GY802 1.00
GZ30 1.00
GZ31 1.00
GZ32 1.00
GZ33 4.50
GZ34 2.15
GZ34MUL 3.95
GZ37 4.50
HAA91 1.00
HABC80 0.90
HBC90 0.75
HBC91 0.80
HF93 0.75
HF94 1.50
HK90 1.06
HL2K 3.50
HL23DD 4.00
HL90 0.70
HL92 1.50
H133/DD 3.50
HR2 4.00
HY90 1.00
HVR2 3.00
K3118 86.00
KR6/3 45.00
KT8C 7.00
KT33C 3.50
KT36 2.00
KT44 4.00
KT45 4.00
KT61 4.00
KT63 2.00
KT66 OSRAM 10.50
KT66 USA 6.90
KT66 GEC 14.95
KT77 Gold Lion 9.50
KT81 7.00
KT88 USA 9.00
KT88 Gold Lion 16.95
KTW61 2.50
KTW62 2.50
KTW63 2.00
KTZ63 2.50
L63 1.50
L102/2K 6.95
L120/2K 12.00
LB7-20 95.00
LS9B 6.95
M502A 60.00
M537A 60.00
M5143 155.00

M8079 6.00
M8082 7.50
M8083 3.25
M8091 7.50
M8096 3.00
M8098 5.50
M8099 5.00
M8100 5.50
M8136 7.00
M8137 5.50
M8161 6.50
M8162 5.50
M8163 5.50
M8190 4.50
M8195 6.50
M8196 5.50
M8204 5.50
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M8225 3.50
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MU14 1.50
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N78 9.85
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OB2WA 1.25
OC2 2.50
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P41 2.50
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PC88 0.75
PC92 3.50
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PC800 1.10
PC900 1.25
PCC84 0.40
PCC85 0.54
PCC88 0.70
PCC89 0.70
PCC189 0.70
PCC805 0.70
PCC806 0.80
PCE82 0.80
PCF80 0.65
PCF82 0.60
PCF84 0.65
PCF86 1.20
PCF87 0.40
PCF200 1.80
PCF201 1.80
PCF800 0.40
PCF801 1.35
PCF802 0.60
PCF805 1.25
PCF806 1.00
PCF808 1.25
PCH200 1.50
PCL82 0.85
PCL83 2.50
PCL84 0.75
PCL85 0.80
PCL86 0.85
PCL800 0.80
PCL805 0.90
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PL84 0.78
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U192 1.00
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UF85 1.20
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WEATHER SATELLITE UPDATE

Terry Weatherley G3WDI

Since the last update appeared in *Radio and Electronics World*, several dramatic changes have occurred. By the time this appears in print, a new Polar Orbiting Satellite should have been launched.

NOAA-8

The attitude controls on NOAA-8 failed on June 11th, and the spacecraft began to tumble. There appears to be some chance of recovery, but at the present time no systems are being used operationally. The beacon on NOAA-8 is being left on when it does not conflict with the NOAA-6 beacon on the same frequency.

NOAA-7

NOAA-7 has developed a serious power regulation problem caused by a loss of power supply shunt loads, but at the present time all systems continue to work nominally.

NOAA-6

This spacecraft has been re-activated to replace NOAA-8 as the primary morning spacecraft transmitting on 137.5MHz. Since July 1st NOAA-6 has been transmitting two channels of infrared data during the night. Depending upon user-response, this experiment may be introduced on NOAA-7.

NOAA-F

NOAA-F was scheduled for launch on November 2nd, 1984. After launch it will be NOAA-9. It will be the primary afternoon satellite with an equator crossing at 1430 local time each day. The period will be 102.2 minutes and the inclination 98 degrees. As well as instruments concerned with its weather measurements, the satellite will also carry a search and rescue package (SAR).

This package, first carried on NOAA-8, is part of a continuing demonstration to evaluate a satellite search and rescue system.

NOAA-next

The next NOAA in the series has been cancelled for budgetary reasons. However, three more satellites of the advanced TIROS-N type will be used to continue the series into the 1990s.

More trouble

The GOES geostationary satellites have also run into trouble. The failure of the second encoder lamp on GOES-east has had a major impact upon the GOES programme. The encoder lamps are tungsten filament lamps which are used in the control of the VISSR/VAS instrument. GOES-east covered an area from mid-west United States to western Europe and from Canada to South America.

GOES-west was moved to 98 degrees west to cover the Atlantic and part of the Pacific during the hurricane season, and provided vital information during the recent hurricanes. GOES-4 was reactivated at 139 degrees west.

Since GOES-west is not relaying WEFAX data both GOES-4 and GOES-east will be used to relay VISSR data called by GOES-west. GOES-1, stationed at 131 degrees west, may be used to broadcast WEFAX data using a dish at the NASA/Goddard Space Flight Center if tests are successful. There was speculation that this satellite might be moved to 108 degrees west in November, and GOES-central would possibly then move to 113 degrees west. Life gets complicated up there doesn't it!

The Americans weren't the only ones with problems. Japan's GMS-2 suffered a partial failure of its imaging system in early 1984. GMS-1 was moved to 135 degrees east, GMS-2 being moved to 145 degrees east. During May and June GMS-1 suffered progressive failure in its imaging system. Complete failure occurred in July. Images at six-hourly intervals are still being received from GMS-2. GMS-3 was launched on August 2nd and should be on station at 140 degrees east (and operational) by now.

Celebration

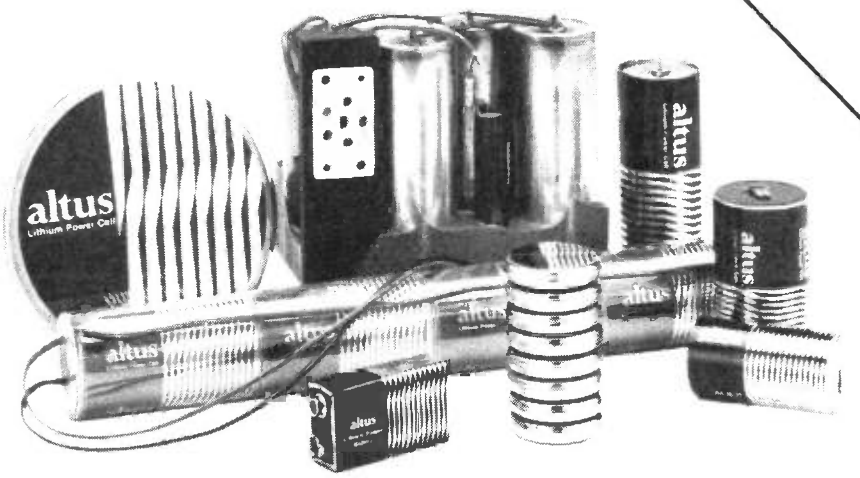
As part of the celebration of the 25th anniversary of Weather Satellites, NOAA are requesting photographs of receiving stations and images received. They hope to make slides and displays showing the high level of professional and amateur achievement since the construction and operation of direct readout stations. This is an opportunity to give something back for all the information made so freely and readily available by NOAA. Material should be sent to:

United States Department of Commerce, National Oceanic and Atmospheric Administration, Washington DC 20233, United States of America. REW

A NIGHT IN THE CELLS

by Duncan Reid

or 'How not to assault your batteries'.



When looking through advertisements in magazines and listening on the air, it is obvious to anyone with two brain cells to rub together that there is a lot of portable and even more mobile equipment being used these days. Most of this is powered by Nicads or lead-acid accumulators (the car battery – idiot!) yet how many people give a thought to the rough treatment that they dish out to their all-important (and expensive!) sources of power?

Considering the cost of all types of secondary cell it is worth taking some care to avoid abusing them beyond the point of no return.

I will deal firstly with the lead-acid accumulator; this type of cell has a nominal voltage of 2V per cell and a low internal resistance when charged (typically 0.01ohms). I will not go into great detail about the chemical action of this cell, as this is not really necessary and is covered adequately in the many text books available. It is, however, worth noting that the cell is formed of two plates (or nets of plates), the negative being lead and the positive being lead peroxide, when the cell is charged. These are mounted on lead-antimony grids and the electrolyte is diluted sulphuric acid.

It is also important to realise that during discharge both plates become lead sulphate and water is generated, which lowers the specific gravity of the electrolyte. Towards the end of a charging period it can be seen that oxygen and hydrogen are liberated inside the battery.

NOTE: oxygen and hydrogen in certain proportions are highly explosive. *Always* charge batteries in a well ventilated area, if not mounted on your car, and never use any naked flames near a battery under charge.

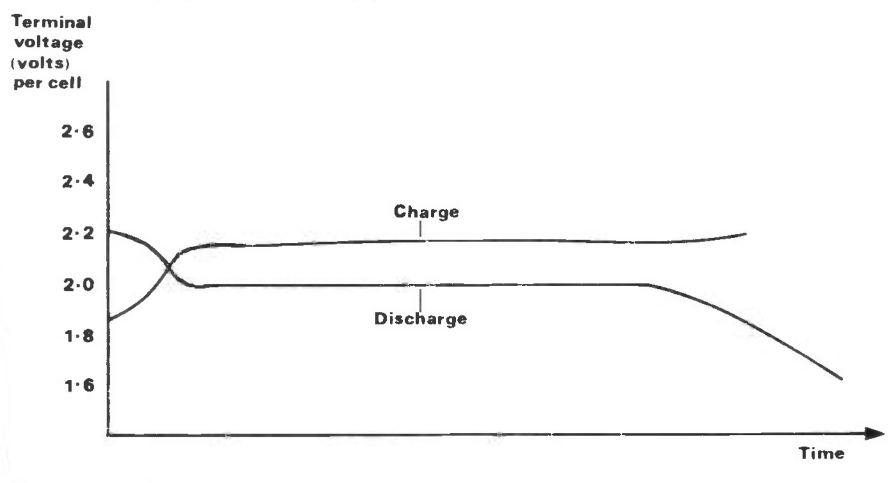
Now that that's over we can go on to the practicalities.

Battery life

How long will my battery stay charged?

The best approximate answer to this, apart from your own experience of your power consumption, is to look at the manufacturer's data for your battery. Somewhere, you will find a specification known as ampere-hour capacity (AHC). This will probably be printed or stamped somewhere on the actual battery. The AHC is the product of the rate of discharge in amps and the time of discharge until the manufacturer's lowest charge level is reached.

It is very simple to understand; for example a battery with an AHC of 100 could deliver 100 amps for 1 hour, 50 amps for 2 hours, 1 amp for 100 hours, 0.5 amps for 200 hours or 200 amps for half an hour etc. In each of these cases the product of current and time is equal to 100 – the AHC of the battery.



Showing variation of terminal voltage

How well charged is my battery?

In general, as long as the manufacturer's instructions are adhered to and certain situations avoided your battery should give you a long life. However, you may be interested or need to know the state of charge of your battery.

There are two main indications of this; the terminal voltage and the specific gravity (Sg) of the electrolyte, ie how much water it contains.

As can be seen from the graph, the EMF of a freshly charged cell may be as high as 2.2V; however, this falls to 2.0V almost as soon as the discharge begins. It then stays at this point for the remainder of the safe discharge period and only when the cell is nearly completely discharged will it fall below this level. If this happens there is a possibility that the cell may be permanently damaged.

False sense

So as can be seen, simply measuring the terminal voltage of your cell could lull you into a false sense of security; a much more reliable method is to measure the specific gravity of the acid in the battery.

If you remember, when a cell is discharging water is produced as a by-product of the reaction. It is then a simple matter to compare the gravity of the diluted acid with that of pure water to find the degree of discharge.

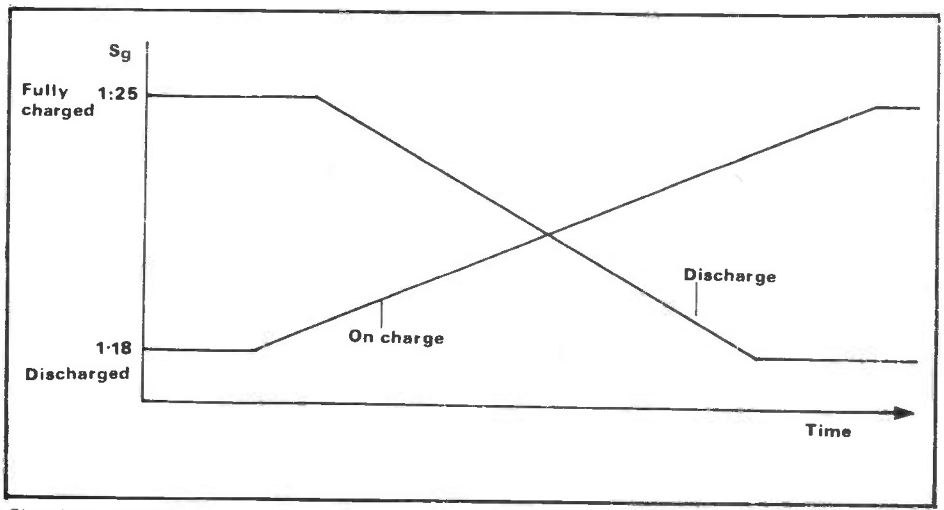
A fully charged cell has a specific gravity of 1.25 but a discharged one only 1.18. The electrolyte goes from being 1.25 times as dense as water to 1.18 times; this can be measured on an instrument called a hydrometer, which is available quite cheaply from most car accessory shops and is foolproof to use; just follow the instructions on the packet.

The much more informative variations of specific gravity are shown in the graph.

However, if you don't wish to go to this trouble there are other rough indications that a battery is charged.

If the plates are brown and grey alternately, due to the different substances on positive and negative plates, the battery can be assumed to be charged.

If when on charge the plates are gassing freely, then this shows that the battery is more or less fully charged. However, please remember that those fumes given off are highly explosive in certain circumstances.



Showing variations of specific gravity

Caring for your battery

Always keep your battery clean and dry. If possible smear the contacts with petroleum based jelly or grease; this will help to prevent corrosion caused by splashed acid which can come out of the vent holes when the cell is under charge. Keep the acid at the correct level (about ¼inch above the plates) by topping up with distilled water when necessary. This is vital to prevent buckling of the plates.

Keep the air vents clear from any debris or you could find yourself in an explosive situation! Avoid heavy currents on charge or discharge or the cell will be damaged by the excessive heat caused. If you want to store the battery then leave it in a charged condition; failure to do so could lead to a fault known as sulphation which if allowed to occur would destroy the battery. Of course, as in all things, conform to the manufacturer's instructions as regards charging/discharging rates and use.

Main faults

There are three main faults that occur with lead-acid batteries. These are detailed below.

Sulphation; this is the formation of insoluble lead sulphate on both plates, caused by discharging the cell beyond safety limits, or by storing in a discharged state. If it is not too severe it can be cured by a long trickle charge, during which the sulphates will disintegrate and fall to the bottom of the battery. There is usually a well provided at the bottom for this type of debris to prevent it shorting the plates out.

Buckling of plates can occur if too large currents are drawn from, or put into, the battery; this can lead to internal short circuits in the plate network of the battery. In severe cases the plate may crack. The same effect can be caused by uneven chemical action on the plates if the electrolyte is not kept topped up. If this happens you may as well throw the battery away.

Corrosion of the terminals can occur when, during charging, acid splashes through the vents and reaches the terminals. These can simply first be wiped clean and greased lightly to prevent further corrosion.

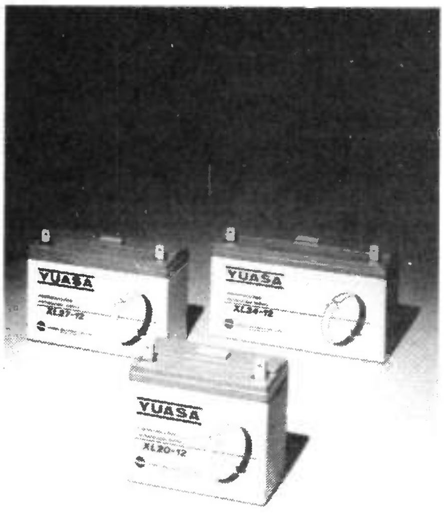
If you follow these guidelines you should get many hours of life out of your battery, and more importantly it shouldn't pack up on you during a field day on a windy hilltop!

Nicads

Now on to the infamous Nicads which seem to power almost every other rig you see these days.

Nicad cells can be used as a direct replacement for dry primary cells in most applications, the only real difference being that they have a lower open circuit voltage of 1.2V as opposed to the 1.5V of a standard dry cell. These have one problem, in that their performance is limited below 0°C, but that also applies to standard dry cells and doesn't really bother us greatly.

These cells have a very low internal impedance so currents of several amps can be obtained; as with lead-acid cells, this will damage the cell if continued for more than several seconds. Because of this it is an idea to include a fuse in any circuit you are designing which could lead to the cells being shorted if a component were to malfunction.



Trouble free

Nicads are much more trouble free in maintenance, and if obvious precautions are observed, should give no trouble. Because of this, our main interest is in the expected life of the cell before it is worn out. This depends upon several factors, most of which are related to how it is used and charged.

A cell under normal use can be expected to have a useful life of a couple of hundred charge/recharge cycles. One factor that can limit the life is that of extremes in temperature: both high and low can reduce the life span of the cell, so beware on cold frosty mornings! The cell, in fact, will work best and longest at proverbial room temperature, about 15 to 25°C suiting it well.

One area in which Nicads often fail is in charging; the manufacturer's instructions should therefore be carefully followed. Nicads have been known to explode when incorrectly charged, and this makes a mess of anything, or anyone, in the immediate vicinity. This does not, of course, mean that the very best, highly priced charger has to be bought; indeed with a reasonable junk box a suitable one can be built for a couple of quid. A simple yet effective circuit is shown later and is ideal for the given charging currents, or could easily be adapted to give others.

Two ways

There are two ways in which Nicads are often overcharged, both of which damage the performance of the cell in different ways. The first is when there is a slight but prolonged overcharging; this is not too serious and can be identified by a slightly lower output voltage from the cell than normal. It can be cured by giving the affected cell(s) a deep discharge, but this will slightly shorten the life of the cell.

Excessive

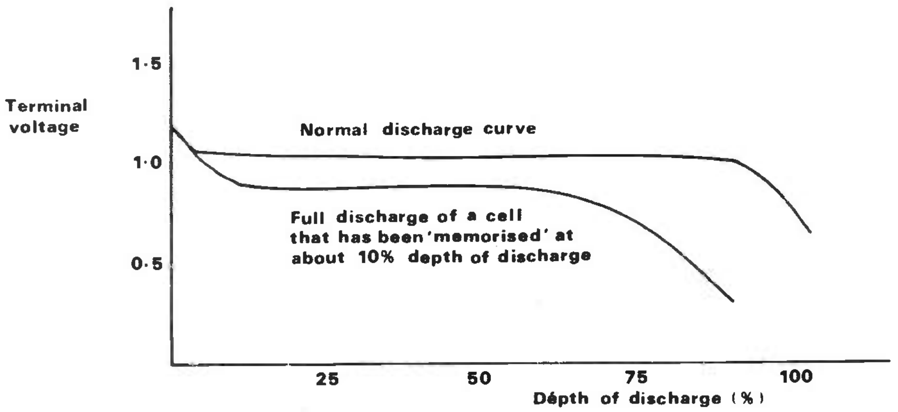
The other type of damage is when the overcharge is excessive; this causes the temperature of the cell to rise and gases are given off. These should escape through a vent hole, but if the build-up is too rapid then the cell may explode. Even if things don't come to this then the life and capacity of the cell are severely impaired because of the loss of some of the active chemicals as gases. This is, unfortunately, incurable.

The best ways to overcome this are to use a charger with a timer or with automatic voltage limiting. When charging the cells they should be in a low state of charge or you may come across the 'memory effect' discussed later. Cells must only be charged in series because the current is constant; if they are charged in parallel each cell will pass a different current and some could be undercharged and others overcharged.

Conversely, if a deep discharge is called for, this should only be done with cells in parallel as each cell will hold a different charge. If they were charged in series it could lead to cells becoming reverse charged, which has a similar effect to excessive overcharging.

Memory effect

The 'memory effect' previously referred to is an interesting phenomena first detected by NASA. It happens when the cell is partially discharged a number of times. The accompanying graph is self-explanatory for this condition. The effect can be overcome with little damage to the cell by giving it a deep discharge.



Showing the 'memory effect'

It is fortunate that the memory effect is not serious and has few long term effects, for how many of us give Nicads a deep discharge every time?

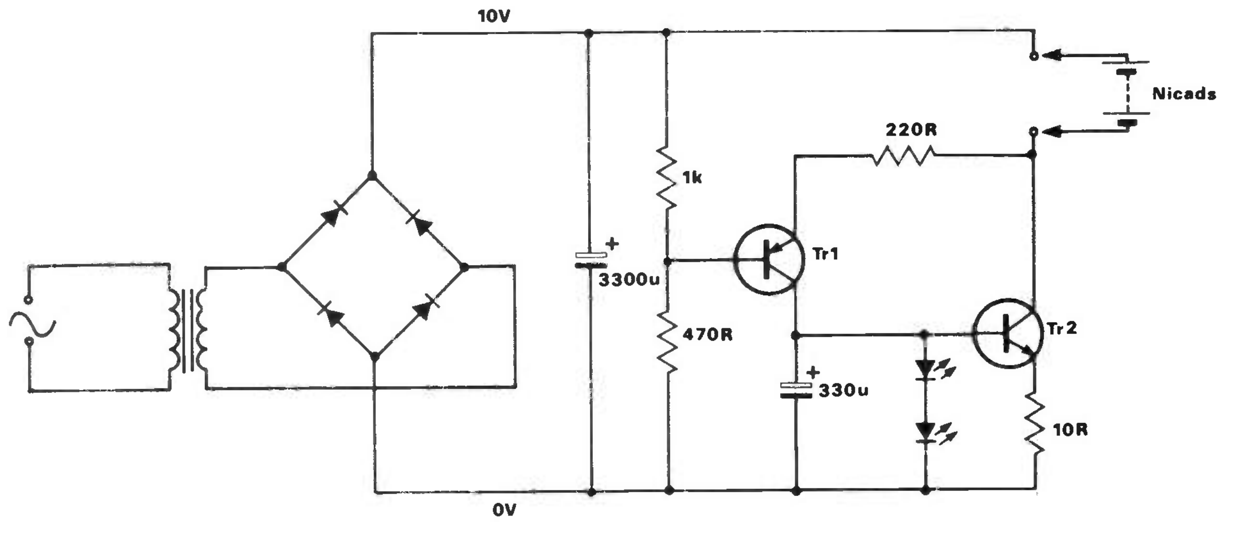
Talking of long term effects, if you are going to store Nicads for some time then do so when they are in a charged state. This will prevent formation of internal short circuits and/or the cell being damaged by formation of chemicals which the charging process will not reverse.

Long life

If all these precautions are taken and the cells well treated generally then they should last for quite some time longer than the manufacturer's rated minimum life.

Earlier on I mentioned a circuit for a Nicad cell charger, the diagram for which you will find below. It will charge four type 'D' cells in series at constant current with automatic voltage limiting. Tr2 is the current source, with its base voltage stabilised at about 3V by the two LEDs which also serve as a charge indication. This transistor can be a BC301 or similar. Tr1 gives a voltage limiting action when the voltage across the cells approaches that at the 1K branch of the potential divider. This transistor can be a 2N3638 or similar.

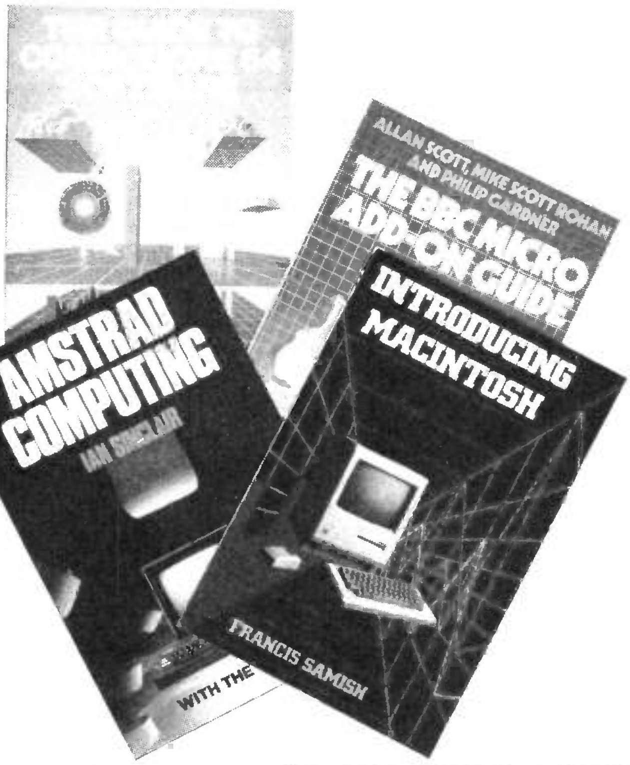
The circuit values shown will give an initial charge current of about 260mA, dropping to about 200mA when the voltage across the cells reaches 5.5V, and to almost zero when the voltage reaches 6.5V. The cost of components (new), including the transformer, often the most expensive item, is somewhere about £7. REW



Nicad cell charger unit

LATEST LITERATURE

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



THE GUIDE TO COMMODORE 64 SOFTWARE

By John Darling

The author of this volume has compiled a catalogue of commercially available software for this computer, and worked with the co-operation of most of the software houses in Britain.

The programs available are split into seven sections, the first three covering games (arcade, adventure and traditional), the next two covering educational software (4 to 14 years and 14+ years) and the last two covering business software and utility programs.

Within each section the software is listed alphabetically, and each section begins with a short introduction.

All the software is fully described, although not reviewed, with the retailer, price and format (cassette, disk or cartridge). An appendix lists the addresses of the various software houses.

The most striking aspect of this book is the tremendous diversity of software available for the Commodore 64 and the imagination that goes into devising names for the programs (how about *'Revenge of the Mutant Camels'!*).

Granada Publishing Ltd, £5.95

INTRODUCING MACINTOSH

By Francis Samish

The Macintosh computer was designed by Apple Computer to be intelligible to the 'average person.' It is intended for the small business user, and aimed at making it easier to operate a computer through using a 'mouse' pointer and pictograms on the screen.

Consequently this is not a 'how to program' book, the intention being that off-the-shelf software is used. The author concentrates on describing how to use the Macintosh to the best advantage, providing some simple worked examples.

The ideas are set out clearly, with some very good advice given concerning, for instance, copying programs and regularly 'saving' information in order to prevent power failure or operator error from spoiling anything in memory.

Advice is also given on buying software, with a warning to beware rushed-out 'quick-and-dirty' packages which do not make full use of the computer's abilities.

To complement this section there is a brief list of software, with good descriptions, which the author considers worthy of consideration.

The text concludes with a glossary of computing terms which is, unusually, truly 'user-friendly'.

Granada Publishing Ltd, £7.95

AMSTRAD COMPUTING

By Ian Sinclair

The new Amstrad CPC464, claimed to be a major step forward in computing, uses a dialect of BASIC which apparently requires learning almost from scratch if the user has previously used the simple version of the language on earlier makes of computer.

This book complements the manual of the CPC464, and was written while the author was using one of the computers, with the listings obtained from a printer connected to it.

The approach taken is to present the various commands in detail step by step. The author writes in a clear, idiot-proof style, beginning with a chapter on how to set up the computer. He progresses to elementary commands, and then expands on these in such a way that the reader has covered a fair amount of ground before he has even realised that he is well on the way to programming.

Sound and graphics are covered, of course, as well as windows and other effects.

Granada Publishing, £6.95

THE BBC MICRO ADD-ON GUIDE

By Allan Scott, Mike Scott Rohan and Philip Gardner

This book is intended to give an easily understood outline of peripherals available for the BBC, with an evaluation of quality and value for money.

It is not comprehensive, but of course this would be impossible considering the rapid rate of change in this market. The coverage of hardware available is good, with useful descriptions of the advantages and drawbacks of the various devices written in clear non-technical language (prices, too, are included).

Each type of peripheral has its own chapter, and the scope of the book extends so far as to give a brief mention to the field of control and robotics (which could fill several volumes itself).

The writers are clearly BBC enthusiasts of the first order, but this has not affected their discrimination when it comes to evaluating hardware (in fact it has probably enhanced it, since they will only want the best for their favourite computer!).

For those with a BBC Micro a book such as this will be an invaluable addition to their bookshelves. Others can benefit from the general descriptions of the uses of the various peripherals, but might well find themselves dashing out to buy a BBC after being infected by the authors' enthusiasm.

Collins Professional and Technical Books, £6.95.

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OA90	4p
OA91	4p
OA200	7p
OA202	7p
IN914	2p
IN4001	4p
IN4002	4p
IN4003	4p
IN4004	4p
IN4005	4p
IN4006	4p
IN4007	5p
IN4148	2p
IN5400	9p
IN5401	10p
IN5402	10p
IN5403	11p
IN5404	11p
IN5405	12p
IN5406	13p
IN5407	13p
IN5408	13p
LOW PROFILE SOCKETS	
8pin	6p
14pin	8p
16pin	9p
18pin	12p
20pin	14p
22pin	16p
24pin	18p
28pin	20p
40pin	25p
ZENERS	
400MV BYZ88 Range 2V7 to 39V	6p
1.3W Zeners BZX61 Range 2V7to39V	12p
VOLTAGE REGULATORS	
7805	35p
7812	35p
7815	35p
7818	35p
7824	35p
7905	35p
7912	40p
7915	40p
7918	40p
7924	40p
78L05	28p
78L12	28p
78L15	28p
78L18	28p
78L24	28p
79L05	40p
79L12	45p
79L15	48p
LM309K	100p
LM317K	220p
LM317T	180p
LM323K	420p
LM723	32p
78HGKC	570p
78HO5KC	520p
78GU1C	190p
79GU1C	215p
79HGKC	670p
VALVES	
DY87	53p

DY802	45p
ECC82	40p
ECC83	43p
ECC84	40p
ECC85	40p
ECH81	49p
ECH84	52p
ECL80	57p
ECL82	59p
ECL84	57p
ECL85	57p
ECL86	49p
EF80	31p
EF85	34p
EF89	43p
EF183	45p
EF184	53p
EL34	190p
EY86	31p
EY87	31p
PC97	100p
PCC85	42p
PCF80	58p
PCF200	135p
PCF801	110p
PCF802	57p
PCF806	115p
PCH200	100p
PCL81	54p
PCL82	63p
PCL84	50p
PCL85	55p
PCL86	55p
PCL805	55p
PFL200	85p
PL36	80p
PL504	95p
PL508	190p
PL519	450p
PY81	70p
PY88	48p
PY500A	160p
CMOS	
4000	27p
4001	27p
4002	27p
4006	80p
4007	27p
4008	65p
4009	50p
4010	50p
4011	27p
4012	27p
4013	50p
4014	60p
4015	60p
4016	45p
4017	65p
4018	60p
4019	60p
4020	75p
4021	58p
4022	58p
4023	27p
4024	47p
4025	26p
4026	80p
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4030	36p
4032	67p
4034	145p
4035	70p
4038	71p
4040	57p
4041	40p

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4055	90p
4056	85p
4060	72p
4066	42p
4068	25p
4069	27p
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4072	27p
4073	27p
4075	27p
4076	70p
4077	27p
4078	27p
4081	27p
4082	27p
4093	45p
4094	85p
4098	85p
4099	82p
4501	40p
4502	55p
4503	52p
4504	75p
4506	110p
4507	45p
4508	125p
4510	57p
4511	57p
4512	57p
4513	120p
4514	110p
4516	65p
4518	65p
4520	65p
4522	60p
4526	60p
4527	60p
4528	65p
74 SERIES	
7400	22p
7401	16p
7402	18p
7403	22p
7404	18p
7405	10p
7406	100p
7407	80p
7408	25p
7409	20p
7413	35p
7414	45p
7417	32p
7420	22p
7421	25p
7425	15p
7430	25p
7437	28p
7447	60p
7442	45p
7450	22p
7451	10p
7454	25p
7470	30p
7473	30p
7475	25p
7481	90p

7482	70p
7485	45p
7486	28p
7489	100p
7490	35p
7492	45p
7493	35p
7495	48p
7497	80p
74107	30p
74111	52p
74116	85p
74119	85p
74122	40p
74123	20p
74125	40p
74126	45p
74132	42p
74141	55p
74145	70p
74153	45p
74155	45p
74157	45p
74160	50p
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74167	35p
74173	50p
74174	75p
74175	65p
74176	45p
74180	50p
74182	45p
74192	40p
74196	40p
74197	45p
74393	70p
74LS00	60p
74S04	45p
74LS08	20p
74LS09	18p
74S10	35p
74S11	18p
74S14	40p
74LS20	25p
74LS30	35p
74LS32	60p
74LS38	40p
74LS73	28p
74LS74	35p
74LS75	38p
74LS76	30p
74LS86	38p
74LS112	40p
74LS113	32p
74LS125	45p
74LS138	50p
74LS139	45p
74LS151	45p
74LS153	60p
74LS157	35p
74LS161	65p
74LS163	70p
74LS164	80p
74LS174	60p
74LS192	60p
74LS197	52p
74LS221	80p
74LS240	95p
74LS241	100p
74LS244	180p
74LS245	180p
74LS247	50p
74LS248	50p
74LS251	30p
74LS257	55p
74LS266	25p
74LS290	30p
74LS293	30p

74LS367	52p
74LS399	85p
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LINEAR IC'S	
LM324	30p
LM380	60p
LM381	100p
LM709Dil	30p
LM723	32p
LM741Dil	15p
LM741 Met	45p
LM3900	25p
NE555	16p
NE556	40p
AN-214P	200p
AN-240P	150p
AN-360	120p
AN-7110	150p
AN-7114	170p
AN-7115	180p
AN-7120	150p
AY3-1270	680p
AY3-1350	300p
AY3-8910	360p
AY3-8912	400p
AY5-3600	570p
CA270	40p
CA3046	60p
CA3048	190p
CA3060	280p
CA3080E	70p
CA3086	25p
CA3089E	150p
CA3090AQ	300p
CA3130E	80p
CA3130S	100p
CA3140E	45p
CA3189E	250p
CA3240E	90p
HA-1156W	160p
HA-1197	180p
HA-1306W	220p
HA-1319	250p
HA-1339	220p
HA-1342	200p
HA-1366WR	200p

HA-1368	190p
LA-1201	120p
LA-1365	170p
LA-3301	180p
LA-3350	150p
LA-4031	140p
LA-4032	190p
LA-4051	250p
LA-4101	140p
LA-4102SK	140p
LA-4420	150p
LA-4430	150p
MB3712	150p
MC1327	70p
SAS560	110p
SAS570	110p
SN76003N	140p
SN76013N	140p
SN76023N	140p
SN76033N	150p
SN76110N	70p
SN76115	70p
T2800D	52p
TA-7120	100p
TA-7137P	110p
TA-7200	200p
TA-7201	200p
TA-7203	240p
TA-7204	110p
TA-7205P	90p
TA-7210	200p
TA-72222AP	120p
TA-7310P	100p
TAA550	16p
TBA120S	45p
TBA395	60p
TBA396	60p
TBA520	75p
TBA530	80p
TBA540	75p
TBA560	80p
TBA750	100p
TBA800	35p
TBA810S	60p
TBA820	75p
TBA920	80p
TBA950	80p

TBA990	80p
TCA270	40p
TCA800	80p
TCA940	85p
TDA1170	90p
TDA1412	60p
TDA2002	80p
TDA2003	150p
TDA2020	140p
TDA2030	140p
TDA2522	90p
TDA2530	90p
TDA2532	90p
TDA2540	75p
TDA2560	75p
TDA2593	100p
TDA2690	80p
UPC-555H	60p
UPC-556H	80p
UPC-575C2	100p
UPC-577H	150p
UPC-592H2	120p
UPC-1025H	300p
UPC-1026C	140p
UPC-1028H	160p
UPC-1031H2	180p
UPC-1032H	70p
UPC-1156H	200p
UPC-1181H	120p
UPC-1182H	150p
UPC-1185H2	250p
MEMORIES	
2114	200p
2716	300p
2516	200p
2532	400p
2732	400p
2764	700p
4116	75p
4164	380p
6116	600p
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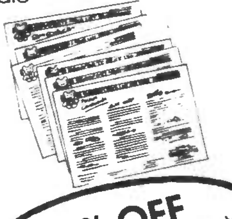

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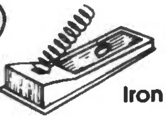

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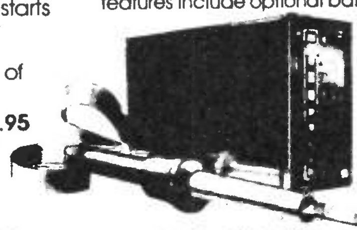

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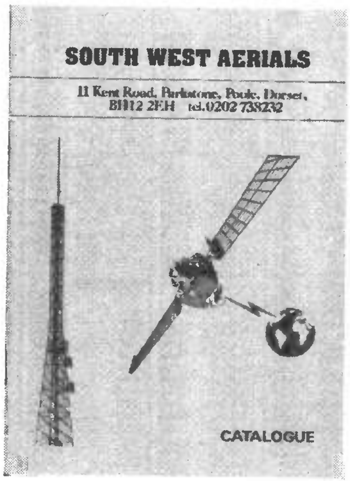


South West Aerials

The 1985 catalogue is now available from South West Aerials. This small illustrated booklet contains 21 pages of aerials, amplifiers, diplexers etc, covering most receiving requirements. Also included is a range of TV DXing equipment, including the Waltham 416 6in VHF/UHF TV for System B/G operation (made for the West German market).

The company can also obtain equipment for specific requirements that is not found in the lists. The catalogue is available for 60 pence.

South West Aerials,
11 Kent Road, Parkstone,
Poole, Dorset BH12 2EH.

Data I/O

The latest edition of Data I/O's Product Guide is now available from Microsystem Services (MSS) of High Wycombe, Bucks.

This free booklet illustrates Data I/O's range of PROM and logic device programmers, programming systems and software; it also includes a description and specification for each product together with details of the most effective applications.

The wide range of products covered includes a system for programming up to eight EPROM-loaded boards at the same time, a complete design/programming system for over 130 programmable logic devices, and a stand-alone or host PC controlled system that can program over 1,200 devices.

Copies of the Data I/O Product Guide can be obtained direct from Microsystem Services.

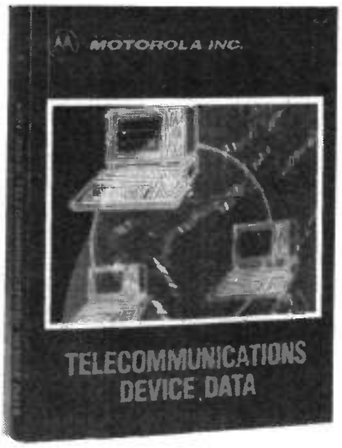
Microsystem Services,
PO Box 37,
Lincoln Road,
Cressex Industrial Estate,
High Wycombe,
Bucks HP12 3XJ.

Simpson

Simpson Electric Company's test equipment catalogue is available free of charge on application to the company.

This well illustrated publication is divided into five sections covering digital meters, analog VOMs and electrical testers, environmental test equipment, communications service test equipment, and accessories. Complete specifications of the units are included, with the prices prominently displayed.

Simpson Electric Company,
853 Dundee Avenue, Elgin,
Illinois, USA.



Motorola

Motorola Logic and Special Functions Division has announced the availability of the new Telecommunications Device Data Book.

This publication contains complete technical data for design engineers, and covers Motorola's semiconductor devices which are dedicated to applications in telecommunications.

As well as extensive data sheets, there are application notes and technical articles to aid understanding of systems and devices.

The Telecommunications Device Data Book costs $2.80, with discounts for quantities of ten or more, and can be obtained from the nearest Motorola sales office or the company's literature distribution centre.

Motorola Literature
Distribution Centre,
Broadway Building #1,
616 West 24th Street,
Tempe,
Arizona 85282, USA.

Thorn EMI

The Communications Division of Thorn EMI Electronics has recently published a new twelve page A4 brochure outlining its capability in terrestrial and satellite communications.

The new shortform catalogue summarises the division's diverse product range, which includes digital microwave links operating at 4.5, 7.5, 13, 15, 19 and 22GHz, Ku-band and C-band high-power travelling wave tube amplifiers, and satellite earth station communications equipment.

Copies are available on application.

Public Relations Department,
Thorn EMI Electronics,
120 Blyth Road, Hayes,
Middlesex UB3 1DL.

Maplin

The 1985 edition of Maplin's Buyer's Guide to Electronic Components is now available from Maplin shops and branches of WH Smith.

By extensively sourcing new products worldwide the range of products has been extended over 1984, and all prices are featured alongside the products.

In many cases these prices are lower than before. The catalogue costs £1.35 retail, or £1.75 including p&p mail order from Maplin.

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

HART

LINSLEY HOOD 300 SERIES AMPLIFIER KITS

Ultra high quality. Mosfet output, Hi-Fi amplifier kits by this famous designer. Two models of identical appearance are available, one giving 35 watts per channel output, the other 45. Careful design has made these amplifiers capable of superb sound quality. The delicacy and transparency of the tone quality enables them to outperform, on a side by side comparison, the majority of commercial amplifiers. Building is very easy as almost all components are fitted on easily removed printed circuit boards. Subsequent setting up needs only a simple multimeter to obtain the full specified performance. Both kits come with very comprehensive building instructions.

35 Watt Complete Kit — **£79.50** 45 Watt Complete Kit — **£83.50** Reprints of Original Articles from 'Hi-Fi' News **£1 no Vat.**

LINSLEY-HOOD CASSETTE RECORDER CIRCUITS

Complete record and replay circuits for very high quality low noise stereo cassette recorder. Circuits are optimised for our HS16 Super Quality Sendust Alloy Head. Switches bias and equalisation to cater for chrome and ferric tapes. Very easy to assemble on plug-in PCBs. Complete with full instructions.

Complete Stereo Record/Play Kit — **£25.26**
VU Meters to suit — **£2.30 each**
Reprints of original Articles. **75p no Vat.**

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Our complete kit for this brilliant new design is the same size as our Linsley-Hood Cassette Recorded 2, Kit includes all parts for two power amplifiers with large heatsink area, huge power supply and speaker protection circuit. Total cost of all parts is **£114.46** but our special introductory prices for all parts bought together is only **£105.50.**

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Beautiful, precision make High Quality variable capacitor tuned FM Front End with Dual-gate MosFet. 2-AM Gangs and 3:1 reduction gear.
FM range 87 to 109MHz 12v 30mA Max. AGC and AFC. OUR PRICE ONLY £3.99 INCLUDING VAT AND POSTAGE (Circuit if required 35p).

MULLARD UHF TV FRONT ENDS
Compact Varicap tuned modules. U322 is used in 'ELEKTOR' teletext decoder. U321 £9.24 inc vat U322 £9.76 inc vat.

COMPLETE STEREO TUNER MODULE

Three band LW/MW/FM Stereo Tuner fully assembled on PCB 165 x 85mm. Supplied with Ferrite rod aerial and band switch fully wired. Facility provided to drive tuning meter and stereo LED. Only needs 12v DC supply. FM sensitivity. 2.5uV. **Prices only £7.99inc. VAT and post.**

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Following the runaway sellout of our last cassette deck we have now obtained a small quantity of an even nicer one. Min features are full auto-stop. Chrome/Ferric Switch, Manual record level control (invaluable for computer use), twin VU meters and 3-digit counter. Complete with all record and replay circuitry, control keys and cassette carrier/door. Very good quality and only **£21.80** inc Vat and Post.
Circuit diagram and notes **35p.**
SET OF 5 SUB-MINIATURE IF TRANSFORMERS for high quality AM tuner. THE SET ONLY 38p!
Application circuit required **10p**
Suitable ferrite rod antenna **85p**

AM VARICAP DIODE BARGAIN Due to a fantastic bulk purchase we are now able to offer the super SMV2012 varicap diodes at unbelievable prices. These are a wide range diode for use in AM tuner applications. They are also supplied in matched sets to eliminate tracking errors!
Matched pair only 25p. Matched 4 only 60p.

AM TUNER COIL SET Set of 4 coils for long medium and short wave AM tuner. Coils are LW Osc, MW Osc, SW Osc and SW Aerial. Normally 30p each. OUR PRICE FOR THE SET ONLY 55p
Application circuit using coils and matched pair of SMV2012 varicaps. 35p 168A E162 455KHz IF Transformer **30p**
Sitable PC Board **£1.50**
PC Mounting Wavechange Switch **£1.60**

HIGH QUALITY REPLACEMENT CASSETTE HEADS


Do your tapes lack treble? A worn head could be the problem. Fitting one of our replacement heads could restore performance to better than new! Standard mountings make fitting easy and our TC1 Test Cassette helps you set the azimuth spot-on. We are the actual importers which means you get the benefit of lower prices for prime parts. Compare us with other suppliers and see! The following is a list of our most popular heads, all are suitable for use on Dolby machines and are ex-stock.
HC20 Permalloy Stereo Head. This is the standard head fitted as original equipment on most decks **£5.11**
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HQ551 4-Track Head for auto-reverse or quadrophonic use. Full specification record and playback head **£9.73**
MA481 Latest version Double Mono (2/2) record/Play head. Replaces R484 .... **£8.90**
SM166 Standard Mounting 2/2 Erase head. Compatible with above or HQ551 4 Track head **£5.90**
H524 Standard Erase Head. Semi double gap, high efficiency **£1.50**
H561 Metal Tape Erase Head. Full double gap **£4.90**
Please consult our list for technical data on these and other Special Purpose Heads.

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One inexpensive test cassette enables you to set up VU level, head azimuth and tape speed. Invaluable when fitting new heads Only **£4.66** plus VAT and 50p postage.
Tape Head De-magnitiser. Handy size mains operated unit pevents build up of residual head magnetisation causing noise on playback **£4.54**
Full details of the entire range of HART products is contained in our illustrated lists. Ask for your FREE copy NOW.
Enquires for lists are also welcome from overseas but please let us have three IRCs to cover the cost of surface post or 5 IRCs for airmail.
Please add part cost of post, packing and insurance as follows
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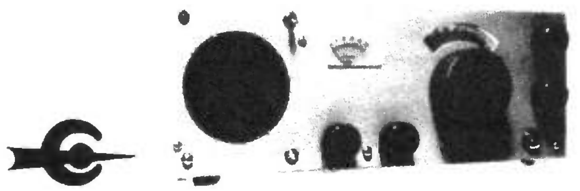
GENERAL COVERAGE RECEIVER KIT

NEW

FCR 130

This is a complete kit which allows you to build and learn as you go. Suitable for anyone who has an interest in radio and can manage a soldering iron. It really is within the scope of most beginners. You don't have to be a 'semi-professional amateur' to understand how it works as we supply very comprehensive and complete instructions, written in plain language. Well spaced components so its OK for fat fingers! The receiver tunes, in 3 bands from 1 to 30 Mhz. Solid aluminium tuning and control knobs and base panel. Black anodised front panel. Nice to build . . . nice to look at . . . nice to own

Model FCR **130** Receiver kit . . .



- 30:1 Geared analogue tuning
- 3 Band switch with spare position
- Tape record socket
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- A.F. Gain and Tone Control
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14 Will tune any Transmitter/Aerial combination to optimum
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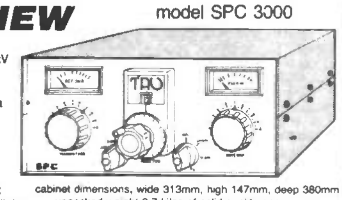

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PRINCIPLES OF MORSE DECODING AND Z80 MODE 2 INTERRUPTS

DR. MA KIAM-LAINE

Radio amateurs in particular may be interested in some details of how to tackle the problem of decoding Morse signals with a computer, since it has become commonplace to be doing so nowadays.

The use of RTTY and data-transmissions over short wave links is spreading rapidly into its *guaranteed* future, along with visual display on TV monitors and error-checking repeat-request microprocessor circuits.

So this general field of activity is going to become normal procedure for radio operators before too long.

Having just written such a program to run on a Nascom-3, using 1K byte of RAM, it was concluded that 95% of the work was not dependent on the machine being used and so could be of interest to *all* computer users.

Z80 code experts may like to know about the Mode 2 interrupt techniques employed, as it makes a change from inputting pulses via the conventional serial UART or PIO running on 1 bit, and furthermore the method of pulse analysis has applicability to many data streams *other* than Morse code, and so could be adapted to industrial uses.

Easy facility

The Nascom bus line 22 $\overline{\text{INT}}$ is an open collector pulled up to +5V, and any circuit sinking 6-10mA can pull it to zero volts in order to cause a maskable interrupt. Thus an easy facility exists into which a Morse signal can be fed, and this will form the core of a routine which decides whether a space or mark (dot or dash) is being received, prior to counting delay loops to time the durations of either.

However, the pulses supplied to the computer should be clean and fairly square, so you may have to build an interface from your communications receiver. The *Elektor* (May 1983) circuit is an excellent solution for most situations, but does not sink enough current at its output in order to interrupt the Nascom. The simple addition of a PNP transistor will cure that aspect (see *Figure 1).*

Reference to any Z80 book will show there to be three modes of maskable interrupt possible. Mode 1 always jumps to location 0038 HEX to find its processing routine, but this may not be convenient, especially if you have a ROM monitor over that area.

Careful use

Mode 0 jumps to any of eight restart addresses or executes a call instruction, but all require the interrupting device or peripheral to have circuitry to put a necessary instruction byte onto the databus at the right time. Provision of such circuitry can be avoided by careful use of Mode 2, if you can determine what state your databus is in at the time of interrupt.

The principle of Mode 2 is a two stage jump. The first address is obtained by combining the I-register contents with the databus value; the Z80 goes to that address to get the contents of it, plus the next RAM byte, to form the destination address at which the processing routine must be placed. Sounds complicated doesn't it? But it isn't too bad once you study it, and it allows great flexibility in multi-peripheral systems.

Now both the I-register and the two RAM bytes can be loaded by program to any value you want. The only problem is to know what value the databus will be at by itself at the time of interrupt, if no external circuits set it to any other value.

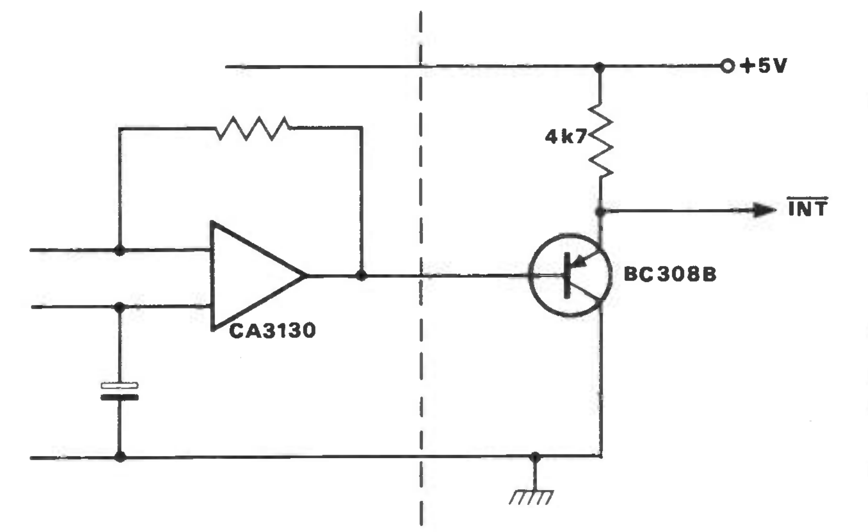


Fig 1 *Interface circuit for cleaning the pulses supplied to the computer*

MORSE DECODING

One might think it would be all lines high at +5V giving (FF) HEX, but on the Nascom at least it was found to be at (BE) HEX when exiting from a JR-2 loop, and (00) HEX from a NOP window provided by the instructions:

```
EI      enable interrupts
NOP     window during which
        INT is allowed to occur
DI      disable interrupts
```

Thus it might be expected to be at other values, depending on the type of instruction being executed at the time of interrupt. Maybe these values are published somewhere?

Anyway the databus can only adopt 256 different states, so by filling a spare block of RAM with a chosen symmetrical (high byte same as low byte) first stage address one can catch it wherever it lands in that block, and then do a binary reduction on the block length to converge on its exact value, which we shall refer to as (WW) HEX.

So we now know how to use Mode 2 by program only – with no hardware:

```
IM2          set Mode2
LD A, ZZ   } load I-register
LD I, A    } with ZZ
EI
NOP
DI
```

The following must also be provided:

Address	Content
ZZWW	XX low byte
(ZZWW + 1)	YY high byte
YYXX	start of processing routine

(WW) = (BE) HEX in this case.

We can now progress to a mark or space discriminating routine:

```
JR + 3
CALL SPACE            JUMP IF INT. OCCURS
IM2                   LOCATION YYXX
LD A,ZZ               DI
LD I,A                CALL MARK
EI                    LD A,01
NOP                   LD (10B2) A
DI                    RET
LD A (10B2)  } TEST
SUB 01       } FLAG
JPM
LD A,0       } RESET
LD (10B2) A  } FLAG
JP
```

where location 10B2 is being used as a flag to record whether each previous loop was interrupted (yes = 01) or not.

Returns from interrupt go back to the window and continue looping.

That is all we need to say about interfacing and interrupt catching; the rest is the more straightforward job of counting the lengths of each space and mark to decide whether:

1 the marks are dots or dashes (dash should equal 3 dot lengths);
2 the spaces are inter-mark (should equal 1 dot length);
3 the spaces are inter-characters (should equal 3 dot lengths);
4 the spaces are inter-words (should equal 5 dot lengths).

Note the use of the word 'should'!

Erratic

Even if you are accustomed to reading Morse you may not have adequately appreciated how erratic most senders' styles are, although the ear/mind of a listener has the faculty to decide what the sender was probably intending to send rather than what electrically was transmitted.

One famous radio operator in the Ukraine regularly sends his own CQ and callsign at 100wpm as one continuous string of dots and dashes, whereas the rest of the message comes in at 20wpm. Ironically the poor computer can't cope with that sort of burst unless 'signature' storage routines are incorporated, but this is hardly worth the effort for normal non-espionage decoders like ourselves.

However, this underlines the need for our program to be able to automatically adjust itself as the incoming speed varies – at least over a defined range – and to be tolerant of extra long gaps or dashes etc.

Most hand-sent Morse one hears is in the range 8-25wpm, so the program should cover, say, 5-40wpm for normal use. The method used for auto-adjusting the speed is to maintain a store of dot, dot*2, dot*3, and dot*4 lengths and continually update the values to that of the last dot which came in. All other lengths are compared with this store, so it will always provide a valid reference within its range.

The initial dot length setting is calculated for a nominal 12wpm input to minimise the chance of the very first dash of a fast sequence being mistaken for a dot, but either way the first true dot would soon locate and immediately thereafter adjust.

Duration

Any duration less than dot*2 is said to be a dot or inter-mark separator.

Any duration ⩾ dot*2 but less than dot *4 is said to be a dash or inter-character separator.

Any duration ⩾ dot*4 is said to be an inter-word separator.

Regarding the so-called 'speed' of Morse, you have to note that its (X)wpm rating is a very imprecise statement on its pulse composition. Morse characters vary from 1 to 6 marks in length, and some contain all dots and others all dashes, so the shortest character is 'E' at 1 dot length while 'O' (5 dashes) is 5*3+4 = 19 dot lengths.

20wpm plain language is officially reckoned to be equivalent to 16wpm random code, since the latter contains fewer short characters like E, A, I etc, but even that statement is inadequate. Therefore, we must plan for worst-case

Many micro-computers use the Z80 processor chip, including the Tatung Einstein (reviewed in R&EW December)

sequences of all Es or all Os so that the program won't fail in such events.

It has been calculated that the worst-case dot length at 50wpm should not be less than 10mS.

Furthermore, regarding *'durations'*, you will need some perspective on the speed of Z80 instruction execution relative to the incoming Morse as well as a short excursion into 'real time' programming.

Even though you think the Morse may be fast, the Z80 is a thousand times faster, so if a pulse of say 100mS was to be measured it would be unnecessary to look at it every 10μS (giving a count of 10000). Instead we build a delay loop of known duration (about 2mS in this case) and look at the pulse only once every 2mS (giving a count of 50).

Many Z80 machines run at 2MHz, which means ½μS/cycle, and the total time for any particular instruction to execute is published in most books.

So a loop such as:

```
   ↓
   LD A,7F (=127 DECIMAL)
┌→ INC IX ⎫ TIME          10 CYCLES
│  DEC IX ⎭ CONSUMERS     10 CYCLES
│  DEC A                   4 CYCLES
└─ JPNZ                   12 CYCLES
   ↓
```

will have a delay of (10 + 10 + 4 + 12)*½ = 18μS/loop, or 18*127 = 2.286mS to decrement the A-register to zero.

Actually the 'LD A, 7F' takes 7 cycles once on entry, and 'JPNZ' only takes 7 (instead of 12) cycles once on exit, but this hardly affects the calculation.

'Real time'

Incidentally, the definition of 'real time' programming simply means that the data for analysis by a program is only available for (usually short) durations. So, by contrast with permanent data which you could take all day to look at, the real time data has to be processed fast enough not to miss it or falsely measure it, and thus the actual cycle times of program steps becomes very important. Bad news for programmers who normally write yard long bird's nests of inefficient coding!

So: every time we call the 'mark' or 'space' routines we will also call 'delay' prior to adding one to a counter. Obviously we can only sum the count of a mark at the instant it changes to a space and vice versa, so the first instruction in a 'mark' routine has got to be to call 'space length' to sum the previous duration – and vice versa.

An 8-bit location is used to store the marks from an incoming character, and a pointer moves along it setting logic 1 for a dash and logic 0 for a dot, until a space ⩾ 'dot*2' says the character is complete and ready to decode and print, or display on the VDU. If the space is also⩾ 'dot*4' the character must have been the last in a word, so output a VDU space as well.

'Decoding' consists of a table holding two HEX values for each Morse character. The first value is that of the 0s and 1s built up in the character store, and the second is its ASCII equivalent required for printing. Thus the table has to be searched in steps of two to find the first value, then one more step to get its ASCII value.

Tricky

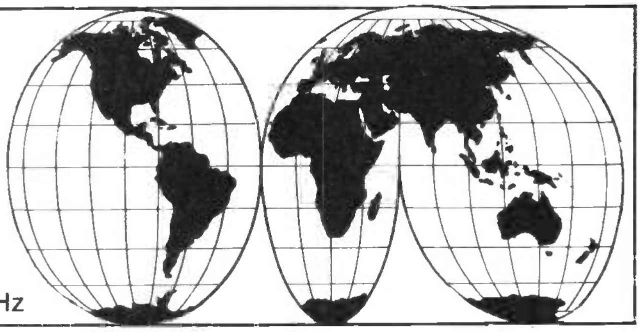
There are admittedly some tricky points to include in the general program, but all describable as 'normal' to experienced programmers, so no further detail is given at this stage.

The purpose of this article is to outline the primary approach techniques to the problem. Many programs to suit particular machines are nowadays advertised in magazines, so unless you are addicted to 'knowing how its done', you'll save a lot of headaches by just buying one for £5! 73 and good DX...Dr Kiam-Laine. REW

SHORT WAVE NEWS FOR DX LISTENERS

By Frank A Baldwin

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



In the previous issue, some of the stations located in Bolivia and currently operating on the 60 metre band(**4750** to **5050**) were brought to the attention of readers. In this instalment some more Bolivian stations in this band are listed, together with those on the 90 metre band (**3200** to **3400**) which are reported from time to time in the SWL press.

Probably the most frequently reported Bolivian on the LF bands is Radio Illimani on **4945** located in La Paz, from where it is on the air from 1100 (Sunday from 0900) to 0400 (Sunday until 0300) but has recently been reported operating on a 24-hour schedule. With a power of 10KW, it identifies as La Voz de Bolivia and operates in parallel on **6025.** The snag with the former channel is that it is also occupied by no fewer than three Brazilians, one Colombian and one Uruguayan, the real problem being Caracol in Neiva, Colombia on a 24-hour schedule in the Caracol network.

On **4991** there is the less frequently reported Radio Animas in Chocaya, which would be quite a catch for any UK based DXer to log. R Animas is scheduled from 1100 to 1400, from 1500 to 1900 and from 2100 to 0400, only the latter period of course being of any use to us here in these northern climes. The power is 1KW and the snag is that the more powerful Radio Barquisimeto in Venezuela is on the adjacent **4990** channel from 1000 to 0400 at 15KW.

Go up to **5030** sometime during its 2130 to 0100 (Saturday until 0300) operating period and you may be fortunate enough to hear Radio Cuarta Centenario in Tupiza from its 1KW transmitter, through co-channel QRM caused by the 15KW Venezuelan Radio Reloj Continente in Caracas. This has been done by several UK DXers including the writer just recently.

That just about winds up the list of Bolivians that one could reasonably expect to log here in the UK with some dedication and luck, but before ending the Bolivian list of probabilities, mention will now be made of some even more difficult targets.

The 90 metre band is a difficult hunting ground for most of us DXers, to say the least.

It abounds in commercial QRM which necessitates the use of a highly selective communications receiver, preferably attached to an efficient outside aerial system via an aerial tuning unit.

On **3310** there is the often reported Radio San Miguel in Riberalta which, despite its low power of 0.5KW, does succeed in putting a signal into the UK. Logged on several occasions by the writer and other DXers, its schedule is from 1000 to a variable closing time of 0300. Any snags? Of course, aren't there always! This time it is the frequency that can be variable in addition to the closing time. However, just tune either side of the **3310** mark and you may succeed with this one.

A recently reactivated Bolivian station is Radio Viloco, Viloco on **3340.** It is scheduled as operating from 1005 to 0130 with a power of 1KW.

Lastly there is Radio Camargo, Chuquisaca on **3390** at which point on the dial it is listed as working from sign-on at 2230 to closing at 0200 (Sunday at 0100). It has a power of 1KW but is rarely heard by DXers.

The main snag with these last two stations is the co-channel and surrounding commercial QRM, but then that is a feature of the 90 metre band one must contend with for any eventual success in the Bolivian quest on this LF band.

AROUND THE DIAL

Imparting information to active SWLs and DXers is the object of this monthly article – the times, the channels and other relevant information are published here for guidance.

AFRICA

Central African Republic

Bangui on a measured **5034.5** at 0500, YL with the station identification 'Radio Centrafrique' and a newscast in French. With a power of 100KW, Bangui is on the air from 0430 to 0700 and from 1630 to 2300, but the frequency can vary from that shown down to **5032** on occasions. Bangui is a port on the River Ubangi and is the capital of the Republic.

Egypt

Cairo on **9475** at 1938, YLs with songs and local-style music in a programme of the Arabic Domestic Service, which may be heard on this channel from 1800 to 2345.

Djibouti Republic

Radio Djibouti on **4780** at 0328, OM with a talk in a local language, presumably Somali, the transmission overlaying some weak interference from the USSR station on the same channel. R Djibouti now has a 20KW transmitter and operates from 0300 to 0800 (Friday 0500 to 0900) and from 0900 to 1900 (Ramadan until 2200) in Somali, Afars and Arabic.

Gabon

Moyabi Relay on **21695** at 1540, with a relay of Radio Japan, Tokyo featuring a talk on Japanese traditional food during an English transmission directed to America, Europe, the Far and Middle East, timed from 1500 to 1600.

Mauritania

Nouakchott on **4845** at 0634, YL with chants in a local vernacular complete with pipe music accompaniment. This 100KW transmitter is on the air from 0600 (Sunday from 0800) to 0900 and from 1800 to 2400.

Namibia

SWABC (South West Africa Broadcasting Corporation), Windhoek on **3270** at 1927, OM with a talk in vernacular then into a programme of light orchestral music – the CW QRM permitting! Windhoek is scheduled from 1615 to 2200 and from 0358 to 0515. There is also an All Night Service from 2200 to 0358.

Nigeria

FRCN Kaduna on **4770** at 2025, OM with a talk in Hausa. Kaduna is timed on the air from 0400 to 0100 with a power of 50KW, and the transmission heard was that of Channel 2 which uses English and Hausa languages.

South Africa

RSA (Radio South Africa) Johannesburg on **25790** at 1315, OM with announcements during an English programme for Africa, Europe and the Middle East and timed from 1300 to 1600.

Tanzania

Dar-es-Salaam on **5050** at 1936, OM with a song in Swahili complete with accordion background music. Radio Tanzania on this channel is on the air from 0300 to 0700 with the National Service, and the Commercial Service from 1300 to 2015, all in Swahili. The power is 10KW.

Tunisia

Sfax on **15225** at 2011, OMs with songs and music in the Arabic Domestic Service which may be logged on this frequency from 1800 to 2330.

AMERICAS

Brazil

Radio Educacao Rural, Campo Grande on **4755** at 0143, YL with a sad and slow song in Portuguese then OM with the station identification complete with echo-effect at 0145. The schedule is from 0800 to 0500 and the power is 10KW.

Radio Timbira do Maranhao, Sao Luis on **4975** at 0232, YL with a pop song in Portuguese. This programme was also in parallel on **5045** Radio Cultura do Para, Belem. Useful things these memory banks, one can rapidly switch from one channel to another in order to determine parallel operation. R Timbira operates from 0800 to 0300 with a power of 2.5KW.

Colombia

Radio Super, Medellin on a measured **4877** at 0302, OM with a newscast of local interest in Spanish. The schedule of this 2KW transmitter is around-the-clock but the frequency is variable from **4875** at times.

Ecuador

Emisora Gran Colombia, Quito on a measured **4910.8** at 0256, OM with folk songs in Spanish. This station is on the air from 1100 to 0500 with a power of 10KW, but it is not quite as simple as that for those who aspire to log this one. The frequency can, and often does, vary from **4910** to **4911** and the transmission times can vary from closing at 0400 to 0500 but at times working around the clock.

ASIA

China

Xinjiang PBS, Urumqi on **4735** at 0111, YL with a talk in the Uigher Home Service, which is on this channel from 2300 to 0125 and from 1030 to 1730, and including relays from R Beijing from 0030 to 0125 and from 1300 to 1355. Xinjiang also relays the R Beijing Foreign Service in Russian from 1800 to 2055, this being jammed by Moscow.

Radio Beijing on **7010** at 1920, YL with announcements then some Chinese music during the Rumanian programme for Europe timed from 1900 to 1930.

Radio Beijing on **7035** at 1923, YL with a talk in the Russian programme, jammed of course. Both these amateur band intrusions spoil the chances of any CW DX; I most certainly have great sympathy for the 40 metre key bashers. In desperation around the times quoted I usually resort to using Top Band for my dots and dashes listening sessions – but see later.

India

AIR (All India Radio) Hyderabad on **4800** at 1557, YL with a talk in English about Vietnam. The schedule is from 0025 to 0215 and from 1200 (March to April inclusive from 1130) to 1740. There are English newscasts at 0032, 1230, 1530 and 1730.

AIR Delhi on **4860** at 1540, OM with a newscast in English. This one operates from 0130 to 0135 and from 1235 to 1315 with a programme for the armed forces and from 1330 to 1335, 1345 to 1415, 1420 to 1435, 1445 to 1630 (variable) and from 1730 to 1740 with English newscasts at 1430, 1530 and 1730 with a power of 10KW in the North Regional Service.

AIR Delhi on **11620** at 1929, OM with a song in Hindi, YL with announcements and the station identification in the English transmission for the UK and West Europe, scheduled on this channel from 1845 to 2230.

Pakistan

PBC Islamabad on a measured **4758.2** at 1526, OM with a talk in a local language, presumably Pushtu or Baluchi. Also heard a few days later when closing at 1600 but on a measured **4762.4**, so the frequency is rather erratic to say the least.

United Arab Emirates

Dubai on **15320** at 2047, recitations from the Holy Quran, OM announcements and station identification in Arabic, the national anthem and off at the end of the Arabic Service directed to Europe and North Africa and scheduled from 1645 to 2050.

Vietnam

Hanoi on **10040** at 2041, YL with a talk about border violations. The English transmission is timed from 2030 to 2100 and beamed to the UK and Europe.

Yemen Arab Republic

Radio San'a on a measured **4852** at 0314, recitations from the Holy Quran. The schedule is from 0230 to 0700 (Friday until 1000) and from 1000 to 2130 (Ramadan until a variable closing around 2230). The power is 100KW.

EUROPE

Albania

Tirana on **9500** at 1941, YL with the news and programme in English for Africa timed from 1930 to 2000.

Greece

Athens on **15630** at 1846, OM with a newscast of local events in an English programme intended for Europe and scheduled from 1840.

Hungary

Budapest on **6025** at 1930, YL with station identification then OM with a newscast in the English transmission for Europe timed from 2000 to 2030.

Iceland

Rikisutvarpid on **13797** at 1910, YL and OM with a discussion in a relay of the Domestic Programme 1 for Icelandic seamen, scheduled from 1830 to 2000 but sometimes extended.

Rumania

Bucharest on **11940** at 1943, ballet music during an English presentation for Europe timed from 1930 to 2030.

SOUTH EAST ASIA

Australia

Melbourne on **7205** at 1605, OM with a newscast of world events, this English transmission also being heard on the parallel **6035** channel. This newscast is timed from 1600 to 1610.

Indonesia

RRI (Radio Republik Indonesia) Ujung Pandang on **4719** at 1550, YL with a slow sorrowful sounding song in Indonesian. The schedule is from 0800 to 1600 and the power is 50KW.

RRI Jakarta on **4774** at 1554, OM with announcements in Indonesian and then into a programme of gamelan music.

Jakarta is on the air from 2158 to 0100 (Sunday until 0200) and from 0800 to 1300 (but sometimes until 1600). The power is 50KW.

RRI Yogyakarta on **5046** at 1546, YL with songs in Indonesian, gamelan music as the accompaniment. The schedule is from 2200 to 1605 and the power is 50KW.

RRI Pekanbaru on a measured **5882** at 1555, OM with a song in Indonesian. Pekanbaru is on the air around-the-clock with a power of 1 to 5KW and the frequency can vary from that reported here up to **5886** on occasions.

Singapore

SBC Singapore on **5052** at 1547, YL with a pop song in English, YL announcer. The schedule is from 2200 to 1605 and the power is 50KW.

CLANDESTINE

'Voice of the United Muslim Fighters of Afghanistan' on **15050** at 1505, OM with a talk in vernacular, presumably Pashto/Dari, being jammed with an overlay of a Moscow programme and identified in CW as 'GI'. Also logged in parallel on **11630** with the attendant jammer 'BG'. The schedule of VoT United Muslim Fighters of Afghanistan is from 1500 to 1600.

NOW LOG THIS

Radio Difusora San Martin, Tarapoto, Peru on **4810** at 0443, OM with a folk song in Spanish then OM with the station identification. RD San Martin is on the air from 0930 to 0500 but sometimes works around-the-clock and has a power of 1KW.

TOP BAND

Just for a change from listening on the broadcast bands, I occasionally venture on to the CW allocations of the amateur bands – just to keep my hand in as it were with the dots and dashes. Two quick visits to the limits **1835** to **1851** on successive evenings resulted in signals being heard from DL1GK/HB0, F0AHY/FC, GI3YFY, I2AY, PA0DIN, PA3CWL, SM6CST, UQ2GMB and UQ2PQ.

Well, at least it made a change, and if Toby Jug of Chatham on the CB Channel 13 at 0413 *was* atop the North Downs at Bluebell Hill then I can verify his signals were getting well into East Anglia.

REW

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Mr David,
Goldrange House,
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Tel: 01-247 3328/3329
Telex: 892460

QSO

THIS MONTH:
A special look at the Leicester Amateur Radio Show, where QSOs abounded

Friday 26 October saw us up bright and early in order to get away in plenty of time on the journey to Leicester for 1984's Leicester Amateur Radio Show.

We arrived at Granby Hall, venue for the show, after a trip blessed by a crystal clear sky and the first few hours of the day's glorious sunshine. (*Duncan, this is a technical journal, not a breeding ground for poet laureates. Stop waxing lyrical: let's have some facts – Ed*).

We found a substantial queue restlessly awaiting the opening of the doors, by then only a matter of minutes away.

This hall must be close to ideal for such a show. It is spacious and well-lit, with facilities which include an efficient cafeteria and a comfortable, well appointed lounge with a bar (although from early lunchtime the staff of these were hard-put to cope with the sheer number of people demanding service).

This is the twelfth amateur radio show staged here, of which two (this and the previous one) have been arranged by the present organisers. The show committee consisted of members of the Leicester Repeater Group and the Leicester Radio Society.

Exhibitors

There were about 60 exhibitors present, and John Theodorson G4MTP, the committee chairman, told me that they could easily have filled half as much space again.

However, John pointed out that the feeling amongst the organisers was that a larger show would have been at the expense of making it a more impersonal affair, losing something of the friendly and relaxed atmosphere.

In addition, of course, a show with more traders exhibiting and only a limited increase in attendance would mean greater competition for the available spending money, and consequently a smaller slice of the cake for each dealer. With the present arrangement it would seem that everybody's happy.

According to Geoff Dover G4AFJ, the committee treasurer, last year's show was hugely successful, with approximately five thousand people attending over the two days.

On the early showing (I talked to Geoff on Friday morning) this one seemed set to do rather better. Similarly, secretary Frank Elliot G4PDZ told me that last year all the exhibitors had been happy with the response (when we talked sometime after the show he said this year he had certainly not received any unduly adverse reports).

Frank was certainly in a position to pass comment on this particular subject, since he runs a local electronics business and had a stand himself at this show (stategically sited near the entrance to the cafeteria and bar!).

Among the many interesting items on display at the show were some new products from some well established manufacturers.

On the day before the show South Midlands Communications had received three new Yaesu units, which were on display for the first time. These were the FRG8800 general coverage receiver, the FT270RH high power two metre mobile, and the FT270R 2m/70cm full duplex rig.

Another relatively new product present was the TAU Systems SPC3000 ATU (which is fully reviewed in the December edition of *Amateur Radio)*. The number of ATUs sold on the spot, with a price tag of £350 or so (a little more than pocket money for a show like this), is ample testimony to their quality.

Over on the muTek stand, their relatively recent transverter was 'shifting well', according to Chris Bartram. They also had a microwave system set up, using the new Gunn diode back end (see *Product News,* November) and were maintaining a QSO with the Microwave Society in the club section (which certainly made a change from the numerous handhelds that are always in action at these events).

This club section was situated just off the main hall, and partly due to the lower ceiling here was given a somewhat more intimate (and warm!) atmosphere.

During the afternoon I talked to Glen Ross G8MWR on the Microwave Society stand, who said he had been swamped with enquiries during the morning. They had sold out of much of the equipment on offer, and had gained many new members (the society now includes a member from as far away as Nairobi; they love him, since he's the first ever to send three years' subscription in advance!).

Glen was providing a setting-up service for anyone bringing microwave equipment along to the rally, in return for which all he asked was a nominal few pence in the contributions box (he'll be applying for charitable status next!).

He said there has been a large increase in microwave operation in the last year or so (funnily enough, since the Microwave Society started up!), a view shared by Chris Bartram.

This may be due in part to the low cost of setting up on microwaves; Glen had a unit on his stand which cost about £30 in total.

This year the Microwave Society had an 82% renewal rate for subscriptions, which is very high considering the number of people who join such groups on impulse and don't usually renew.

Nearby on the G-QRP Club stand were three gentlemen who clearly took a very relaxed attitude to the show (appropriate perhaps?), but nevertheless professed

New Yaesu beastie

Three lunatics

to being very busy. Fortunately one of them was able to summonup enough energy to leave his chair and talk to me!

He pointed out that you don't need state-of-the-art technology to succeed in the hobby, and you can get on the air for a very low figure. Anyone can build the HF transmitters involved (which is in itself an absorbing hobby), and the members of the G-QRP club include some very high-level technical experts. The design of equipment for QRP operation is really very good, and selectivity can be as good as, if not better than, commercially available black boxes.

Membership of the G-QRP Club is, of course, centred in the UK, but there are also a good many members in the USA. The club now has members in 68 countries, and recently gained their first member from the USSR, UA9CDC.

They already have members in most of the Eastern European countries, who are all enthusiastic participants (they must, through necessity, build all their own equipment).

The lads from the G-QRP club were at Leicester primarily to provide information, since they found at the NEC that they were deluged by people wanting to buy their merchandise.

BARTG

Another group who appeared to be overwhelmed at the Leicester show were the staff on the BARTG stand. There was considerable interest shown in data transmission, and when I talked to them during the afternoon they had already sold out of some of their equipment. The number of new members enrolled here was, I'm told, very good for such a show.

The Radio Amateur Invalid and Blind Club were represented. Francis Woolley G3LWY pointed out that they attend these shows to provide a meeting place for members, and to give out information to people who might know someone who could benefit from the organisation.

This club is worth sparing a thought for, since I know many enthusiasts are too busy seeking the bargains at shows and rallies to give much notice to a stand taking such a low-profile stance as this.

The BATC, with membership at almost 2000 now, seemed happy with the response to their stand. Tom G3LMX said that, despite what many people think, the cost of ATV was really very low (this seems to have been a common theme in the club section).

If you are already on 70cm the cost of setting up could be less than £100 (approximately £30 for a receive converter and £30 for a small transmitter, with cameras available quite cheaply at rallies).

On display at the Leicester Repeater Group's stand was their latest unit. This repeater consists of two receivers and two transmitters; one of each is operational at any time, and if it goes down for any reason the other is automatically switched on.

This repeater was commercially built for the group by LMW Electronics and operates on 434MHz. Also operational are repeaters for 2m and RTTY/data (the latter came on the air only that week), and a video repeater on 24cm.

At lunchtime I was lucky enough to get a chance to talk to the man who had a large part in getting two of the repeaters built.

Some time ago, after the group had got GB3LE (70cm) and GB3CF (2m) on the air, Paul G4MQS said he felt somewhat despondent at the lack of activity after these two repeaters had been successfully completed. He therefore formulated a few ideas of his own concerning a TV and a data repeater. He was persuaded to present these ideas to the group, and then 'got dragged into the system'.

Having prompted the TV and data repeaters, Paul got on with building them. The TV one he did on his own, and the data repeater was done with Kevin G8MXV (without whom this repeater would not have been built, as he handled the complex software requirements).

When designing the data repeater, the philosophy was to make it as complicated a transmission unit as they were likely to need, and all credit must go to the group that they achieved their goal (although not without a few headaches).

Now their ideas have snowballed, and they are thinking of some very advanced projects. Problems now arise with the state of play in the rest of the country (and attitudes within the RSGB), since if they get too far advanced provision just has not been made to cope with their ideas.

Paul is now aiming for what could be called a universal repeater, covering almost all bands and modes of transmission, (and a step further than the American Metroplex). This man certainly has ambition!

From far away . . .

Getting back to the exhibition, Dave G6YZZ on the LRG stand told me that five car loads of enthusiasts had come over from Ireland for the show, having saved for some time to be able to afford to stay for a few days.

In addition a coachload was expected from Newport, Gwent, for the Saturday.

The organisers had set up a special event station providing talk-in on various bands, and there was a raffle arranged with some worthwhile prizes.

Near the LRG stand, the RSGB were doing their usual brisk business in books and enquiries, and the bring-and-buy stall was also fairly busy.

Attendance this year turned out to be an impressive 6500+, a significant advance on last year's 5000 (which was itself deemed a great success). This show was the culmination of twelve months' hard work by the committee and the local enthusiasts helping them, and no doubt work will have started almost immediately for next year's show.

All those concerned with the staging of this event deserve a pat on the back for the splendid outcome of their efforts. Next year's show will certainly be well worth attending, judging by this year's high standard.

QSO

Antipodean radio

We have heard from John VK4QA, treasurer of Redcliffe Radio Club (PO Box 20, Woody Point, Queensland 4019, Australia), and editor of the club journal.

The club has been licensed since 1971, with callsigns VK4RC (full licence) and VK4VRC ('novice licence'), and equipment includes a Yaesu FT103Z. Preferred bands are 80m, 15m and 10m.

The club is on the air Sunday and Wednesday on 3612KHz from 0930UTC, and Saturday on 21190KHz from 0400UTC.

These club nets will enable others to gain the Redcliffe City Award; VK/ZL/P29 = 6 points, the rest = 4 points (club stations = 2 points). A log extract of contacts made is required, plus $A2 to cover p&p.

Spring RTTY contest

Peter Adams G6LZB, the contests manager for the British Amateur Radio Teleprinter Group, has written with details of the spring RTTY contest. He also thanks ***R&EW*** readers on behalf of the BARTG committee for their past support.

The contest will run from 0200GMT Saturday 23 March until 0200GMT Monday 25 March 1985 on bands 3.5, 7, 14, 21 and 28MHz, with separate categories for single operator, multi-operator and short wave listener stations.

The ARRL DX countries list will be used.

Summary and log sheets are available from Peter (on receipt of an A4 size sae for addresses in the UK, or 3 IRCs for countries overseas).

Peter Adams G6LZB, 464 Whippendell Road, Watford, Herts WD1 7PT, England.

Forthcoming show

The Northern Amateur Radio Societies Association will be holding their 23rd Annual Radio & Electronics Exhibition and Mobile Rally in the Central Hall, Belle Vue, Manchester on Sunday 10 March 1985.

Admission will be £1, and this venue has good facilities including car park, restaurant and bar. Talk-in will be on S22, SU8, or any other clear frequency.

SSB on 10MHz

Increasing use of SSB on the 10MHz band has been noted recently. Although this band is allocated for SSB, IARU Region 1 in its Band Planning proposals has recommended that only CW and RTTY should be used, due to the fact that it is only 50MHz wide and thus cannot carry much traffic of the SSB type.

Oscar 10 RTTY

The 'official' attitude to the use of RTTY on Oscar 10 was that it is not a 'preferred' mode. This is because RTTY has a 'high duty' cycle and thus wastes power due to the continuous carrier. This was very much the case with the earlier satellites. A1A – space only – RTTY was at one time accepted but it did not catch on.

However, the advent of AMTOR and the successful use of this error correcting technique on Oscar 10 has put a new look on the matter and the pundits are having to revise their views on the use of RTTY on satellites.

Radio exhibition

On 21 October, Hornsea Amateur Radio Club, in co-operation with other local clubs (Scunthorpe, Scarborough, Hull, Goole etc), staged an exhibition to promote the hobby. Each club presented a different aspect of the amateur radio world, and working exhibits included slow and fast scan TV, RTTY, and satellite operation.

Madame la President in Hornsea

There was a limited number of trade stands, and clubs and traders alike reported an excellent result, with nearly 700 visitors.

The new RSGB president (?), Joan G4CHH, attended and reportedly got 'stuck in' at the sharp end.

Details of the Hornsea club can be obtained from Norman G4NJP, QTH.

Learning Morse

Following last month's article about learning Morse, we have received an interesting letter from C B Raithby G8GI:

'. . . I cannot imagine anything more 'off putting' to many aspiring to learn Morse than, quote, *You will also need access to a sound generating home computer, a tape recorder, a Morse key and bleeper.* Never!

'All that is required is a key, an audio oscillator and a receiver with a BFO – preferably covering the short wave bands as well as the amateur ones – plus determination and a friendly fully licensed amateur.'

Mr Raithby has been a Morse operator for nearly 50 years, mostly as an amateur but with 5 years in a professional capacity.

In all fairness to the author of the article, I don't think he was proposing the purchase of a computer and tape recorder merely in order to pass the Morse test! In addition, how many *determined* licensees have the time to spare?

Beatle City

The 'Beatle City' Museum in Liverpool has activated a special event callsign block GB-BCL operated by the Merseyside Special Event Group.

Members involved are Paul G4UVB, Tony G4SYW, Tony G1DFQ, Phil G4KIW, Frank G4YPD, Mike G6ICR, Terry (QSL Manager) G4VKV, Mike G4HSF, Paul G6PZW and Henry G4OJK.

The QSL card to be issued on successful contact will be accompanied by a small fact pack about 'Beatle City', for interest. REW

DATES FOR YOUR DIARY

4 Jan Used Equipment Extravaganza – Radio Society of Harrow. Meetings every Friday at The Harrow Arts Centre. Details from Dave Atkins G8XBZ.

10 Feb 'Hamfeast' Mobile Rally – Bury Radio Society, Mosses Centre, Cecil St, Bury. Further details from M B Priestley, G1BWN. (Talk-in on S22).

On these pages we present details of interesting contacts from clubs and individuals. We would be happy to receive any similar items from readers

DX-TV

RECEPTION REPORTS

Compiled by Keith Hamer and Garry Smith

Despite the decline in Sporadic-E activity, September wasn't all gloom and doom. According to reports from around the UK, short openings did occur with several instances of exotics in evidence, the 9th, 10th and 13th being the most spectacular days. Tropospheric enhancement permitted Band III and UHF reception on the 2nd, 12th, 13th and 16th but openings were not as widespread and intense as those noted during the previous month.

Band I reception

Sporadic-E on the 2nd produced the Norwegian 'NORGE STEIGEN' PM5534 test card on channel E2 during the morning. This, incidentally, was seen in Aberdeen and as far south as Norwich. Many DXers noted activity on the 9th (this being a Sunday) from several European countries.

The most consistent signal came from Soviet television on channels R1 and R2 with programmes lasting for much of the day. Here in Derby at 1250BST a comedy and variety show was received from the USSR. This was followed at 1300 by a female announcer and ice hockey. Excellent quality sound was noted together with SECAM colour.

On the 10th an early morning opening provided DX enthusiasts in Leeds with reception from several countries including Sweden and Spain. Even the 100W relay at Birkfeld on channel E3 in Austria appeared simultaneously with transmissions on E2a and E4.

There was also a possible instance of double-hop Sporadic-E reception on channel E3 at 1037GMT on the 13th in the form of a slow-fading signal. It was the Spanish-style GTE test card but there were two images. It is thought that the signal may have originated from the Izaña transmitter in the Canary Islands rather than the Spanish mainland. Unfortunately, the Spanish TV service (TVE) tends to radiate the GTE test card for most of the test transmission periods each day, and this particular test card does not normally carry any form of regional identification.

DX log for September

This month we are featuring some of the highlights from Kevin Jackson's log received in Leeds.

2/9/84: Enhanced tropospheric conditions provided reception from the following services: TDF (France) on channel E39 from Dunkirk, E43 (Reims) and E7 (Rouen); NOS1 on channel E39 from the Netherlands (Wieringermeer); BRT (Belgium) on E10 from Wavre and E43 from Egem.

9/9/84: RAI (Italy) channel IA on programmes; TSS (Russia) R1, R2 (two stations) with progs; MTV (Hungary) R1 and R2 on progs; JRT (Yugoslavia) on channel E3 with programmes. All reception via Sporadic-E propagation.

10/9/84: TSS R1 on the 'UT 0167' electronic test card at 0736; SR1 (Sweden) on E3 and E4 with their 'TV1 SVERIGE' PM5534 test card; CST (Czechoslovakia) on R1 and R2 radiating the 'RS-KH' EZO-type electronic test card. CST were also noted on R2 using the PM5544 test card with the identification 'SR1 TV BRATISLAVA'; ORF (Austria) on E2a, E3 and E4 on programmes. The E3 reception was from the 100W relay station at Birkfeld and was noted at 0823BST; JRT E3 and E4 on progs (there were two stations on E3); TVE (Spain) E3 on 'tve tve1' GTE colour test card with Spanish colour bars noted on channel E2; Switzerland was noted on E2 and E3 radiating the '+PTT SRG1' FuBK electronic test card; RAI IA with 'Televideo' teletext pages. All reception was via Sporadic-E.

12/9/84: TDF E39, E42 and E45 (all from the Dunkirk transmitter), channel E5 from Lille on test programmes, also a French 'CANAL PLUS' caption at 1207 and a PM5544 test card at 1558 with the identification 'TDF RESEAU 4'; BRT/RTB E43, E46 and E10; NOS1 on E39, NOS2 on E27 (from Lopik). All reception via improved tropospherics.

13/9/84: TDF E39; NOS1 E39 via trops; TVE E3 on 'tve tve1' GTE test card at 1037 (the signal faded resembling typical reception via trop and there were two images. Kevin suspects reception to have originated from the E3 transmitter at Izaña in the Canary Islands via double-hop Sporadic-E).

16/9/84: NOS1 on channel E39 via tropospherics.

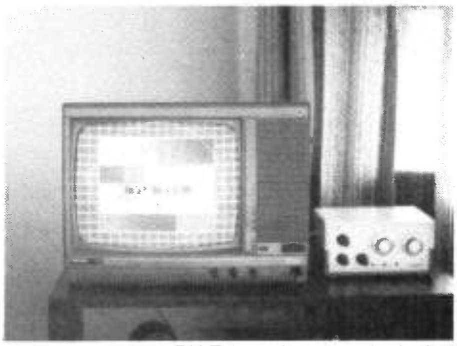
28/9/84: TDF E39, E42 and E5 on test transmissions with a 'CANAL PLUS' caption at 1229. Also received from France was the 'TDF RESEAU 4' PM5544 test card at 1558 with station closedown at 1559; BRT/RTB (Belgium) E43 and E46 via trop. Reception occurred along the cold-front of a weather system.

Our thanks to Kevin for sending details of his DX-TV successes.

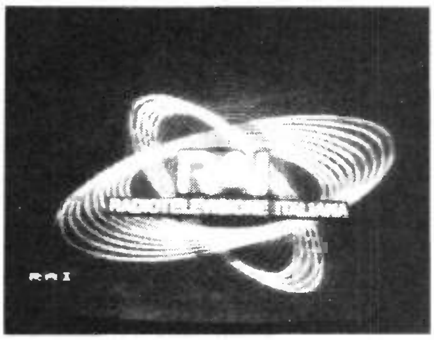
Reception reports

After reading the article about long distance radio and television reception in Bands I, II and III via Sporadic-E (see ***R&EW,*** August 1984), Martyn Stroud of Gillingham was sufficiently enthused to 'give it a go'. Armed with a second-hand upconverter and a home-made wideband Band I dipole, he was successful in receiving extremely good quality signals even though his hand-rotated aerial was indoors.

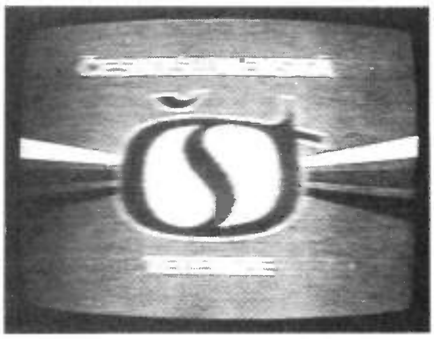
Martyn has received West Germany on channel E2 from Grünten on the FuBK test card, ORF (Austria) programmes on E2a, the PM5544 from RAI in Italy and Czechoslovakia on their 'RS-KH' electronic test card. During slightly improved conditions he also logged Norway (NRK),



Kevin Jackson's DX-TV equipment displaying the Finnish FuBK test card on E4



Scene from the opening sequence used by RAI in Italy via Sporadic-E



Identification caption radiated by Ceskaslovenská Televise (CST)

Sweden (SR) and Hungary (MTV) via Sporadic-E. His reception shows would-be TV DXers just what can be achieved with the minimum of equipment.

Simon Hamer (New Radnor, Powys) has once again been busy with his portable DX-TV equipment atop a local hill. From his vantage point he received excellent quality signals from the UHF transmitters at Oxford, Mendip, Hannington, Ridge Hill, Bromsgrove, Sutton Coldfield, Sandy Heath, Winter Hill, Llandrindod Wells and Moel-y-Parc. He also received snow-free pictures from the RTE (Eire) channel H transmitter at Kippure.

Looking east!

On a recent trip to Eire, Simon couldn't help noticing the profusion of tall masts supporting UHF aerials for reception of programmes from the Welsh transmitter at Presely. In some communities there are even cable TV networks relaying British programmes.

Clive Athowe (Blofield, Norfolk) is in the throes of replacing his ailing Bush TV125 and TV161 DX monitors with hybrid Rediffusion Mk13 sets. These are 20 inch monochrome receivers and he reports excellent results. Clive has fitted selectivity filters (ex-Philips G8 colour TV sets) to the IF strips.

Keeping an ever watchful eye on channel E5/R6 he was rewarded with meteor-shower DX on several days. On the 14th and 24th it was a glimpse of the Czechoslovakian test card, the 'EZO' type. On the 20th he saw a game of chess in progress from Russia. Also via meteor-shower, Clive saw the elusive 'JRT SA1' FuBK test card on channel E3 on the 27th.

Trops from Switzerland were in evidence on the 2nd and 13th, the latter being the most productive day. He received the '+PTT TSI1' FuBK test card on channels E34 (La Dôle transmitter) and E35 (La Chaux-de-Fonds). On channel E31 the Swiss German language service was present with programmes from DRS/SRG1. The SRG1 network appeared in Band III as well on channels E6 (from the Rigi transmitter near Luzern) and E7 (Säntis). The French language service in Switzerland was received on E9 from the SSR1 transmitter at La Chaux-de-Fonds.

Kevin Jackson (Leeds) has received a QSL card from Elliniki Radiophonia Tileorassis (EPT) in Greece, confirming his channel E3 reception of August 4th. Full details were given in last month's column.

Several photographs arrived with his log. Some show the view from his excellent DX location high up in a tower block. One of the other pictures shows his DX equipment, which comprises a Philips 12 inch UHF portable fed from a D-100 DX converter which features switchable IF bandwidths. The receiver has been modified for positive or negative-going vision to allow reception of French system 'L' pictures.

Kevin's DX set-up looks quite impressive and would grace anyone's lounge. His indoor aerial can pick up several French, Belgian and Dutch coastal FM radio stations for most of the time, using a Grundig 'Concert Boy' receiver on its whip aerial. Not bad going at a distance in excess of 200 miles.

John Bray (St Neots, Cambridgeshire) has queried a blank PM5544 test pattern which is occasionally received at his location on channel E23. This is actually radiated by the IBA from the Crystal Palace transmitter after closedown. It has caused quite a lot of head-scratching in the past among many DX-TV enthusiasts.

Another mystery of John's was the sighting of colour bars on E2 on September 10th. Many enthusiasts have asked about this pattern, and we can only assume that the source is TVE (Spain) as they have been noted using this pattern without any form of identification.

John has joined the ranks of the lucky few who have invested in a multi-standard Luxor SX9-series receiver. He too noted the TSS reception on the 9th in glorious SECAM colour.

Bob Brooks (South Wirral) noted the excellent Sporadic-E of the 9th. He saw TSS on R1 with ice hockey. Sweden, Czechoslovakia, Spain and Austria were also around in Band I during the day. The 10th brought in Czechoslovakia on channel R2 radiating the 'SR1 TV BRATISLAVA' PM5544 at 1020BST. A little later in the day the Czech 'RS-KH' test card was received from various CST transmitters on R1 and R2. DX-TV signals are often noted from West Germany at Bob's location. He frequently sees the Bayerischer Rundfunk 'GRÜNTEN' FuBK on E2 and the 'SWF BADN1' FuBK on E4 from the Raichberg transmitter which is operated by Südwestfunk (SWF).

Norway and Sweden have also been regular visitors during the month via meteor-shower and Sporadic-E. Bob is also using a D100 DX converter and he's very pleased with its performance. Signals from Eire on channel H can now be easily resolved thanks to the narrow IF bandwidth settings. When using a typical wideband IF receiver (these are frequently used for DX purposes) he found that the local 405-line broadcasts obliterated the Eireann channels. This problem has been overcome by using the D100.

Way up north!

Iain Menzies has written from Aberdeen to tell us that auroral disturbances have affected Band I frequencies during the second half of the month. These occurred on the 17th, 18th, 19th, 20th, 23rd, 26th and 30th. The activity of the last day was described as 'mushy' but he managed to identify weak signals from

News programme broadcast by Sender Freies Berlin (SFB-1) on channel E7 in West Germany

American Forces Radio & Television (AFRTS) news bulletin received from Berlin on channel A25

Italy, Austria, West Germany and Spain.

The Sporadic-E opening on the 9th brought in Italy on IA with the test card, the West German Südwestfunk outlet at Raichberg on E4, Bayerischer Rundfunk from Grünten on E2, Austria on E4 and Yugoslavia on E3. At 0820 an English language programme was noted on E2 and E3. This was eventually identified as a 'teach yourself English' programme from Switzerland. At 0850, Czechoslovakia appeared on R1 showing a cowboy Western.

Iain has added a system 'L' 14 inch colour portable to his DX set-up. It's manufactured by Fidelity and caters for reception from France. He was fortunate enough to sample the French 'Canal Plus' service from Lille on channel 5 recently. Apparently, signals were 'romping in with colour showing disgusting videos and film clips which the BBC would never show!', according to Iain. Channel 4 might, but not the BBC.

Arabian mysteries

The profusion of Arabic transmissions received during the early part of the Sporadic-E season has generated a lot of mysteries, many of which will never be solved. Gösta van der Linden (Rotterdam, Netherlands) has kindly sent us a few details from *'TV Logboek'*, as published in the July 1984 edition of the Benelux DX Club's magazine. Hopefully, the following notes will help DXers recognise some of the Arabic signals from the details given.

On May 23rd from 1603 until 1615BST a strong channel E2 signal with sound was present consisting of a female newsreader with a vignette to her right, above Arabic text. At 1615 the Koran appeared but the signal faded completely at 1621. Between 1643 and 1717, two E3 signals were resolved on E3 – both were of Arabic origin. From 1643 until 1655 a female newsreader was present but without the vignette and Arabic text. A studio/station caption appeared at 1700 followed by an American film with subtitles, called *'Meet the Grangerrots'*. A second film followed between 1740 and 1838. A further programme was noted which consisted of a woman talking. Arabic music was heard between 1813 and 1825.

On May 24th from 0910 until 0945 the Aramco TV service at Dhahran in Saudi Arabia was noted on E3. A sports programme was resolved featuring highlights of a hockey match. At 0940 a caption was seen displaying 'PRAYER INTERMISSION'.

In May's column we mentioned the possibility of Clive Athowe receiving Aramco TV on the 24th, when a 'CHANNEL 3' caption appeared together with signals from Greece (EPT) and Jordan (JTV) shortly before his remarkable reception from Iran (IRIB). The above reception, noted in the Netherlands around the same time, does tend to confirm that Clive's signals were indeed from Saudi Arabia.

New DX publication

The reception of radio and television signals over long distances is a thriving hobby throughout the world. Today, there are many books which deal either with FM or TV DXing but few cover both subjects in one volume.

This situation has been rectified by West German DX enthusiast Norbert Kaiser. He has written a 180 page book which has just been published in German. It's very impressive, and so is its lengthy title: *'UKW/TV-DX Eine Einführung in das Hobby des Uberreichweitenempfangs'*.

All the various modes of propagation are discussed, with detailed information about Sporadic-E, tropospherics, transequatorial skip, meteor scatter, lightning flash and aircraft reflection.

Apart from tables showing the parameters of all the main transmission standards, there is also a very useful list detailing the various systems used in most countries throughout the world. Colour systems are also mentioned.

There is a very informative 17 page section which deals with suitable aerials for FM radio (Band II) and TV DX work. It should be noted, however, that there are no details about aerial pre-amplifiers.

Suitable equipment for receiving FM and TV DX signals is covered briefly and in general terms. There are no circuit diagrams in the book, and information about improving the performance of equipment (such as receiver selectivity and the use of notch filters, etc) appears to have been omitted.

Other useful sections include: notes about using video recorders to obtain a permanent record of DX-TV reception; off-screen photography; a list of European FM stations with transmitter locations, ERPs and frequencies; addresses of European TV services; and a map showing all the time zones for Europe, Africa and Asia. There is also a section which lists magazines catering for radio and DX-TV enthusiasts. We're pleased to report that ***R&EW*** is featured!

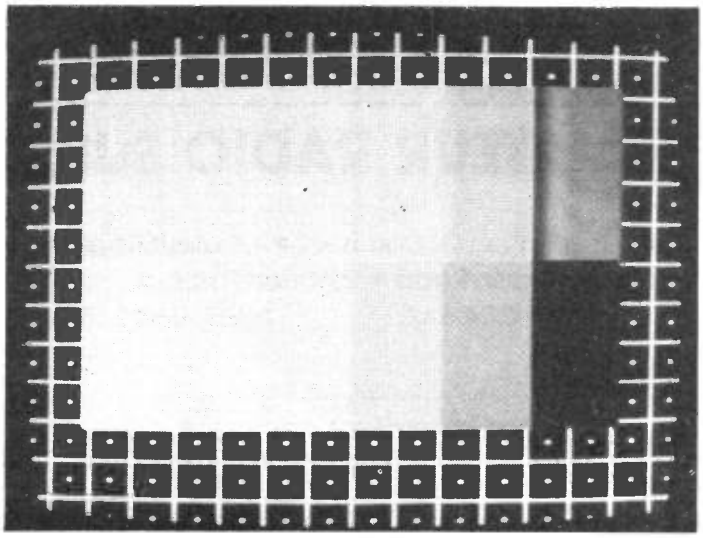
Finally, of special interest to television enthusiasts, there is a 20 page section featuring test cards used throughout Europe.

Further details about this most interesting publication (such as price and availability) are available from: *Norbert Kaiser, Unterer Kreuzweg 6, D-8735, Oerlenbach 1, West Germany.* We thoroughly recommend it to those who can understand German.

Service information

East Germany: The VHF channel E4 transmitter at Cottbus is expected to transfer to the UHF channel E53 in the early part of 1986. REW

The identification caption from TVP-1 (Poland), which was received in West Germany



Electronic test pattern radiated by AFRTS in Berlin on channel A25. Pics courtesy Jürgen Klassen

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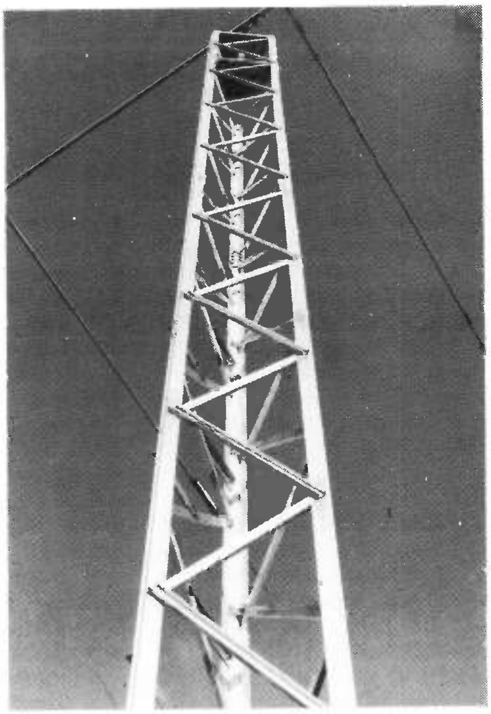

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ATV ON THE AIR

Presented by Andy Emmerson G8PTH

As befits your roving reporter I get around to a number of events which have some ATV interest, even if the connection at first appears slight. There is a lot to learn from these exhibitions nonetheless, and I was particularly impressed by the International Broadcasting Convention in Brighton and the Midlands VHF Convention which were held recently.

Shopping list

The IBC is where the broadcasters get together to plan their next year's shopping list. The Metropole exhibition area is occupied with stands from every manufacturer of broadcast TV (and radio) equipment, while on the seafront outside broadcast vans and satellite dishes are arrayed by the dozen. What a sight for sore eyes!

Ex-ATVer and present satellite king Steve Birkill was there on the SATVRN stand and David Stone G8FNR (Quantel) and other amateurs were around.

Of interest to TVers was the British Aerospace stand, where they had an array of TV screens and push buttons which enabled TV reception to be simulated from a number of satellites with different sizes of dish aerial and grades of LNA.

The BBC were issuing their customary booklet of new engineering techniques, and two projects in this struck me as having amateur applications.

One was the fully digital Test Card F, in which all the test pattern (including the colour picture of the girl and blackboard) is stored in digital memory. Hmm...

The other was the stereo sound-in-syncs. Not that I am suggesting we put out stereo sound, but if a low cost method of sending sound in the picture line sync could be devised then we would solve the problem of sound accompanying vision on 70cm, where subcarrier audio is not really feasible. I understand there are no simple integrated circuit designs for sound-in-syncs though, so perhaps we shall have to wait a few more years!

Best ever

The Midlands VHF Convention was held under the auspices of the RSGB on 13 October at the British Telecom Training Centre, Yarnfield (between Stafford and Stoke).

Just about everyone who went agreed it was the best ever, and if you have previously thought of going but decided against it I suggest you make a resolution to do so next year. If you are interested in ATV you must also be keen on VHF and UHF, and this event is a must. The convention is a fairly cosy affair – no great crowds, but all the people there are VHF enthusiasts.

Among the attractions are a measurement bay where you can check out RF power, noise figures and so on, or else shock yourself by putting your home-brew transverter on the spectrum analyser!

A selected number of traders are invited – people such as Fortop, Piper Communications and Johnny Birkett, and there is also a bring-and-buy stall.

A lecture session and excellent catering complete the show – this year's lectures were excellent, ranging from antenna design to radio astronomy.

Product parade

Now I'd like to alert you to some product news.

A few columns back I mentioned that Sony were having a clearout sale of accessories at prices not to be missed. The HVS2000P camera switcher/effects generator was singled out for attention since it is a very handy gadget in the ATV shack.

Apart from supplying dc power it will make a top class keyer for inlaying captions, and it will colourise them as well. I did not realise then how cheap it was; the new price is just £29.95, and it was good value even at the original price of £69.95. Grab one while you can – I have done so!

Not all dealers have them, so check the advertisements in magazines like *What Video*.

On test

At the RSGB's Woburn Mobile Rally I was walking around, minding my own business, when Alan Wood (of Wood & Douglas fame) thrust a package into my unexpectant fist.

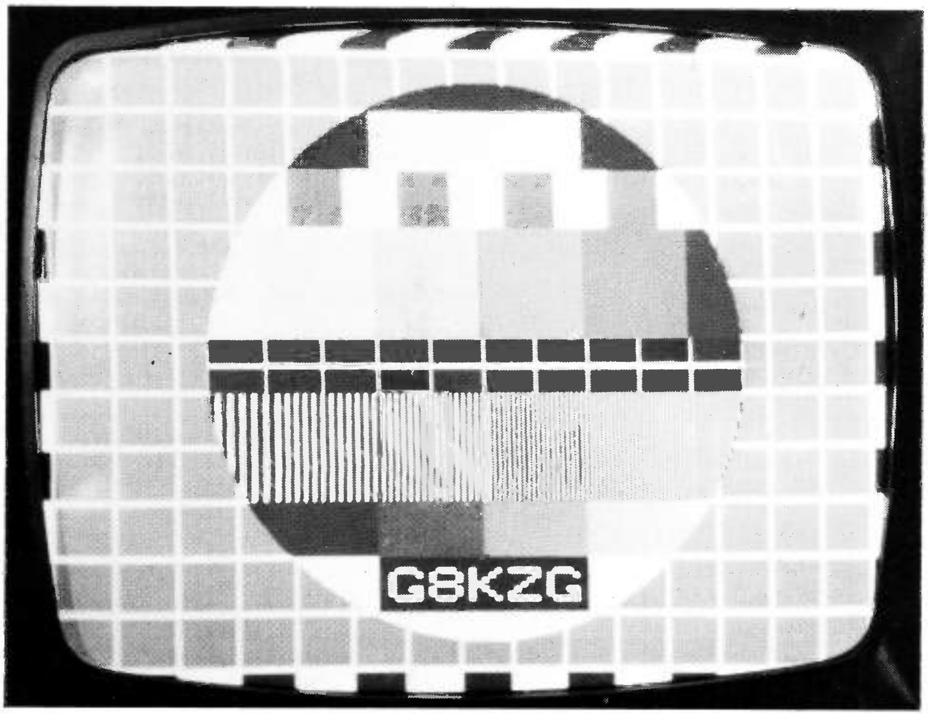
'Take this, it's new,' he said. 'Try it out and let me know how it works'.

I did and I have done, and now I'll tell you too. The item in question is their 1250DC50, a tunable downconverter to match their VIDIF module released earlier. With this new unit (and the VIDIF) you can build a high performance receiver for 24cm FM TV.

Unlike block downconverters which convert the 23/24cm band down to Band IV/V in one lump, this unit is tunable and produces an IF output of 50MHz, ready to feed into the Wood & Douglas VIDIF demodulator (or any other similar device, such as the BATC IF board).

It comes in a rather fine-looking tinplate box; we are more accustomed to

You have got to go a long way to beat the BATC colour pattern generator, designed by Richard Russell (who had a hand in the BBC microcomputer and many of the electronic logos on BBC TV). This is Peter Delaney's version, with a neat electronic callsign inlay



diecast boxes, but with the need to ground the case effectively at RF a tinplate enclosure is probably a better bet.

In any case the tinplate case forces you to select a more decorative housing for your receiver, and I chose a number 202 Verobox, which gives room for the IF board as well (also in the same size tinplate box, which is available as a spare from Wood & Douglas).

No DIY job

Most W&D products are available in kit form, but this one is not. Many of the components are delicate and the RF can easily get lost in over-generous dollops of solder. Also the finished object needs to be swept for proper frequency response, so you can see why it is sold only as a finished unit.

Sneaking a look inside (after removing countless self-tapping screws) I was impressed by the high standard of assembly; I'd have a job to solder as neatly as that!

No circuit diagram is supplied, but you can see a bandpass filter at the input, which gain-matches the incoming signal to the GaAsFET first amplifier (MGF1100). The signal is now led through another filter to the discrete schottky ring mixer. Two BB221 varactor diodes control an NE219 VCO and a BFR91 lifts the signal to a standard Plessey SL560 amplifier on the output.

Design

The design shows a lot of thought and it certainly works well. I use it mainly to monitor the Dunstable TV repeater, which is a consistent P1 signal here at Northampton, 35 miles away (I hope to improve this with some extra preamplification).

I have tried four 24cm converter designs so far, and this is the best of them. Good limiting circuitry gives good rejection of radar interference and there are no spurious responses (one of the other converters can 'see' the Daventry DME beacon at 1320MHz – in reality it's on 1198). Also the tuning is rock steady – no drifting (which makes that other one an absolute pain to use). Price of the 1250DC50 is £69.95 plus 75p postage. The VIDIF is £38.95 as a kit or £54.25 assembled and swept.

New repeaters

I mentioned the Dunstable repeater a moment ago, which reminds me that there are several people planning new TV repeaters.

It's unfortunate that we do not have all the Phase 1 machines on the air yet but time will doubtless see to that. Listed below are new repeaters known to me, together with contacts if you want to get involved (although of course you can always go out and plan your own 'box').

CRAWLEY, GB3CT. They already have a callsign in mind and I understand the repeater is built as well.

The location is ZL08h, which is 325 feet ASL, and tests indicate good coverage of north Sussex and Surrey. Power output is 20W to an Alford slot antenna.

Low-cost

The repeater was built from easily obtained parts and cost about £150. The logic is the GB3US concept with additional vision detector and switching circuitry.

The caption generator is the Cropredy Electronics test card (a previous ***R&EW*** project) giving callsign, QRA and frequency. Further details from Bob G6LVN (QTHr) or Jack G4TVC on (0293) 28612.

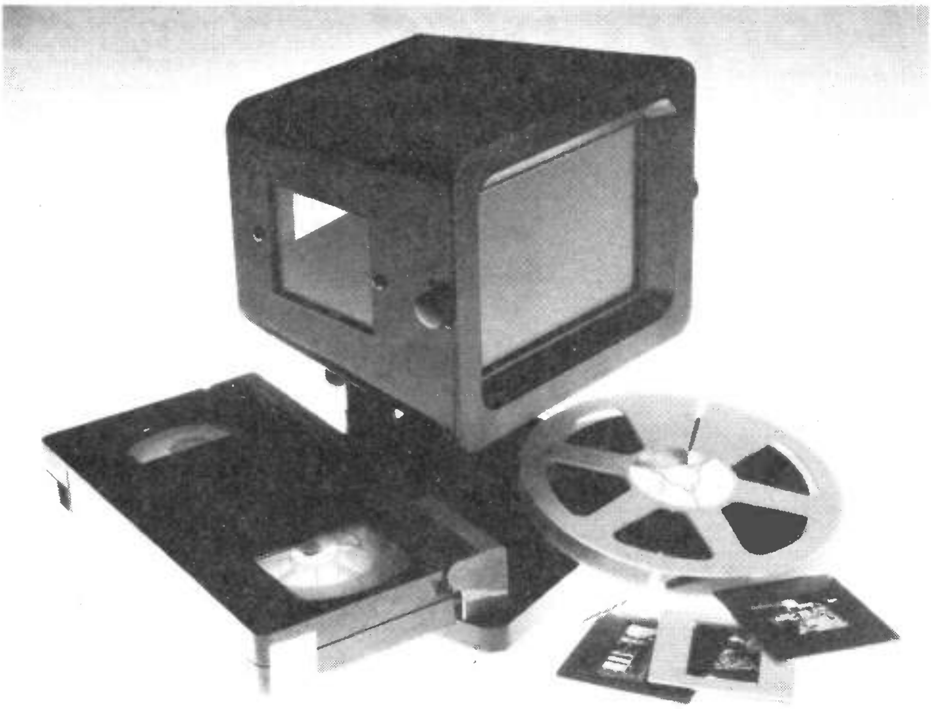
CENTRAL SCOTLAND. This is the brainchild of Norrie Macdonald GM4BVU and his comrades. It is still at the planning stage so contact him in Hamilton for information.Telephone: (0698) 423121.

WEST YORKSHIRE. Dave Long G3PTU is the man in charge in Huddersfield. They have a site agreed – the top of Europe's tallest building, the Emley Moor TV tower! For details telephone: (0484) 606506.

SOLENT REGION. This was mentioned on page 70 of November's ***R&EW.***

Nick Foot G4WHO in Wimborne is co-ordinating this project, which may end up with two repeaters (perhaps linked?). One would serve Poole and Bournemouth, the other Southampton and the low-lying areas nearby.

All these repeaters will be on the FM system (of course!).



Apart from the videotape cleaner Markplan also supply a low-cost telecine converter. Priced at £49 95 it undercuts similar products considerably, though it lacks some of the more sophisticated facilities of the Panasonic and Sony units

Video filth

Most VCR owners will know that domestic head cleaners in cassette housings cannot reach all the parts they need to, and in any case are not recommended by professionals. They are either too abrasive or merely serve to spread the dirt in a wet slurry from point A to point B.

A better plan would be to remove loose oxide from tapes before they deposit it in the machine, and such a tape cleaner has now come onto the market.

Distributed by Markplan it is available in the larger video shops at £49.50 and comes in both Beta and VHS versions. The VTC200 machine (as it is called) is mains powered and actually draws the tape out of the cassette placed in it, then pulls the tape past a capillary roller which draws trifluoroethane from a bath below.

Probably not for the average ATVer, but it should appeal to the keen videophile. It will also be useful in video libraries, where tapes can come back pretty filthy after rental. REW

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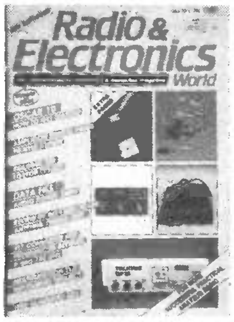
BACK ISSUE SERVICE

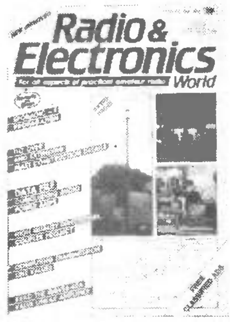
All issues from October 1981 onwards are still available, with the exceptions of January and February 1982, and December 1983. All orders must be pre-paid, the cost of each issue being £1.00 inclusive of postage and packing. A contents index spanning the issues from October 1981 to September 1983 is 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.

MAY 1984
Projects –One Week's Work (VHF/UHF Frequency Meter); Spectrum Analyser Update; Assembling a Logic Probe Signal Generator, 2 Metre J-Stick Aerial, SX-200 Relative S-Meter.
Features – Data File – 4046B Phase-Locked Loop CMOS IC; Hamey HM203-4 Oscilloscope review, A Beginners Guide to Meteor Scatter Propagation; High & Low Measurements – A Guide to Measuring Outside the Conventional Ranges

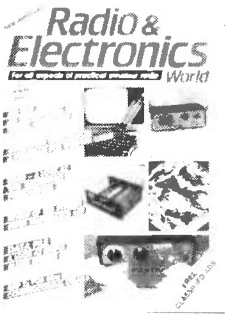
JUNE 1984
Projects – Microprocessor Controlled Dot Matrix Printer; One Nights Work – Replacement Plug-in Module for 2532 EPROM; A low-cost Frequency Standard; Radio Frequency Bridge, Modifying the RGB Interface for the Ferguson TX90.
Features – High Speed Data Transmission; Trio-Kenwood TS-430S Transceiver; ZX Spectrum Data Transmission Program; Data File – National Semiconductors LM Range of Dual Audio-Preamplifier ICs; Data Brief – MC 1648 (SL 1648) Voltage Controlled Oscillator; HP41CX Calculator Review



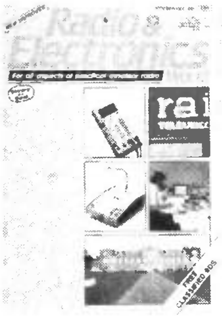
JULY 1984
Projects — VLF converter, a unit for the very low frequency; Teleprinter Terminal Interface; Multifunction Test Instrument, a versatile piece of test equipment; Building the Fortop TVT-437; Improving Indoor Aerials, getting better reception without an aerial amplifier; Logic Probe for CMOS 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 9984
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.

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NEXT ISSUE

Radio & Electronics World
For all aspects of practical amateur radio

DATA FILE
Ray Marston continues with the opto-electronics theme and looks at LM3914-based display circuits

TOUCH SENSITIVE JOY STICK
Peter Rouse describes the construction of a 'joystick' control that is self-centering and has no moving parts

AIRBORNE TV
Ray Herbert looks at some previously unpublished experiments made with TV transmissions from aircraft in flight before the last war

LOW-PASS FILTER
Duncan Walters G4DFV outlines the theory and construction of a high power low-pass filter

DIRECT BROADCAST BY SATELLITE
An outline of the DBS systems currently in use in the Western World

HORSESHOE NAIL SYNDROME
Ken Williams looks at how the short production life of modern ICs effects the purchaser

PLUS all the usual features!
New products ● News ● Reception reports . . .
DON'T MISS the February issue – on sale **10th January**

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FOR SALE

■ Transverter FTV107 unused, under guarantee, complete with satellite 2 metre and 70cms modules, FRB707 relay box included, plug in any Yaesu solid state Tx and go, cost £439, offered at £385, no offers. FT707 Tx excellent condition, FM fitted scanning Mic, MM 144/28 transverter mobile bracket, all three together package deal £385, no offers. G4WLD John 01 857 8096

■ Sony 2001 digital portable 5-30MHz, as new, £110. Datong Morse Tutor, £30. Datong agile frequency audio filter, £20. Will swap for IC4E or possibly IC2E in good condition. Tel: 01 517 2747

■ One Trio R600 communication receiver in excellent condition, only 3 months old, price £150 ono. Contact: Mr Philip Stones, 78 Stanmore Road, Edgbaston, B'ham. Tel: 021 420 1112

■ Lafayette HA700 general coverage receiver, 150KHz – 30MHz good condition, £60 ono. Also, Aiwa AD3500 cassette deck, with Dolby B and C Nr 3 head, soft touch controls, variable bias, good condition, £60 ono or px for Yaesu FRG7 (digital read out model). Tel: Leeds 663814, after 1pm

■ Yaesu FT203 VHF synthesised handheld. Complete with 10-8V Nicad pack and charger. All in excellent condition £125 ovno. Tel: Botley (Hants) 5628 after 8pm please

■ Exchange: Spectrum 48K computer, Currah speech unit + £70 worth of games all as new, will exchange for Eddystone EC10 Mk11 must have battery container and handbook and be in good condition. Collectors item R1155 receiver, unmodified, immaculate PSU test unit, built in speaker and amplifier. Exchange for Vega 402DE TV receiver, must be in good condition with handbook. Borthwick, Torwood Lilliesleaf, Melrose Borders Region. Tel: 08357 314

■ 2 metre PA boards. 1 watt I/P 60 watts + output 24V supply £25. 2V 4A/Hr lead-acid batteries (unfilled) £2.50 each. £12.50 for 6. 23cm Ga AsFET pre-amp £25. Tel: 0277 214406

■ Yaesu YC601 digital frequency display for use with any 101, or 401 series rigs, £65.00; prefer buyer collects and inspects, or carriage extra. Maurice, G6IMV, 18 Mossvale Grove, Washwood Heath, Birmingham, B8 3QJ

■ Complete 2m station, FT-290R 144-148, 2.2AH Nicads, charger, case, helical, quarter wave flexi, 30W HF-VHF dummy load, SWR meter, 17m UR67, SMC colinear (6.4dB gain) both never been used or outside, all boxed, £289. Buyer collects or pays carriage. Signal R528 airband scanner, new in July, crystals for Manchester, London, airways, helical, case, boxed, £95. Tel: Blackpool 0253 45431

■ GW Morse key, solid brass (polished). Chip board base. In good condition, working order. £10. Paul Harris, 22 Avondale Court, Glynfach Porth, Rhondda SW CF39 9NH. Tel: Porth 687147

■ Creed 444 telex/RTTY machine. Recently removed from service. Complete with additional Boyden sound proof cover and full Creed service manual. Beautiful condition. Can deliver in Midlands area but buyer inspect first. £50 or nearest offer. Tel: Yoxall (0543) 472 054

■ Manuals, valves, some parts for AR-88, national HRO, Hallicrafters, Hammarlund, Collins VFO, Nems-Clarke BC-221 freq meter and a few others. SAE to Bob Wright, 249 Sandy Lane, Hindley, Wigan, Lancs WN2 4ER. Tel: 0942 55948

■ Heathkit HW12 80m SSB transceiver and HW32 20m SSB transceiver and power supply, £120 ono. 70cm xtals for pocket phones, Wood and Douglas FDK multi VII RB2 RB4 RB14 SU8 SU20 Rx. ATV Tx. Converter crystals 38.666MHz and 42MHz. Tel: 0453 83 3411 or write 71 Norton Wood, Nailsworth, Glos

■ WW2 sets. WS19 Mk3, spares and accessories, WS62, WS46, WS31, 38AFV, C12, PSU for WS11, PSU for C29, R209, R109, R208, HRO, CR100, S27, R1392 Offers or exchanges for military gear, will send anything anywhere. Mr D Skilton, 40 Mid-Street, South Nutfield, Surrey. Tel: Nutfield Ridge 2888 after 6pm weekdays

■ ZX81 16K Memopak £10; Hella universal hazard warning conversion for any car new £10; Solartron CD 1014/2 scope DB sweep runs but needs attention as stops after several hours good condition. £20. Phone Hythe Kent (0303) 68854

■ LCL trans; modified 10 metre FM not used to transmit, in fact as new, £35.00. Woodstock 812278

■ Wireless World 1960-1984, unbound. Valves, V/holders, components, radios, circa 1940-60. Enquiries SAE please or Tel: (Long Ashton) 392811 Webber, office hours

■ Icom 240 rig with SS-240 scanner, manual, mag mount antenna and power supply included, £100. Mint condition Apple 11+ computer with hi-res monitor, manuals, software etc, £400 ono. Tel: 01-693 8375

■ Ex-Govt. Portable test receiver. Built-in signal meter, variable oscillator and attenuator. Made to very high standard. Excellent reception, £35. Rack-mounted test receiver with integral oscilloscope and PSU data available from Eddystone, high quality construction. £50. Phone 0475 38998 after 5.30pm

■ Creed model 444 teleprinter complete with PSU/terminating unit. Stand available if required. Would exchange for HF receiver. Phone 0475 38998 after 5.30pm

■ Atlas 210X/215X de-luxe ac console, £80. Atlas 206 digital VFO, £100. All as new. Mirage B108 80W. 2m linear, new, £80. Gem Quad 2EL. Kit, new, £85. Jaybeam 14EL 2m beam, new, £25. Sure 444 desk Mike, £20. Jim Taylor, G4ERU, 5 Luther Road, Winton, Bournemouth. Tel: 0202 510400

■ Honeywell Alpha numeric keyboard and logic boards £30. Rob Johns, 3 The Forge, Marsworth Rd, Pitstone, Beds LU7 9AS. Tel: 0926 661555

■ R1155 communication receiver, original condition, no mods, DF valves still in place, been stored, offers. Pair of Dymar handheld portables, three channel FM frequency range 80MHz, 102MHz, good condition complete Nicads, £36 pair. Pye UHF PFIs Rx/Tx, clean condition, complete Nicads, £8 pair. 2 amp 13.5V regulated power supply suitable CB, £3. 4C x 250B valve new, £10. Other new valves, state requirements. Tel: (0903) 66329.

■ Scope. Telequipment S51R single beam, rack mounting with circuit diagrams, plus Solartron ac milli voltmeter and bag of parts. £40 the lot. Tel: 01 397 2428 after 6pm. (South London area).

■ BBC 5¼ disc drive, ½ size (opus), 40 track, no PSU, plus BBC 5¼ disc drive, full size with PSU in dual case. Sharp M28OK with disc interface and interface box and software. Offers to Michael. Tel: 051 449 2044.

■ Electronic piano, Sound City 'Joanna', 5 octave, portable, in working order but needs minor repairs to some of the key contacts. Sounds very similar to real piano. Buyer would have to collect. Nearest offer to £40 secures. Write to Brand, 4 Temple Park Crescent, Edinburgh EH11 1HT.

■ KDK2030 2m FM 25W. New five months, never used mobile, boxed, manual, scan mic ⅝ whip and mag mount, £150. Prefer buyer collects. Perfect wkg condition. G3BGR, QTHr. Tel: (0905) 356576.

■ Datong auto speech clipper ASP/A £40. Azden mic DX354 £18. Codar RQ10 Q mult valve £8.50. Akai stereo amp £30. Yaesu SP/02 ext spkr £35. SMC T3-170L 3.5-170MHz SWR meter £15. All ono. Tel: Brighton (0273) 309127.

■ Icom IC240 2 metre FM transceiver covering all repeater and simplex channels. In mint condition with original packing, instruction manual etc, £130. GM4/TE3ST. Not QTHr Tel: Bishopton (Renfrewshire) 862151.

■ FRDX400 amateur bands comm's receiver. 160 to 10, 4 and 2M. CW wide and narrow, SSB, AM, wide and narrow, and FM. Notch filter, clarifier, S meter. 100 KHz and 25 KHz calibrator. AVC fast, slow, and off. Buyer inspects and collects, £100 no offers. G6XM, James, 43 Rosehill Drive, Bransgore, near Christchurch, Dorset BH23 8NR. Tel: (Bransgore) 73584.

■ Free to SWL or new ham, 90% of a 10 element 2m yagi. Also 2 log periodic antennae covering bands III, IV, V, £15 the pair. Steve G8KUX. Tel: (0449) 741366.

■ 25-550MHz AM/FM Rx station, complete: AOR AR2001 + PSU, Discone ant, Triax VHF/UHF masthead preamp + 12V interface unit. (AR2001 still under guarantee little used), £320. Phone Ely (0353) 61323 any time.

■ Yaesu FRG7 SSB, AM, CW, LSB receiver new and boxed vgc, £125. Mr P Bailey, 103 Jarden, Jackmans Estate, Letchworth, Hertfordshire. Tel: LET 4995.

■ Control data type BR5A6 hard disk drive 60mb capacity. Fully maintained and recently serviced, £325. Ken Saunders Tel: (066689) 307.

■ Scale model radio controlled trawler elaborate detail with chargeable battery for electric motor. Complete with 4ch radio gear. Cost £200, materials only £110, ono. Also radio controlled jeeps, two, with all gear charger etc, £55 each. All above in new condition. Walker, 23 Forest Hill, Yeovil BA20 2PF. Tel: 25225.

■ Oscilloscope 10MHz S54A telequipment, good order, complete with manual, £60. Haywards Heath, Sussex Tel: (0444) 454029.

■ Ekco ACT96 mains valve supzr-het rwdio receiver, made about 1935. Works OK, heavy bakelite case, swivel base. Very collectable, £55. Also a range of post-war valve mains radio sets most of which work OK, from £10. Help to preserve these great radios of years gone by. P Titlow, 13A High Street, Leiston, Suffolk. Tel: (0728) 831812.

■ Daiwa search 9 2m receiver VFO 2 xtals fitted accepts 11 xtals base or mobile £30. Colonel FR360 transceiver freq 26.965-28.805 AM USB LSB digital readout £70. Pair celestion ditton 22 hi-fi speakers quality sound handling cap 80W bargain £65. Grundig TK140 reel to reel plus mic & tapes £20. All above items in good condition, would consider exchange for portable colour TV or good scanner ie, 5 x 200N Bearcat etc. For details tel: Mr Lindley, Runcorn 711393 (Cheshire).

■ Four Akai 4000D reel to reel's converted to four channel replay, £30 ono each. Tel: 01 574 5265.

■ FT200 FP200 all 10m xtals, mike, handbook, vgc, spare PAs £195. MM2000 RTTY receive converter, mint conditon £70. Heathkit SW717 GC Rx, £15. Buyers collect or carriage extra. Wanted ATU 160-10m KW Ezee match or similar. G3IMI QTHr. Tel: Wellinborough 680181.

■ Teletype model 33 ASR C/W plinth, paper tape, service manuals, vgc, offers. Labgear Prestel terminal, brand new, boxed and unused, £80 ono. Prefer buyer collects. Wanted any info on Acorn Atom, RTTY SSTV, CW, Wx sattelite reception, also roms, expansion boards etc. K D Galloway, 18 Trent Road, Corby, Northants NN17 2HD. Tel: Corby 200329.

■ KW2000E in reasonable condition some spare valves, £200 ono. Semi automatic bug key £15 ono. 4 Grundig, office dictating machines £5 each ono. Contact Keith GW4NBY QTHr. Tel: (0656) 56576.

■ Tasco 610E conv'r RTTY and CW into VDU or TV. Baudot ASC11 and Morse also code practice on screen has socket for key or phones cost, £175 asking £120, includes guide to press agency freqs and full instructions, ring Ted on Bacup 874928 after 7.00pm.

WANTED

■ NRD515 Rx, in good working order, preferably realigned, negotiate price. Mr Allen, 51 Island Road, Handsworth, Birmingham B21 8NS. Tel: 5237158 (after 6pm).

■ MCP40, Tandy or similar four pen graphics printer and Thandar PFM200A frequency meter. Other frequency meters considered if cheapish. Needed for unfunded research project. Dr Andrew Brown, Dept of Oral Surgery, John Radcliffe Hospital, Oxford OX3 9DU. Tel: (0865) 65164.

■ Roberts radios, especially early models such as M4Q, M4D, M5A, Junior, RP4, RMB, R66, R77, R88, RT1. Working condition of no consequence. Also any data or pamphlets relating to Roberts radios. Tel: Reading 883799.

■ Freq meter for 174MHz. Walker, 23 Forest Hill, Yeovil BA20 2PF. Tel: 25225.

■ Manual or circuit R107 receiver. Also AM/FM generator, must be in good order. Good scope 20MHz double beam. EF39 valves. Lots of odds and ends for sale. Write: Mr White, 29 Nunnery Street, Castle Hedingham, Essex CO9 3ND.

■ Belcom FS1007P manual wanted, to purchase or borrow for a few days. Will pay postage. Dave Carter, 32 Welland Crescent, Stockton-on-Tees, Cleveland TS19 0UT. Tel: (0642) 582581.

■ Philips 4307 reel to reel mono tape recorder. Anyone with a motor in working order, reasonably cheap. Cranshaw. Tel: Lymm 3335.

■ 16mm GSAP Bell Howell cine-gun camera, ex govt electric 24V dc drive magazine load, with or without lens. Have for exchange, Bendix Rx GC aircraft Rx Hewlett Packard scope. Tel: Melksham (0225) 706795.

■ Yaesu FT208R, nicads, charger, soft case etc. Vgc, about £120, or similar rig, eg 100M02E, TR2400 etc, maximum £180. Nicholas von Fircks, Applegarth, Lymington Bottom, Four Marks, Alton, Hants. Tel: Alton (0420) 63445.

■ FDK Rx40 with accessories. Will buy or part exchange Rxs and CB hand-held new. Tel: (0274) 724144 (10am or 3pm). (0274) 676556 (after 6pm).

■ Circuit Eddystone 888A. Also BFO unit or just good coil for 888A. Price etc to: B E Viney, 10 Heol Meirion, Barmouth, Gwynedd LL42 1LA.

■ Valve HF linear amp, 3.5MHz to 28MHz, power input 10 watts, output 100 watts. Must have own power supply. Also amateur radio software for Apple IIE. G4VJK, J H King, 36 Haroldslea Drive, Horley RH6 GDU. Tel: (02934) 3556.

■ Marconi Atalanta for mains supply, vgc essential, no objection to dealer. Trower, 2 Natal Road, Brighton, Sussex BN2 4BN. Tel: (0273) 680723 (8.15am to 9am) Mon to Fri.

■ Any amateur communications receiver, any condition, must be in working order. Have CB base station + aerial etc. Part exchange and/or cash. T Ikram, Steggall House, 341 Perth Road, Dundee, Tayside.

■ Yaesu FRG7700/FRT7700 wanted in exchange for realistic DX-400 Chinon CE-4S Optomax 135mm telephoto lens, Miranda wide angle lens. Tel: (0443) 755876.

■ Names and addresses of companies or individuals willing (and able!) to produce finished and working equipment from the various kits advertised in this magazine. I am a handicapped SWL and am willing to pay for any services rendered. Write to: Flower, Avenue Labby 12 B-5989 Bossut, Gottechain, Belgium.

■ Good clean HRO and one for spares. Coils, MW command Rx, BC348, HW101 or KW2000B. N A Maxwell GW3UMD, 1 Nantfawr Crescent, Cyncoed, Cardiff CF2 6JN. Tel: (0222) 761813.

■ A service manual of Ekco valve mains radio Rx, A172 model (1954 approx date). Details of cord drive especially required (clear photostats accepted). M Horne, Barkwith House, Haylings Road, Leiston, Suffolk IP16 4DJ.

■ Old Marconi marine receivers, manuals and catalogues. Books on submarine communications and ships aerials. Scrap T1154 for coils. Cossor ganging oscillator or similar. Woodhouse, 'Trenoweth', Porthpean, St Austell, Cornwall PL26 6AU.

■ MMC435/600 converter. Also good scanner, ie Sx200N, Bearcat, PRO2001 etc, plus portable colour TV. See my For Sale ad in this issue. Mr Lindley. Tel: Runcorn, Cheshire. 711393.

■ Bird type 43 elements 100C, 100H, 250H or WHY? R B Lever, 4 Hambleton View, Wigginton, York YO3 8PN. Tel: (0904) 768545.

■ Oscilloscope, portable, dc to 10MHz or higher, in good condition, with service manual. Will pay up to £40. E Schofield, 26 Birkenshaw Lane, Birkenshaw, Bradford, West Yorkshire BD11 2HA.

■ Valves Thorpe K4, Cosmos SP18 and A45, Marconi Osram V24, and any valves made by 362 Radio Valve Company, east London. Manual Eddystone 680X receiver. Buy or swap large selection new receiver valves 1930 onwards. Philip Taylor, 14 Willow Walk, Canewdon, Rochford, Essex SS4 3QH. Tel: (03706) 598.

■ Wanted for Yaesu FT301 transceiver 600Hz CW filter (XF-90C) and 6KHz AM filter (XF-90B), also external VFO FV301 or other suitable VFO. Tel: St Albans 39333.

■ ZS Spectrum hardware and software for RTTY, AMTOR, CW, etc. Also VHF/UHF equipment for satellite work. Edgar W Abraham, PO Box 1136, Klerksdorp 2570, Rep of South Africa. Tel: (018) 2-7380.

■ RAE tutor requests help. Can anyone please loan me copies of the March, May and December 1984 (any or all) Radio Amateur Examination papers? Your help will be much appreciated by my enthusiastic but apprehensive students. Seven day return promised and expenses refunded. John G8PWO QTHr. Tel: Sevenoaks (0732) 62481.

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			series rates for consecutive insertions		
61 x 90	⅛ page	£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

COLOUR AD RATES

depth mm x width mm	ad space	1 issue	3 issues	6 issues	12 issues
		colour rates exclude cost of separations	series rates for consecutive insertions		
128 x 186 or 263 x 90	½ page	£420.00	£395.00	£375.00	£335.00
297 x 210	1 page	£810.00	£760.00	£730.00	£650.00

SPECIAL POSITIONS

Covers:	Outside back cover 20% extra, inside covers 10% extra
Bleed:	10% extra [Bleed area = 307 x 220]
Facing Matter:	15% extra

DEADLINES

*Dates affected by public holidays

issue	colour & mono proof ad	mono no proof and small ad	mono artwork	on sale thurs
Feb 85	6 Dec 84*	12 Dec 84*	14 Dec 84*	10 Jan 85
Mar 85	17 Jan 85	23 Jan 85	25 Jan 85	14 Feb 85
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

CONDITIONS & INFORMATION

SERIES RATES
Series rates also apply when larger or additional space to that initially booked is taken.
An ad of at least the minimum space must appear in consecutive issues to qualify for series rates.
Previous copy will automatically be repeated if no further copy is received.
A 'hold ad' is acceptable for maintaining your series rate contract. This will automatically be inserted if no further copy is received.
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.

COPY
Except for County Guides copy may be changed monthly.

No additional charges for typesetting or illustrations (except for colour separations).

For illustrations just send photograph or artwork.

Colour Ad rates do not include the cost of separations.

Printed — web-offset.

PAYMENT
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
Radio & Electronics World, Sovereign House, Brentwood, Essex CM14 4SE
(0277) 219876

Overseas payments by International Money Order.
Commission to approved advertising agencies is 10%.

CONDITIONS
10% discount if advertising in both Radio & Electronics World and Amateur Radio. A voucher copy will be sent to Display and Colour advertisers only.
Ads accepted subject to our standard conditions, available on request.

All diodes at 10p or less in this list 20 of one type £1.00

OA 47	8p
OA 90	8p
IN 60	5p
IN 541	5p
IN 914	3p
IN 2069a	10p
IN 2070	10p
IN 4001	3p
IN 4002	3p
IN 4003	4p
IN 4004	4p
IN 4005	4p
IN 4006	4p
IN 4007	5p
IN 4148 x 40	£1
IN 4448 x 40	£1
IN 4742	10p
IN 4722	10p
IN 4751	10p
IN 5235	10p
IN 5254	10p
IN 5349	10p
IN 5392	10p
IN 5393	10p
IN 5928B	10p
1AV 30	10p
IM 72Z55	10p
IR 106a	20p
IR 3051	10p
IS 164	10p
IS 921	10p
IS 3011a	10p
IS 3072a	10p
IS 5024a	50p
IS 5030	50p
ITT 210	10p
ITT 921	10p
ITT 923	10p
ITT 1075	10p
ITT 2001	10p
ITT 2002	10p
ITT 4150	10p
ZE 1 5	10p
ZF 3	10p
ZF 3.3	10p
ZF 4.3	10p
ZF 10	10p
ZF 11	10p
ZF 12	10p
ZF 15	10p
ZF 33	10p
ZF 43	10p
ZF 47	10p
ZF 82	10p
ZPD 3 9	10p
ZPD 4.7	10p
ZPD 5.6	10p
ZPD 10	10p
ZPD 47	10p
ZPY 8v2	10p
ZPY 12	10p
ZPY 16	10p
ZPY 24	10p
ZPY 43	10p
ZPY 47	10p
ZPY 56	10p
ZTE 2	10p
ZTK 22	10p
ZTK 33	10p
ZTK 33a	10p
ZW 13	12p
ZW 27	10p
ZW 4.3	10p
ZW 310	10p
ZX 68	30p
ZY 47	10p
ZY 72	10p
AA 113	10p
AA 119	8p
AA 144	10p
BA 102c	10p
BA 157	8p
BA 159	8p
BA 173	8p
BA 182	8p
BA 201	8p
BA 202	8p
BA 243	8p
BA 248	8p
BA 316	5p
BA 318	5p
BAV 10	10p
BAV 21	10p
BAW 21	10p
BB 103	10p
BB 105A x 12	£1
BB 105B x 12	£1
BB 105G x 12	£1
BB 121a	10p
BRC 83c13	10p
BZX 46c22	15p
BZX 61 9.1	6p
BZX 61c110	6p
BZX 61c20	10p
BZX 61c30	10p
BZX 61c220	10p
BZX 70c6v2	8p
BZX 70c12	20p
BZX 70c33	8p
BZX 79c3v9, 4v7, 5vl, 5v6, 6v2, 6v8, 7v5, 11, 12, 30, 47	10p each
BZX 83c4v3, 5v6, 8v2, 12, 13, 24, 27, 33	10p each
BZX 84c6v8 x 10	30p each
BZX 85c8v2	10p
BZX 88c0v7, 3v9, 4v3, 6v2, 8v2.12	10p each
1A/1600V	10p
CV 8617	10p

Min 12 volt Relays	75p
Y 716	10p
Y 729	30p
Y 730	10p
Y 827: 6A/1KV	20p
Y 860	30p
Y 933	5p
Y 969	50p
Y 997	30p
R 1038	40p
R 1039	40p
R 2009	80p
R 2010b	£1
R 2029	50p
R 2210	60p
R 2257	50p
R 2265	60p
R 2305	50p
R 2306	50p
R 2322/2323	pair 80p
R 2323	15p
R 2396	50p
R 2461	80p
R 2030	50p
R 2443 = BD124	40p
R 2737	40p
R 2738 = TIP41	30p
R 2775 = TIP41c	40p
R 3129 = TIP47	40p
S 2008b	80p
BU 105/04	80p
BU 108	£1
BU 124	50p
BU 126	80p
BU 180a	65p
BU 204	70p
BU 205	£1
BU 206	£1
BU 207	£1
BU 208	80p
BU 208 on heat sink	70p
BU 208A	£1.10
BU 208D	90p
BU 222	£1
BU 326	£1
BU 407	60p
BU 426V	60p
BU 500	£1.10
BU 508A	£2
BU 526	75p
BU 807	£1
BUX 84	50p
BUW 84	30p
BUY 71	£1
TIC 106a	30p
TIC 116m	40p
TIC 116n/Y 1003	35p
TIC 126N	40p
TIC 206m	30p
TIC 225S	40p
TIC 226E	40p
TIC 226m	30p
TIC 236m	30p
TICV 106D (T092 case 2A/400V)	10p
TIP 29	20p
TIP 30	35p
TIP 30A	35p
TIP 30B	40p
TIP 30C	45p
TIP 31	30p
TIP 31A/RCA 16334	35p
TIP 32	25p
TIP 33B	50p
TIP 33C	70p
TIP 34A	50p
TIP 34B	60p
TIP 34C	70p
TIP 35B	50p
TIP 35C	70p
TIP 35D	80p
TIP 36	50p
TIP 36C	70p
TIP 41B	40p
TIP 41D	70p
TIP 42/BRC 6109	30p
TIP 48	40p
TIP 49	30p
TIP 57	30p
TIP 100	30p
TIP 102	30p
TIP 112	30p
TIP 115	50p
TIP 117	50p
TIP 120	35p
TIP 125	35p
TIP 130	30p
TIP 131	25p
TIP 136	30p
TIP 140	50p
TIP 147	50p
TIP 640	50p
TIP 2955	35p
T 6032	30p
T 6036	40p
T 6040	40p
T 6047	40p
T 6049	40p
T 6051	40p
T 6052	40p
T 9004	40p
T 9005	40p
ZTX 102c	10p
ZTX 107	10p
ZTX 108c	10p
ZTX 109k	5p
ZTX 213	5p
ZTX 341	10p
ZTX 342	10p

SPECIAL OFFER CVC 21
Chassis complete £35
Computer Transformer 20v/2.25A; 20v/1.5A; 17.5A; 19/5A; 28/05A £3

ZTX 384	10p
ZTX 451	10p
ZTX 550	10p
MJ 2253	60p
MJE 3040	60p
MJE 2209	10p
SP 8385	50p

Voltage Regulators

-5V/UA78PO5SC	30p
-5V/LM79MO5CP	25p
-8V/79M08c	30p
-6V/78M06c	30p
-10v/78LA10	20p
LM 337	30p
LM 342/18	30p
LM 340T 5 0	50p
-12V/MC 7912	20p
-12V/LM 340T12	50p
-15V/78M15	15p
-18V/MC78M18	20p
-24V/78M24	30p
MC 7724cp	40p
MC 7824	40p
TIS 90	10p
TIS 91	20p
TIS 92	20p
TIS 93	20p

CB Radio transistor
16119 2A/40v.50Meg
5 for £1.

U 19885	40p
U 3832	15p
U 3845	15p
MR 508	10p
MR 501	10p
MR 502	10p
BCW 71R	30p
BYF 1202	10p
BYF 1204	10p
BYF 3126	40p
BYF 3214	40p
BYX 10	6p
BYX 36/600	35p
BYX 38/300	25p
BYX 55/350	10p
BYX 55/600 (Bead)	10p
BYX 71/350	20p
BYX 71/600	50p
BYX 72/300	20p
BYV 95B	10p
BVY 95C	12p
BYV 96D	10p
BYZ 106	10p
BPW 41	15p
BYW 56 2A/1000v G11	8p
BZY 93c75	50p
BZV 15/18	30p
BZV 15/30	30p
BZW 70c6v2	10p
BZX 79 3v	10p
Bush thyristor RCA 76122	£1
ITT computer bookset 2020	£2
G8 20 turn 100K pot	35p
Transformer 240v/20v-500Ma	75p
Viewdata torroidals	£6
CVC 20 tube base	£2
Mitsumi tape motor	75p
Sankyo tape motor	75p
Swiss made 250rpm/240V motor very small	75p
Mono scan coil 110° small neck	£1.50
Infra red led LD57CA	15p
Mono scan coil	£3
G8 transductor	£1
AT 4041/41 transductor	£1
2K5 Lin pot with 40mm spindle	20p
1982 Hitachi Ae isolator	50p
Mullard FM decoder 1401	£1
Philips service pack, flat films, 57 condensers 56nf-2.2uf	£2
VHF 3 Transistor rotary tuner DX-TV	£1
15K-20 turn pots	20p
Thorn panel 6x100 pot - changeover switch (Irish)	50p
Battery converter TA 75 for colour TV, 12/24v Thorn 3787	£6
Thorn 3500 2A cut out	75p

Stereo GEC amp 20 watt - pre-amp with 4 pots - mains power unit with circuit £6

SPECIAL OFFER
Decca-TTT etc.
FEO4/250AC/4
Mains filters
(grey type) x 4
£1

BRIDGES

SKB 2/08 L5A	30p
KBL 005	30p
KBL 02	30p
KBP 04	30p
W02	15p
W004	15p
W005	20p
GEC remote panel. Main transformer 3/ic SAA 1025/SN 74141/TBA 231	£6
AT 2076/55 GEC split diode transformer	£10
AT 2048/11 LOPT Mullard	£2.50

PHILIPS DIY HOME SECURITY ALARMS KITS

Send for details. Prices **£54 to £112**

10 Mixed TV & radio speakers
£5 - £2 post

8Ω 4in speakers	£1
4700/10v x 10	50p
68/16 x 10	50p
150/16 x 10	50p
47/25 x 10	50p
220/25 x 10	50p
1/250 x 10	50p
8000/30v	50p
470/40v x 10	£1
22/100v x 10	£1
100/350v	70p
400/350v	70p
47/500v	25p
1/600v	25p
022/1kv	10p

Philips stereo magnetic cartridge Philips, GP412, GP406 & GP 412-2 at **£6.00**
Philips GP422 4CH (£40 cost) **£6**
Philips car radio speaker kit 12W speaker & tweeter in cases pair **£10.00**
Stereo Dynamic Cartridge

12 Volt Aerial Changer over Relays £1

GEC Hitachi
V/Cap tuner, after 1979 Series £13
6 Push Button Unit for GEC 2100 Series
Replacement for Touch Button Unit £12

Mullard
Broadband
RF power modules
BLW 60C **£6.00**
12.5 V 175 MC-S 45w
VHF.BGY33 **£15**
UHF.BGY22E
£5 PT4236C
£5 PT9783
£5 PT8706C

Various Tools and Accessories

Philips	£1.00
Freeze	£1.00
Foam Cleaner	£1.00
Contact Cleaner	£1.00
G11 Neon Switch	£1.00
GPO 5 way plug	25p
12v screwdriver tester with lead - croclip	25p
Mains timer, 13 amp - up to 2 hours; easy to use, plugs into socket	£3.00
Sellotape PVC Electric Insulation 25mm x 20M	50p 50mm x 20M 70p
Telescopic aerials (radio)	£1.00
UHF Radio Aerial	50p
Xcelite pliers	£3.90
Xcelite snips	£5.00
Xcelite cutters	£3.90
GKN Supascrew kits	£2.50
VU meter	45p
Pull up large aerial	75p
'V' TV aerial	£1.00
Soldering iron 6v/23w	£2.50
Weller solder iron 15 watt/25 watt	£5.00
Portable TV aerial	75p
Phillips snips	£2
2 way baby alarm/intercom with long leads	£5
Phillips universal battery tester/charger, fuse/bulb tester	To Clear £4
Volt/ohm test meters 1000 ohm/volt	£5
Eisenmann NICAD CHARGER 5.5V/150 ma	£2
12V Nicad pack AA	£2.50
Hitachi TP 007 Battery pack 7.2v/1.6A	£7
Hitachi Silver Oxide Battery G13UCC357 IEC SR44 1.5V	60p
'AA'/1.25V Nicad	£1
'C' Nicad	£2
'D' Nicad	£3
Duracell PP3	60p
Duracell 'C'	50p
70ML Silicone Sealer (clear)	£1
3/4in x 1/2in microphone/speaker	50p
Continental 2 pin plug with 5 1/2ft mains lead (black & blue)	5 for £1
7in Ferrite rod with LW/MW coils	50p
Xcekute 5in bent nose plier	£3.50
De-solder pump - 2 nozzels	£5.20
Plastic box for i.c.s with anti-static pad 6in x 3in x 1/2in	75p
Can of handy oil mobil	40p
Flat Red LED	12p
500gm 60/40 solder reel	£7
Clearweld glue pack	30p
Dual v/u meter -20 - -10db	£1
15 service manuals, Thorn 3504 & 3448 etc	£2.50
3 x C90 Cassettes	70p
Can Freezer	£1.75
K30 thermistor 232266298009	75p
Screwdriver kit 6 different types small in box	£6.00

75R/25 Watt	25p
18R/11 Watt	25p
120R/17 Watt	20p
Front End Music Center VHF/MW/LW x 13in x 3 1/2in	£3
Output Stage for music center	£5
SONY 1400KV Chroma Panel	£6
SONY 1400KV Tuner unit	£3.50
SONY 1400KV Touch button unit	£3.50
Texas Viewdata Decoder VDP 12/80 Issue 3 with all IC's	£10.00

Quantity Reductions

BY204/4	25 for £1.00
BY206	25 for £1.00
BD132/238	20 for £2
W005 bridge	20 for £2
G11 touch button red	6 for £1
BY210/600	25 for £1.00
BY298 3 amp/fast/R	20 for £1.50
BD239	20 for £2.00
MR856	25 for £1.50
BU126	10 for £6.00
BU205	10 for £8.00
BU105	10 for £6.00
2SC2122A	10 for £8.00
BF458	10 for £1.00
BD136	10 for £1.25
BF224	20 for £1.40
OA90	40 for £1.00
BYX10	100 for £4.00
KT3 multicaps	10 for £7.50
50 High voltage ceramic condensers	£1.50
Mixed Mounting Kit for Power Transistors	50p
300 Condensers	£1.50
300 Resistors	£1.50
150 Electrolytics	£2.00
15 Bulbs	40p

SENDZ COMPONENTS

63 Bishopsteignton, Shoeburyness, Essex SS3 8AF
SAME DAY SERVICE
All items subject to availability. No Accounts: No Credit Cards. Postal Order/Cheque with order Add 15% VAT, then £1 Postage. Add Postage for overseas
Callers: To shop at 212 London Rd, Southend. Tel: 0702-332992
Open 9-1/2.30-6. GVMT - school orders accepted on official headings add 10% handling charge.

Video lamps	20 for £5, 200 for £25
Antistatic Discloth	5 for £1
100 Diodes	£1.50
100 Fuses	£2.00
100 W/W Res	£1.50
BF 199	20 for £1
BC 547	100 for £4
10 x 20 Turn 100k pots. Rank	£2
Thorn 9 volt power supply regulated	**£3.00**
BF 470	20 for £2
Metal BD 124	10 for £8
20 Slider Knobs	70p
6 Mixed UHF Aerial Isolating Sockets, some with long leads. Fit ITT, GEC, Philips, Pye	£1.00

Mixed Packs

TO66 12 Power Trans RCA 16182 NPN Replacement for BD124 and Mounting Kits	£1.00
50 Mixed AC series Transistor	£4.50
15 Panel mount rocker switch 250V/10A	£1.50
25 Panel Mount Bulbs & Neons 10A	£1.50
Mixed ribbon cables	£1.00
25 LED red/yellow/green	£1.50
20I/C Holders	£1.20
20 Large LED Red	£1.00
20 Small LED Red	£1.00
10x20 Turn 100K Pots	£1.00
100 Transistor	£2.50
20 Convergence Pots	80p
100 Sticks	£1.00
10 Thermistors	50p
20 Slider Pots	£1.00
30 Presets	50p
15 VDR - thermistors, degaussing, HT etc	£1.00
40 glass reed switch	£1
10 press to make switch	70p
40 Pots	£1.50
10 Gun Switches	50p
5 Tube Bases	£1.00
1,000 Diodes, Condensers, Resistors on Bandolier	£3.00
Lucky Dip 600 gram	£1.00
Jungle Bag 5Kg	£5.00
20 Knobs	£1.00
40 Pots, 1/4in - 6mm spindles for audio TV	£3
20mm Fuse Holders Chassis Mount	10 for £1
IN4001/6 100 mixed	£2.50