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TELEVISION

November 1986

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Issue 433

On sale October 15th

CORRESPONDENCE
All correspondence regarding advertisements should be addressed to the Advertisement Manager, "Television", King's Reach Tower, Stamford Street, London SE1 9LS. Editorial correspondence should be addressed to "Television", IPC Magazines Ltd., King's Reach Tower, Stamford Street, London SE1 9LS.

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We regret that we cannot answer technical queries over the telephone nor supply service sheets. We will endeavour to assist readers who have queries relating to articles published in *Television,* but we cannot offer advice on modifications to our published designs nor comment on alternative ways of using them. All correspondents expecting a reply should enclose a stamped addressed envelope.
Requests for advice on dealing with servicing problems should be directed to our Queries Service. For details see our regular feature "Service Bureau". Send to the address given above (see "correspondence").

this month

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BC184L	15
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BC187	25
BC204	10
BC208	13
BC209	10
BC212	15
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BC550	10
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BD131	50
BD132	49
BD133	60
BD135	38
BD136	38
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BD138	35
BD139	35
BD140	44
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BD150	60
BD159	65
BD160	1.60
BD166	52
BD179	70
BD182	1.20
BD183	1.18
BD201	85
BD202	91
BD203	80
BD204	99
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BD237	57
BD238	65
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BD410	79
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BD510	86
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BD519	1.08
BD520	75
BD535	82
BD536	91
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BF258	34
BF259	34
BF262	84
BF263	81
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BRY55	45
BRY56	57
BSR59	1.80
BSV57B	89
BT100	1.65
BT101	1.20
BT102/500	1.20
BT106	1.60
BT108	1.69
BT109	1.31
BT116	1.87
BT119	3.66
BT120	3.66
BT151/800	2.07
BU104	2.00
BU105	1.58
BU124	1.90
BU126	1.75
BU204	1.50
BU205	1.87
BU206	1.80
BU208	1.60
BU208A	1.65
BU208D	2.20
=BU800	
BUW81A	3.84
BU208/02	2.10
BU326A	2.00
BU407	1.70
BU426	3.07
BU500	2.50
BU526	2.46
BU508	3.20
BU806	1.40
BU807	2.94
BU826	4.95
BUW84	1.45
BUX84	1.50
E1222	40
MCR220	1.50
ME0411	20
MJE340	68
MJE520	50
MJ3000	1.98
MPSA92	35
MR814	45
MR854	55
MR475	2.46
MR479	2.60
OT112	1.91
OT121	1.91
R2008B	1.90
R2010B	1.92
R2265	1.50
R2322	84
R2323	67
R2461	1.50
R2540	3.20
RC4558	2.20
RCA16334	90
RCA16029	1.18
RCA16039	1.18
RCA16092	1.18
RCA16040	96
RCA16041	84
RCA16334	90
=ON447	
RCA16335	90
=ON448	
RCA16957	2.88
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TIC46	60
TIC47	72
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TIP47	93
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TIP3055	63
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2N696	21
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2N3054	60
2N3055	79
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2N3703	16
2N3705	10
2N3706	10
2N3708	17
2N5294	48
2N5296	48
2N5298	69
2SB337	1.86
2N5496	53
2N6107	75
2N6109	81
2SA715	1.98
2SC495	1.10
2SC496	1.31
2SC643A	1.82
2SC1096	1.72
2SC1172Y	5.50
2SC1173Y	1.69
2SC1306	2.73
2SC1307	3.00
2SC1449	1.67
2SC1520	68
2SC1678	2.67
2SC1909	2.90
2SC1953	1.44
2SC1986	
=2SC1061	2.94
2SC2028	1.82
2SC2029	2.60
2SC2078	2.90
2SC2091	1.34
2SC2166	2.73
2SD870 (Sony)	6.35
DEC1	2.20
DEC2	2.20
THY15/80	2.20
THY15/85	2.20
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INTEGRATED CIRCUITS

AN214Q	3.91
AN240	3.84
AN318	6.37
AN262	4.10
AN301	5.15
AN7150	3.97
AN6341N	8.97
AN6344	7.85
BA521	2.80
BA536	3.00
CA555	46
CA556	84
CA741	25
CA748	45
CA1532	4.20
CA3065	1.80
HA1151	3.89
HA1342	2.49
HA1306N	2.60
HA1366WR	2.80
HA1377	3.20
HA11219	4.21
HA11244	4.04
LA3350	1.59
LA4031P	3.21
LA4032P	3.15
LA4102	3.37
LA4112	3.25
LA4400	3.05
LA4422	3.28
LA4440	4.07
LC7130	5.93
LC7120	5.87
LC7137	5.50
LM1011	3.25
LM1340T	75
LM8361= MM5387ANN	3.69
MB3712	2.60
MC1307	1.99
MC1310P	1.84
MC1327	1.70
MC1330P	1.84
MC1351P	2.93
MC1349	1.99
MC1350	1.50
MC1352	1.75
MC1358P	1.50
MC1495L	3.00
ML231	
ETTR6016	2.20
ML232	2.20
ML237	2.50
ML238	6.00
ML239	2.50
ML922	3.29
ML928	2.18
MM5387ANN	4.15
MSN5807	7.87
MS1513L	2.80
MS1515L	3.28
SAA1025	8.50
SAA1124	5.34
SAA1250	4.99
SAA5000	6.15
SAA5010	6.30
SAA5012	6.50
SAA5020	5.90
SAA5030	8.25
SAA5050	8.50
SAF1032	6.30
SAF1039	7.77
SAS560S	2.07
SAS570S	2.07
SAS660	3.25
SAS670	3.25
SAS580	2.90
SAS590	2.90
SL901B	7.00
SL917B	9.25
SL1310	1.80
SL1327Q	1.20
SL1430	1.58
SL1432	3.36
SL76544	2.05
SL490	1.89
SN76115N	2.27
SN76131N	2.00
SN76226DN	2.72
SN76227N	1.18
SN76533N	1.70
SN76033N	2.49
SN76544N	2.35
SN76660N	80
SN76666N	1.52
SN76530A	1.47
STK015	7.36
STK032 = STK078	13.25
STK433	5.65
STK435	9.06
STK436	6.50
STK437	7.85
STK439	8.40
STK459	9.50
STK441	11.57
STK461=465	12.60
STK463	14.30
STK2129	13.20
STR441	6.50
STR451	6.50
STR6020	8.50
SW153	3.90
TA7050P	95
TA7051P	95
TA7063P	2.20
TA7074P	3.46
TA7108P	3.43
TA7120P	2.43
TA7129AP	3.76
TA7130P	1.93
TA7146P	4.67
TA7193P	5.67
TA7171P	8.90
TA7172P	8.90
TA7173P	8.90
TA7176P	2.50
TA7202P	4.27
TA7204P	3.77
TA7205AP	3.72
TA7208P	3.40
TA7210P	6.60
TA7222	2.42
TA7223P	3.74
TA7227P	5.98
TA7228P	5.98
TA7310P	2.78
TA7609P	4.39
TA7611AP	2.92
TAA570	3.98
TAA310	2.83
TAA320	2.00
TAA550	55
TAA630	3.90
TAA661B	1.20
TBA120AS/SA	1.49
TBA120B	1.30
TBA120SB	1.37
TBA120T	1.47
TBA120U	1.49
TBA1440G	1.56
TBA395	1.75
TBA396	1.75
TBA440N (TBA1441)	2.75
TBA440P (TBA1440G)	2.50
TBA480Q	1.82
TBA510	3.00
TBA520(Q)	1.68
TBA530(Q)	1.38
TBA540	1.76
TBA560(Q)	1.93
TBA570	1.79
TBA690	1.50
TBA641BX1	3.50
TBA700	2.12
TBA720	2.64
TBA750	2.98
TBA800	1.62
TBA810AS	1.38
TBA820	1.70
TBA820M	1.25
TBA890	3.94
TBA920(Q)	3.00
TBA950(2X)	3.25
TBA970	4.09
TBA990	1.90
TCA760	2.30
TCA270SQ	2.50
TCA800	5.95
TCA830	3.44
TCA900	2.20
TCA910	2.20
TCA940	1.95
TDA440	2.20
TDA1002	1.95
TDA1003A	5.50
TDA1006A	2.50
TDA1005	3.60
TDA1010	3.30
TDA1011	4.00
TDA1035	4.70
TDA1037	2.95
TDA1044	4.37
TDA1060A	4.44
TDA1062	1.56
TDA1083	1.68
TDA1170S	3.00
TDA1190	3.50
TDA1190P	3.50
TDA1180	2.91
TDA1200	2.95
TDA1220A	2.12
TDA1270	3.95
TDA1327	1.70
TDA1352B	1.60
TDA1412	1.50
TDA1415	1.40
TDA1470	4.67
TDA1770	5.60
TDA1908A	1.95
TDA2002	2.80
TDA2003	1.20
TDA2004	2.52
TDA2006	1.78
TDA2010	2.40
TDA2140	5.95
TDA2151	3.25
TDA2190	3.30
TDA2020	4.66
TDA2030	2.80
TDA2522	2.66
TDA2523	3.40
TDA2524	2.25
TDA2525	4.00
TDA2530	2.70
TDA2532	2.90
TDA2540	3.84
TDA2541	3.84
TDA2560	3.50
TDA2571	4.90
TDA2576A	3.75
TDA2577	4.73
TDA2581	3.30
TDA2582	2.60
TDA2593	2.95
TDA2600	6.90
TDA2610	3.20
TDA2611A	2.35
TDA2640	2.90
TDA2652	7.31
TDA2653	5.90
TDA2680	3.40
TDA2690	2.72
TDA2710	5.67
TDA2720/1	6.77
TDA3190	2.00
TDA3500	6.90
TDA3560	6.00
TDA3561	6.66
TDA3562	8.60
TDA3571	3.75
TDA3651A	4.50
TDA3950	4.37
TDA4420	5.55
TDA4600	2.95
TDA4600-2D	2.95
TDA9503	4.21
TEA1009	1.86
UPC554	2.63
UPC566H	2.95
UPC575C2	3.40
UPC576H	2.60
UPC585	3.06
UPC587C2	2.34
UPC1025H	2.95
UPC1026H	1.24
UPC1028H	2.52
UPC1032H	94
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UPC1156H	4.26
UPC1158H	3.50
UPC1163H	2.48
UPC1167C2	2.70
UPC1168C	3.20
UPC1176C	2.53
UPC1177H	3.15
UPC1178C	4.21
UPC1180C	1.84
UPC1181H	1.62
UPC1182H	2.95
UPC1183H	2.48
UPC1185H	3.66
UPC1186H	1.60
UPC1188H	4.99
UPC1190G	1.20
UPC1198C	4.00
UPC1200V	1.18
UPC1211V	2.70
UPC1212V	1.34
UPC1215V	1.66
UPC1216V	1.20
UPC1217G	2.24
UPC1218H	1.80
UPC1223C	2.20
UPC1225H	2.00
UPC1226C	1.50
UPC1227V	1.20
UPC1228H	54
UPC1230H	4.39
UPC1245V	1.35
UPC1350C	4.15
UPC1353C	4.76
UPC1365C	6.38
UPC1356C2	2.08
UPC1367	2.00
UPC1378H	2.70
UPC1358H	1.88
UPC1360C	2.20
UPC1363C	2.16
UPC1366C	1.84
UPC1368H2	2.15
UPC1370C2	2.58
UPC1382C	1.08
UPC1384	3.78
UPC1447H	58
UPC41C	2.80
UPC577H	2.46
UPC585C	1.28

COMPUTER ICs

74LS260	55
2732	3.30
2764	1.87
27128	3.13
27256	4.75
4116	1.10
4532/20NL	3.00
4164	1.60
6264	2.75
6522	4.09
Z80A CPU	2.14
8271	60.00
ZTX213	17
ZTX313	27
ZTX650/1	35
LM1889	2.00
74LS260	0.55

Commodore Chips

6510	5.66
6526	5.11
6569	20.77
6581	7.79
901225	3.37
901226	6.45
901227	3.52
906114	4.51

VOLTAGE REG.

7805	78
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7812	78
7815	78
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78L08	68
78L12	68
78L24	68
7905	98
7906	98
7908	98
7912	98
7915	98
7918	98
7924	98
79L05	72
79L12	72
79L15	72
79L24	72

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AA119	9
BA102	17
BA115	13
BA145	17
BA148	17
BA154	6
BA155	14
BA156	15
BA157	20
BA317	26
BAX13	4
BAX16	8
BB105G	30
BY122	96
BY126	12
BY127	11
BY133	15
BY164	45
BY176	85
BY179	63
BY182	87
BY184	55
BY199	28
BY206	14
BY210/600	28
BY210/800	33
BY223	90
BY227	28
BY229	1.06
BY298	22
BY299	22
BYX10	20
BYX36/10	30
BYX55/600	30
BYX71/600	90
BY224	2.00
OA47	20
OA91	10
OA95	6
OA202	11
IN914	4
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IN4002	4
IN4003	4
IN4004	5
IN4005	5
IN4006	10
IN4007	10
IN4148	5
IN4448	10
IN5401	12
IN5402	14
IN5403	12
IN5404	12
IN5405	13
IN5406	16
IN5407	16
IN5408	20
ITT2002 = BAX16	
Y969 – Disc.	
REP BZX85 30V	
General Purpose Triac	95
SKE4F	£1.19
SKE5F	£1.19

ZENER DIODES

BZV15 C12	1.24
BZX61 130V	28
BZX61 Range (1.3W)	20
BZX79 Range (400mV)	10
BZY88 Range (400mV)	10
BZY93, 90 (18V)	1.18

FIDELITY – Semiconductors

ML923	2.21
SL490	1.77
TDA2270	1.65
TDA3330	2.21
TDA8180	3.32
BC638	33
BU5080	1.77
TDA3810	3.86

FIDELITY – Switches

On/Off AVS	94
On/Off Remote Cont	2.43
On/Off CTV 140	94

FIDELITY – Transformers

Flyback	FCC2015BE	11.60
	FCC2215AE	11.60
20" LOPT Mod. Kit		66

FIDELITY – Service Manuals (Zero VAT)

Audio	IS500	1.70	ZX2000TV CTV20R	1.70
	IS700	1.70	ZX3000TV AVS1600	1.70
	IS750	1.70	ZX3000TV AVS2000	1.70
TV	CM14	1.70	ZX3000TV CTV20	1.70
	CTM1400	1.70	ZX3000TV Teletext	1.70
	F14R	1.70	VCR 2 Parts VCR	2.90

FIDELITY – Remote Controls

4 Button CTV20R/22R/140R	9.95
8 Button F14R	11.05
12 Button IS500	11.05
14 Button AVS	9.95
32 Button Teletext	12.16
Tuner Flap CTV 14S	83
Loudspeaker CM14/CTV140R	1.99

P. V. TUBES

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SONY SPARES

SEMICONDUCTORS

CV12E		2.34
GH3F		1.42
IS1555		25
U05G	KV1810UB	96
V11N	KV1810UB	96
10E2		25
SG-264A		4.08
SG629	KV1810UB	6.42
SG-6533	SG613	13.20
BX342	SLC7UB	4.08
CX104A	KV1810UB	5.28
CX136A		7.74
CX143A	SLC5/7UB	7.20
CX186	SLC5UB	5.28
M51231P	KV2200UB	2.34
STK2129		13.20
TCP4621AF6	SLC6UB	13.87
TDA2578A		3.24
UPC 1394C		2.34
UPD 546C107	SLC7UB	16.98
UPD 547C049	SLC7UB	8.94
TL494CN	SLC7UB	5.28
2SA 771		2.34
2SA 835		1.42
2SA 1027R		25
2SA 1175	SLC7UB	89
2SB 733		96
2SB 740C		96
2SB 856		1.42
2SC 403C		25
2SC 867A		2.34
2SC 1034		5.28
2SC 1061= 2SC1986		2.94
2SC 1114		5.28
2SC 1124		96
2SC 1316		3.18
2SC 1362-7		25
2SC 1364		25
2SC 1413A		7.38
2SC 1475		25
2SC 1962		1.42
2SC 2009		25
2SC 2278		96
2SC 2335 Kit		7.38
2SC 2369		3.18
2SC 2551		98
2SC 2785		25
2SC 3153		4.08
2SD 257		2.34
2SD 725		8.94
2SD 773		25
2SD 774		96
2SD 1164		96
2SD 1497-02		4.08
2SD 1497-06		4.08

SONY SPARES SUNDRIES

UHF Tuner BT-871	KV1810UB	37.20
Booster Antenna	SLC7UB	31.38
RF Modulator	SLC6UB	60.30

SONY REMOTE CONTROLS

SLC5UB	19.80
SLC6UB	17.40
SLC7UB	42.00

SONY SPARES VIDEO/AUDIO HEADS

Ace Assembly	SLC7UB	24.10
Ace Assembly	SLC6UB SYA-676-104-6A rep	47.22
Video Head DR3-21R	SLC9UB	43.20
Video Head DSR-35A	SLC20/30/40UB	41.34
Video Head DSR-36R	SLC5/C6/7UB	42.00
Video Head DSR-43A	SL8000UB	46.74
Head Record-Playback	PP128-3602C/GEN	13.87
Head Record-Playback	181-3602D TC/HMK	4.12

ANTIFERENCE

SB11 Splitter	2.37
COB11 Outlet	96
CS100 Combiner Splitter	4.77
PU 1240 Power Unit	11.65
UP1300 MHA	9.09
XS2U Xtraset	14.56
4way/VHF/UHF Amp	22.50
6way VHF/UHF Amp	43.13
X68 High Gain A/B/CD/WB	17.10

SONY SPARES MECH. REP.

Main Drum Assy	SLC7UB	192.52
Rewind Idler Assy	SLC7/C5UB	5.95
Rewind Idler Assey	SLC6UB	3.95
Forward Assy	SLC6UB	3.18
Gear Kit	SLC9UB	8.94
Guide Pin Kit	SLF1/C9UB	5.28
Pinch Roller	TC-GEN	96
Pinch Roller	TC204SD	1.42
Pinch Roller	HMK44/44B	96
Pinch Roller	TCK55	96
Cass Holder Assy	TCK44	1.42
Lever Fwd Assy	WM2	96
F Wheel Assy	WM2	3.18
Limiter Assy	SLC7UB	2.34
Idler Assy	SLC7UB/C5/3000	96
Brake Assy	SLC7UB	1.42
Pulley Load Assy	SLC6UB	96
Thrust Bear. Assy	SLC6UB	3.18
Screw Cass. Lid	WM2	25
Coil Spring	WM2	25
Battery Lid	WM2	96
Lid Timer	SLC7UB	96
Threading Gear	SLT6ME	96
C5 C7 Capstan Motor		34.00
C7 Drive Motor		32.95
Pinch Roller	SLC7UB	0.96

SONY SPARES BELTS

Belt	WMR2	96
Rubber Belt	TC-GEN	96
Take Up	TC-GEN	96
Drive	TC-GEN	96
Midway Pull	TC-GEN	96
Capstan	TC92	96
Capstan	TC135/136SD	96
Flat New	TC186SD	96
Capstan	TC-GEN	96
Capstan	HST300	96
Take Up	HMK3000UK	96
Capstan	HMK3000UK etc	96
Fast Fwd-Rwnd	VO2850P	1.62
Forward	VO2850P	1.02
Motor	VO2850P	1.62
Capstan	VP2000	4.32
Forward	SLC7UB/SLC5UB	25
Capstan	SL8000UB	96
Extension	SL8000UB	2.34
Drum	SL8000UB	1.52
Fast Fwd Idler	SLC7UB	96
Threading	SLC7UB	25
Capstan	SLC7UB/CS	96
Eject	SLC7UB	25
Counter	SLC7UB	25
Fast Forward	SLT7ME	96
Forward	SL8000UB	96
Belt	SLC6UB	96
Fast Forward	SLC6UB	96
Counter	SLC6UB	96
Threading	SLC6UB	96
Relay	SLC6UB	96
Capstan	SLC6UB	96
Belt	PS-5520 etc	3.18

SONY SPARES SWITCHES

Sw.(Sfce wave) Filter	KV2022UB	96
PB Switch Channel	1820/2 & 1340	18.86
PB Power	KV-GEN	1.20
PB Switch	SL8000UB	96
PB Power	KV14/2060UB	3.68
Sw Power	KV2022UB	4.08
Sw. Slide Record	SL8000UB	96
Sw. Slide Rec/pback	SL8000UB	1.42
Sw. On/Off	KV1612UB	4.08
Sw. Power	KV-GEN	5.50
Button Stop/Eject	WM4	96
Control Knob	SLC7UB	96

SONY SPARES MANUALS (Zero VAT)

Instruction Manuals

SLC9UB	2.00
SLC6UB Mk 2	2.00
SLC7UB	2.00
SLC5UB	2.00
SL6UB	2.00
KV2212UB/E2	2.00
KV2705UB	2.00

Service Manuals

HMK3000	8.25
KV1810UB Mk 1	8.25
KV1400UB	8.25
SLC7UB	8.25
SLC5UB	8.25
SLC6UB	8.25
SLC9UB	8.25
SLC6UB Mk 2	8.25

PHILIPS – G11 Sundries

47 pot with switch	85
Line Lin Coil	3.80
62 pot RGB	6.75
Line Scan Panel	54.00
Power Panel	41.06
Timebase Panel	37.50
Bridge Transformer	2.35
EW Correction Coil	1.95
Final Anode Lead	3.20
Focus Unit	6.80
39R Resistor	70
RGB 10G Diode	69

THORN SPARES

SEMI-CONDUCTORS

GL4850	TX10	74
TIC45	TX9	1.18
19022W	TX9	43
T9053/4	TX9	1.10
AN6360	3V29	6.81
HA11741	3V32	23.22
M293	TX90	7.10
M50790SP	3V35	6.98
M54544L	3V32	3.80
MC13002		4.98
MC14493	TX9/TX10	
MN1219	3V36	11.43
TDA1236	TX10	3.44
TDA3652	TX10	6.00
TDA4500	TX90	5.84
SL490	TX9/TX10/TX100	
DTC144WF	3V35	30
R2540	9000	3.20
TIP112H	TX90	69
T5051V	TX9	3.43
T6069V	TX9	38
T6071	TX100	1.46
T9063V	TX9	3.64
19064V	TX90	1.14
UPD553C 164	3V29	20.76
UPD7519G 031 036	3V36	17.13
UPD7538C 020	3V38	11.06
10 Volt T05	3V29	

THORN MANUALS (Zero VAT)

Service Manual	1690/1691	5.60
Service Manual	1790	1.14
Service Manual	9600	10.05
Service Manual	9800	7.54
Service Manual	TX9	29.04
Service Manual	TX10	40.00
Service Manual	TX90	11.30
Service Manual	TX100	11.20
Service Manual	3V00	17.50
Service Manual	3V16	26.24
Supplement to 3V00	3V22	1.28
Service Manual	3V23	30.62
Service Manual	3V24	28.42
Service Manual	3V29	29.00
Instruction Manual	3V29	3.28
Service Manual	3V00	17.50
Service Manual	3V30	14.91
Instruction Manual	3V30	2.65
Service Manual	3V31	25.84
Instruction Manual	3V35	1.63
Service Manual	3V35/3V36	27.20
Supplement to	3V35 3V38	1.24
Supplement to	3V35/8 3V39	90
Service Manual	3V42	23.94
Service Manual	3V43	30.72

THORN BELTS/LAMPS

Counter Belt 1	3292/3V00/3V16/3V22	60
Counter Belt 2	3292/3V00/3V16/3V22	60
Reel Drive Belt	3292/3V00/3V16/3V22	1.00
Relay Belt	3V00	2.79
Capstan Belt	3292/3V00/3V01 3V16 3V22	3.28
Unloading Belt	3292/3V00/3V16/3V22	60
Drum Motor Belt	3292/3V00/3V16/3V22	2.79
Cassette Drive Belt	3V23	60
Capstan Belt	3V29/3V30	1.62
Loading Belt	3V23	60
Loading Belt	3V29/3V30	60
Loading Belt	3V35/3V36/3V38	60
Tape Spool Drive	3V35/3V36/3V38	60
Take Up Clutch	3V29/3V30/3V35/3V36/3V38	60
Capstan Belt	3V35/3V36/3V38	1.21

LAMPS

Tuning Indic Lamp	TX9	62
Cassette Lamp	3292/3V00	3.66
Cassette Lamp	3V16	1.53
Lamp Holder	3V16	60
Cassette Lamp	3V23	1.95
Lamp Holder	3V29/3V30/3V31/3V32	60
Cassette Lamp	3V29/3V30	1.41
Cassette Lamp	3V31/3V32	1.60

THORN VIDEO HEADS

Upper Drum Ass	3292/3V00/3V16/3V22	35.94
Upper Drum Ass	2200/3660/3V16/3V23/3V24/	35/94
Upper Drum Ass	3V31/35/36/38/39/3V29 30	35.74

PHILIPS – K13

116 40025	Dual Posistor	1.80
124 70347	Main Electrolytic	6.50
101 20519	Focus Control	3.68
140 10161	LOPT	10.06
	Tripler	12.50
276 80198	Select Unit 933	16.67
276 10673	On/Off Switch	3.84
Panels		
212 20648	Lum. Chroma mk.1	31.09
212 37538	Lum. Chroma mk 2	19.80
212 20616	RGB Panel	12.87
212 20647	Sound Panel	12.50
212 21114	Power Panel	
212 20617 21164	Line Frame Sync	28.49
212 20649	Mains Input Rect. Panel	17.96
212 27445	I.F Module(V321)	16.60
212 27522 212 20646	I.F Module(2003)	18.63
212 20796	Sound Panel	10.20

PHILIPS – G8 Sundries

Knobs sm. or lg.	50
Rear Convergce Panel	23.00
AFC Unit	8.82

PHILIPS – Video Heads/ Tape

Philips	V2000 Head	64.00
	1700 Head	64.00
LVC1700	Tape 1200	17.50
VCC240	Scotch	6.20
VCC360	Scotch	6.33
VCC480	Scotch	7.23

PHILIPS K30

101 20561	Focus Unit	3.68
	EHT Lead	8.30
140 10283	LOPT	17.94
276 17083	On/Off Sw	2.60
276 10781		
310 27455	Prog Select	13.10
1002 late 1002 early		
All Gun Switches		70
Panels		
212 27525	TMS 1000 (1234)	17.03
212 27593	Euro Decoder	46.00
	K30/35 Sound	12.50

V.C.R. MOTORS

Capstan Motor	3292/3V00/3V01/3V16	51.45
Drum Motor	3292/3V00/3V01/3V16/3V22	43.49
SMP Reel Motor	3V23	32.79
Cassette Housing Motor Assembly	3V23	10.32
Capstan Motord	3V23	52.81
Loading Motor	3V23/3V24/3V29/3V30	8.56
Capstan Motor	3V29/3V30	27.32
Reel Motor	3V29/3V30	32.79
Lower Drum Motor Assembly	3V29/3V30	78.72
Cassette Motor	3V35/3V36/3V38	6.92
Mode Control Motor	3V35/3V36/3V38	5.95
Capstan Motor	3V35/3V36/3V38	27.93

THORN REMOTE SETS

T723 Non Text	3767/3788	38.60
T725 Non Text	20A2/2282/3781/37081/ 37101/3714/37351/37361 37371	19.40
T731 Text/ Stereo	20A4/22B4/37063/37093/ 37463/37371	20.01
T736 Text	20A3/2203/3795/3796/ 37003/37103/37353/37363/ 37373/37953/37963	31.60

THORN SWITCHES

On/Off Switch	TX9	2.98
On/Off Switch	TX10	2.74
Focus Unit	TX10	10.20
8 Way Tuner Unit (Not Drawer)	37141	12.88
8 Way Tuner Unit (Not Drawer)	37360	13.50
3 Way Tuner Unit (Not Drawer)	37340/37370	20.44
Volume Control	38030	1.74
6 Way PB Assy	3722/4722/ 6722/8000	20.70

THORN TRANSFORMERS & INDUCTORS

LOPT	9000	25.53
FHT Transformer	TX10	33.80
LOPT	TX10	15.00
LOPT	TX9	23.85
LOPT	38030	6.18
RFI Choke	TX9	3.45
DC Input Choke	TX9	15.36
Mains Transformer	TX90	15.03
Linear Line Coil	TX9	1.77
RFI Input Choke	TX9	60

THORN MECH. REP. VCR

Take Up Rubber Tyre	3V92/3V00	60
Rewind Tyre	3V92/3V00	60
Timing Gear Assembly	3V00	3.97
Audio Control Head Sub Assembly	3V92/3V00/3V01/3V16/ 3V22	42.38
Fast Forward Idler	3292/3V00/3V16	1.63
Fast Forward Tyre	3V00/3V16	60
Pinch Roller	3V92/3V00/3V01/3V16/ 3V22/3V23	7.30
Stop Solenoid	3V16	10.42
Pause Solenoid	3V16	16.60
Take Up Idler Assmb	3V00 up to Serial No 19006	7.54
	3V16 up to Serial No. 16509	
	3V22 up to Serial No. 27700	
Take Up Idler Assmb	3V00 19007 onwds	5.28
	3V16 16510 onwds	
	3V22 27701 onwds	
Rewind Idler	3V16	8.52
Take Up Tension Brkt	3V23	80
Roller Assembly	3V23	4.08
Take Up Spool Idler Assmb	3V29/3V30	
Pinch Roller	3V29/3V30	8.66
Idler Counter Pulley	3V29/3V30	60
Cassette Housing Assmb	3V29/3V30	20.85
Take Up Clutch Assmb	3V29/3V30	2.36
Spool Carrier Idler Assmb	3V35/3V36/3V38	2.73
Cass. Housing Assy	3V35/3V36	36.74
Lower Door Spring	3V35	60
IF Panels	TX10	23.52
Cassette Cover	3V29/3V30	4.34
TX90 Battery Inverter	TA127	£37.81

TUNERS/MIXERS

Mix Booster	3292	30.62
Mix Booster	3V29	24.70
RF Convertor	3V29	59.32
Mix Booster	3V31/3V32	24.50
UHF Tuner	3V35/3V36	38.12
RF Convertor	3V35/3V36/3V38	36.08
UHF Tuner	3V39	21.87
Varicap Tuner	TX9/TX10	16.34

PHILIPS – K35

K30/35 Sound	21.48
Panel	12.50
K35 Tuner Drawer	10.00
K35 Remote Txt. Slim	26.21

PHILIPS – Manuals (Zero VAT)

Philips	G9	4.20
	G11	3.90
	K30	3.90
	KT3	3.90

PYE

IF Gain Module	9.00
CDA Panel	20.00
731 RF Choke	6.50

THORN SUNDRIES

Thorn 1591 Speakers sm or lg	6.20
Thorn 1500 Controls	59
Thorn Focus Control GEC	2.95
Thorn 9000 Focus Unit	8.40
Thorn 8500 Focus Unit	4.75
Thorn TX10 Focus Unit	10.20
390K Frame Control	59
470K Line Control	59

PHILIPS – CTX Chassis

CTX EHT Leads	7.36

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ELC104305 Mullard	12.50
ELC1043-06	8.40
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Philips G11 (U321)	9.90
U322	7.20
U341	9.50
U342	8.50
Thorn TX10	8.75

PUSH BUTTON ASS.

Hitachi 4 way	12.36
Philips G8 (early)	17.82
Philips G8 (late)	18.97
Philips G11 Tip Switch unit	26.50
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Philips KT30	13.22
Pye 6 way (207/715)	18.40
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Pye 725-735 tuning head with PCB	12.50
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Decca 7 way piano key rep kit	22.42
GEC 2110 6 way	10.92
GEC 6 way slim	10.29
GEC/ITT/PYE 7 way	16.67
GEC Conversion kit	16.50
Rank A823	12.36
Rank T20A	11.21
ITT CVC 8/9 (mod)	13.80
ITT 6 way with VCR	8.90
Thorn 8500	6.50
GEC 7 B/P c neons	

SWITCHES/ACCESSORIES

On/off gen. purpose 4A	80
G8 on/off metal or plastic	1.98
G11 on/off	1.58
G11 on/off remote	1.58
Rotary on/off gen purpose	66
ITT CVC5 on/off	1.24
ITT mains switch wity solenoid	4.50
Rank T20 on-off switch	1.95
Rank mains switch with solenoid	4.50
Thorn 1591	2.90
Thorn 9/10	2.Tx 98
GEC 2040 on/off	98
Rank tuner buttons 3 sizes	20
Thorn 3500 A1 beam switch	86
GEC 2110 tuner neons	35
GEC 2110 A1 cont R/B/G	58

POTENTIOMETERS

Midget controls, Insulated Spindle Length 44mm Log or Lin Without Switch 5K, 10K, 25K, 50K, 100K, 250K, 500K, 1M	54
DPST Switched log 5K, 10K, 25K, 50K, 100K, 250K, 500K, 1M, 2M	1.26
Dual Gang Controls	1.25
16mm Rotary Controls 10K, 22K, 100K, 1M	1.25
Convergence Pots	60
3W Stand 5R, 6R8, 10R, 20R, 50R 100R, 200R, 500R	
Metric/Philips Type 5R, 10R, 15R, 20R, 50R	
Skeleton Presets	16
Stand or miniature Horiz or Vert 100R-2M2	
Slider Potentiometers Lin or Log	75
470R, 1K, 2K2, 10K, 47K 470K, 100K, 4K7 Log	
Multiturn Pots	65
GEC/TCE 100K Philips G8, Decca Rank	

Thermal Cut Out Switches

Thorn 3000 2A Metal	2.68
GEC 2040 Metal	2.50

CAPACITORS
Main Replacement Electrolytic

Pye 169 (200/200/100/32)	3.74
Pye 691/7 (200/300/350V)	2.97
Pye 731 (600/300V)	2.55
Philips G8 (600/300V)	2.53
Philips G9 (600/300V)	2.44
Philips G11 (470/250V)	3.19
Philips G11 (7n5 1500V)	1.40
Philips 320 (400/400/200V)	3.02
Decca 30 (400/400/350V)	3.74
Decca 80 (400/350V)	4.37
RBM A823 (2500/2500/30V)	1.83
RBM A823 (600/300V)	3.12
RR1 T20A (220/400V)	2.20
ITT CVC 5/9 (200/200/75/25)	3.28
ITT CVC 20 (220/400V)	2.20
GEC 2110 (600/250V)	2.14
GEC 200/200/150/150	2.91
Thorn 1500V (150/150/100/300V)	2.42
Thorn 1500V (12/300V)	35
Thorn 1591/1691 4700/25V	1.32
Thorn 3500 (400/40V)	33
Thorn 3500 (175/100/100/400/350V)	3.06
Thorn 3500 (1000/63V)	95
Thorn 3500 (1000/70V)	95
Thorn 8000/8500 (2500/2500/63V)	3.72
Thorn 8000/8500 (700/250V)	2.55
Thorn 8000/8500 (400/350V)	2.82
Thorn 9000 (400/400V)	3.61

LINE OUTPUT TRANS.

Philips 320	8.70
Philips 210/300 Mono	10.00
Philips G8	8.75
Philips G9	9.50
Philips KT3	10.06
Philips K30	17.94
Philips TX2	13.39
Philips TX2	14.41
Philips G11	15.58
Pye 713/731	10.00
Pye 725 90	10.50
Pye 169	10.00
Pye 741	8.20
Bang & Olufson (2000,3000)	14.69
DECCA 80	8.58
Decca 100	8.58
Decca 1700	9.00
Decca 1730	8.58
Decca 2230	8.58
GEC 2110	16.75
GEC 2040	9.50
ITT CVC 1/9	10.85
ITT CVC 25/30/32	8.65
ITT CVC 20	8.60
ITT CVC 45	8.60
R B M T20	13.95
R B M A7774 Mono	11.74
R B M BUSHRANGER T16A	10.00
R B M BUSHRANGER T18A	10.00
Thorn 3000 EHT	9.95
Thorn 3000 SCAN	7.95
Thorn 8500	17.50
Thorn 3000/3500 Mains	10.00
Thorn 1615	12.50
Thorn 1691	9.68
Thorn TX9	23.85

RECTIFIER TRAYS

Thorn 1500 3 Stick	5.20
Thorn 1500 5 Stick	5.99
Thorn 3500	7.98
Thorn 8000	6.95
Thorn 8500/8800	7.15
Thorn 9000	8.70
Decca 1730/1830	5.48
Decca 30	6.76
Decca 80	7.12
Decca 100	7.50
Decca/Tatung 120/130	6.50
GEC 2100	7.40
GEC 2200 (20AX)	6.50
GEC 2040/2028	6.60
GEC 2110 (pre or post Jan '77)	7.00
Philips G8 Short Focus Lead	7.12
Philips G8 Long Focus 550	7.12
Philips G9	6.37
Pye/Philips KT3	12.50
Pye 691/3	7.58
Pye 713 4 Lead	8.79
Pye 713 5 Lead	8.79
Pye 731/25	8.75
R B M A823 plug in	8.75
Rank T20/22	7.12
ITT CVC5/9	7.50
ITT CVC20/25/30 (Mullard)	7.12
ITT CVC45	8.65
Universal	6.00

FUSES

Quick Blow 1.25"	
100ma	73
250ma-500ma-750ma-1A	60
1 5A-2A-2 5A-3A-5A	60
Quick Blow 20mm	
100ma, 250ma, 315ma 500ma, 630ma, 800ma	90
1A 1 25A, 1 6A, 2A, 2 5A, 3 15A, 5A	60
Mains Fuses	
2A, 3A, 5A, 10A, 13A	1.00
Antisurge 1.25"	
250ma, 500ma, 630ma, 750ma, 850ma	1.70
1A, 1 25A, 1 5A, 2A	1.70
2 5A, 3A, 5A	2.70
Antisurge 20mm	
80ma	4.80
100ma	2.50
160ma, 200ma	2.20
315ma, 500ma, 630ma, 800ma	1.30
1A, 1 25A, 1 6A, 2A	1.30
400ma, 2 5A, 3 15A, 4A, 5A	1.90

T.T.L. 74LS SERIES

				74LS92	65	74LS160	90	74LS251	65
74LS00	1.12	74LS37	35	74LS93	60	74LS161	85	74LS253	95
74LS02	58	74LS38	35	74LS107	80	74LS162	4.04	74LS257	1.20
74LS03	58	74LS40	35	74LS109	58	74LS163	85	74LS258	95
74LS04	58	74LS42	80	74LS112	50	74LS164	85	74LS259	1.70
74LS05	58	74LS47	85	74LS113	44	74LS165	1.50	74LS273	1.90
74LS08	58	74LS48	83	74LS114	70	74LS173	1.32	74LS283	1.30
74LS10	58	74LS49	33	74LS122	96	74LS174	85	74LS293	1.20
74LS11	58	74LS51	33	74LS123	80	74LS175	85	74LS352	1.40
74LS13	37	74LS54	43	74LS125	85	74LS191	1.02	74LS353	1.40
74LS14	46	74LS55	60	74LS126	60	74LS192	1.30	74LS365	65
74LS15	33	74LS73	60	74LS132	63	74LS193	1.30	74LS366	82
74LS20	35	74LS74	65	74LS138	83	74LS194	75	74LS367	1.67
74LS21	35	74LS75	65	74LS139	65	74LS197	95	74LS368	65
74LS22	35	74LS76	65	74LS151	85	74LS240	2.20	74LS373	1.40
74LS26	44	74LS78	65	74LS153	85	74LS241	2.20	74LS374	1.55
74LS27	35	74LS83	89	74LS155	65	74LS242	2.20	74LS393	1.20
74LS30	35	74LS85	98	74LS156	1.02	74LS243	2.20	74LS670	1.78
		74LS86	39	74LS157	78	74LS244	2.20		
74LS32	90	74LS90	1.22	74LS158	65	74LS245	2.30		

CMOS 4000B Series

CMOS		4026	1.99	4068	22	4510	76	4539	77
4000B Series		4027	39	4069	22	4512	72	4541	96
4001	21	4028	64	4070	22	4513	1.68	4543	1.12
4002	21	4029	90	4071	40	4514	1.88	4551	96
4008	72	4032	1.04	4072	22	4515	1.88	4553	2.40
4011	31	4035	80	4073	22	4516	76	4554	1.20
4012	21	4038	99	4075	22	4518	76	4556	48
4013	30	4040	72	4076	80	4519	64	4560	1.76
4014	74	4042	58	4077	22	4520	75	4561	74
4015	76	4043	71	4078	22	4521	1.68	4566	1.20
4016	42	4044	71	4081	22	4522	88	4580	3.60
4017	66	4046	96	4093	49	4526	88	4581	1.84
4018	72	4047	70	4094	1.56	4527	1.20		
4010	70	4049	32	4099	1.20	4528	88	4582	80
4020	76	4050	32	4160	72	4529	1.04	4583	1.00
4021	70	4051	72	4161	72	4530	62	4584	40
4022	70	4052	72	4162	72	4531	72	4585	88
4023	21	4053	72	4163	72	4532	1.00	4597	1.84
4024	50	4060	96	4502	72	4536	2.64	4598	2.40
4025	21	4066	43	4505	1.88	4538	1.04	4599	2.00

HITACHI/GEC – Semiconductors

LA7801	2.20
STR454	4.73
SM76709	8.00
TDA1870	6.46
TDA4503	5.68
2SD1453	2.20

HITACHI/GEC – Service Manuals (Zero VAT)

GEC	Hitachi	
V4000H	8000	6.49
V4001H	9300E	6.49
V4002H	9500E	8.62
V4004	VT33E	7.18
V4005E	VT63	4.77
V4100	VT11E	6.49

HITACHI/GEC – VCR GEC V4100/ Hitachi VT11E

Belt 312	30
Belt 313	30
Belt 317	47
Belt 318	40
Capstan Motor	22 18
Upper Cylinder (Head)	33.35

HITACHI/GEC – VCR GEC V4000H/ Hitachi 8000

Belt Counter (122)	47
Belt Loading	43
Belt Take Up	30
Idler FF/Rewind	1.87
Lamp Tape Sensor	65
Play Idler Assy	3.74
Pressure Pinch Roller	5.16
Pulley FF/Rewind	52
Relay	2.54
Upper Cylinder (Head)	34.66

HITACHI – Sundries

Vertical Output Module GECC2286, Hit CPT2226	3.98
C2067	
C2069	

HITACHI/GEC – VCR GEC V4001H/ V4002H/Hitachi 9300/9500E

Belt (259)	47
Belt (289)	47
Belt Take Up (213)	30
Capstan Motor	31.00
Idler FF/Rewind	1.80
Lamp Tape Sensor	91
Play Idler Assy	3.72
Pulley FF/Rewind	36
Video Head	34.66
Remote Cont. Handset	9.33

HITACHI/GEC – VCR GEC V4004/ Hit.VT33E

Belt (302)	30
FF/Rewind Arm	2.90

AERIAL EQUIPMENT

Product	**Trade**
Chimney Kits	55
6" pressed bkt	55
6" bkt with kit	1.75
9" welded bracket	1.35
9" bkt with kit	2.90
Double bkts	2.39
Double bkts. witha kit	4.75
13 5" Cradle bkt	2.25
13.5" Cradle with kit	4.25
Std repair pack	1.10
Double repair pack(2)	2.39

Wall Brackets	
6" welded	1.30
12" T&K	3.30
9" welded	1.87
Gutter Brackets	1.00
Clamps	
1" × 1"	68
2" × 2"	1.25
Universal No. 1	1.02
1" u bolts	19
J bolts	20
1 25" u Bolts	20
2" u bolts	28
UHF TV Aerial	
10 element	1.62
18 element	2.63
UHF TV Aerial	
3 element	5.68
4 element	6.50
Masts	
3ft crank 7/s shape	
6ft 1"	1.60
10ft 1 5"	5.25
12ft 1 5"	6.00
16ft 2"	9.00
High Gain Aerials	
Antiference X68	17.10
Antiference X614	17.10
Set Top Aerials	
Mercury Olympic 11	2.30
Antiference Super Set To	5.56
Antiference Carratemna	6.80
Antiference Caravan Kit	11.00
Loop Aerial	1.00
Corner Plates	7
Lashing Wire	75
Lead Wall Nails	4.95
Rawbolts	60
Caple Clips (100)	75
Coax Plugs	18
Line Connectors	12
Attenuators	1.80
Tape	76
Wood Screws	7
Mast couplers	8.92
27Mhz filter	2.10
Outlet Boxes	
Product	**Trade**
Surface Single	80
Surface Twin	1.10
Y Splitter	85
Flush Single	95
Flush Twin	1.20
TV/FM Flush	1.35
Antiference	
SB11 Splitter	2.37
CS200 Comb/Split	3.94
COB11 Outlet	96
CS1000 Com/Split	4.77
PV1240 power	11.65
UP1300 MHA	9.09
XS2 xtraset	14.46
XS04 4wayOA	22.50
XS4/6	43.13
Diplexers	68
Match Trans	2.83
Back Boxes	
Metal Single	45
Metal Double	80
Budget Range	
Outdoor Splitter	5.50
Mast Head amp	5.00
Power Unit	5.00

VALVES CONT'D

30FL2	1.70
DY302	98
DY86/7	66
ECC81	1.08
ECC82	98
ECC83	1.07
ECC84	80
ECC85	98
ECC88	1.35
ECF80	1.30
ECF82	88
ECH81	1.60
ECH84	1.66
ECL80	84
ECL82	1.30
ECL86	1.99
EF80	95
EF86	2.20
EF183	99
EF184	1.09
EL90	1.02
EL34	3.50
EL84	1.05
EY86/7	68
EY500A	2.25
EZ80/81	56
GY501	1.45
GZ34	3.50
KT66	8.50
KT77	8.50
KT88 (alt type)	12.00
PC92	3.00
PC97	1.65
PCC85	85
PCC805	1.40
PCF80	1.00
PCF200	1.35
PCF800	1.38
PCF801	1.13
PCF802	1.12
PCF805	1.80
PCF808	1.63
PCH200	1.45
PCL82	1.20
PCL84	1.20
PCL805	1.09
PCL86	92
PFL200	1.86
PL36	1.87
PL81	94
PL95	2.25
6L6GT	2.30
12HG7	3.20
12BH7A	2.75
PL504	1.65
PL508	2.90
PL509/19	5.30
PY88	81
PY500A	2.30
PY800/1	69
UCH81	2.25
UCL83	1.82
UY85	1.35
PL802T	4.00
40KD6	5.30
21LU8	3.00
17DW4A	4.50
3AT2B	5.00
12BY7A	3.75

We cannot advertise our complete range of products. Please ask if you require something which is not listed, ie:

Axial/Radial Electrolytics, Mixed Dialectric Caps., Polyester Caps., Carbon Resistors, Wirewound Resistors, Filament Lamps, Thermistors, LEDs, IC Sockets, Floppy Discs, Computer Cassettes, Thorn New Life Tubes (collection only), New Mono Tubes, Crystals, Cables (post chgs extra), Aerial Equipment, Electrical Plugs/Sockets, Components for Sinclair, Amstrad and Acorn. Unisef Audio Range.

LINEOUT TRANSFORMERS

3600	DECCA 100	7.95
3601	DECCA 110	9.80
3604	DECCA 1730/1830	11.08
3599	DECCA 80	7.98
3727	DECCA MS1700-2420	10.13
3729	FIDELITY FTV12/TVR120	9.90
5528	FIDELITY ZX3000 22"	14.50
3808	FIDELITY ZX2000/3000	14.50
3731	GEC 2100/2040	5.50
3732	GEC 2114	3.50
3734	GEC 3133	3.60
3733	GEC M1201/M1501H	13.25
3614	GRUNGIG 5010/6010ETC	12.95
3755	INDESIT 24EGB	11.25
3617	ITT CVC30	8.75
3618	ITT CVC45	9.75
3615	ITT CVC5-8	10.25
3620	KORTING A21100 90° HYBRID	14.95
4508	PHILIPS E2 CHASS	10.00
2862	PHILIPS G9	10.95
5305	PYE 691 WIRED	5.00
3628	PYE 725 90°	14.65
3629	PYE 731 110°	13.28
3632	RANK A823	5.50
3634	RANK T16A	8.95
3636	RANK T20A	12.95
3726	RANK T26A	15.50
3637	RANK Z179	11.25
3639	RANK Z718 22"	21.75
3770	REDIFUSION MK1 CHAS	9.38
3771	REDIFUSION MK3 CHAS	15.95
3775	SANYO CTP5101	16.50
3643	THORN 1400 SERIES	5.95
3644	THORN 1500 20"	5.95
3645	THORN 1500 24"	5.95
3646	THORN 1590 SERIES	10.85
3647	THORN 1600 SERIES	10.85
3648	THORN 1615 SERIES	8.95
3649	THORN 1690/91 SERIES	10.50
3713	THORN 1790	8.95
3714	THORN 3787	15.23
3652	THORN 3K 3K5 EHT TX	7.98
3651	THORN 3K 3K5	8.96
6172	PHILIPS G8 SPECIAL	7.98
2868	PHILIPS KT3	10.95

EHT TRAYS

5400	BG1895-641	7.50
5403	BG1897-642	7.50
5404	BG2097-642/333	7.50
3663	DECCA 100	7.25
3665	DECCA 1830	3.00
3662	DECCA 80	7.11
3667	GEC 1028/CS108	3.50
3677	ITT CVC45	7.95
3675	ITT CVC5/9	4.00
3678	KORTING HYBRID	7.95
3683	PHILIPS 550 G8	6.60
3681	PHILIPS 570 (5 LEAD)	4.50
3684	PHILIPS G9	4.00
3685	PHILIPS KT3	6.95
3686	PYE 691/697	6.95
3688	PYE 725/731/741	8.91
5395	SEIMANS TVK186/5	9.50
5393	SEIMANS TVK52	8.50
4696	SEIMENS TVK196/17	11.95
5406	TCE 1400 LARGE SCRN	4.95
3696	TCE 1500 17"-19"	5.65
3697	TCE 1500 23"&24"	4.95
3698	TCE 1600 SERIES	2.95
3700	TCE 4000	4.50
3703	TCE 9000	7.85
3699	TCE3000/3500	7.75
3706	TV11 EHT STICK	0.95
3709	TV20 EHT STICK	0.95
5275	TV45 EHT STICK	2.45
3705	UNIVERSAL EHT TRAY U K	4.95

TV ELECTROLYTICS

3547	DECCA 10/30 400X2/350V	2.90
3549	DECCA 100 400+800 350/250V	4.65
3548	DECCA 80/100CHAS 100/400V	2.90
5304	FIDELITY ZX2000 330 385V	4.95
5303	FIDELITY ZX3000 220 385V	3.98
3557	ITT CVC20/RRI T20 220/400	1.20
3556	ITT CVC5/9 200X2+25+75ETC	3.26
3560	PHILIPS G11 470UF/250V	1.79
3559	PHILIPS G9 2200/63V	1.55
3561	PHILIPS KT3 200+25X2/385V	2.65
3554	PHILIPS G8/GEC 2110 600/300V	3.16
3558	PHILIPS G9/PYE 731 600/300 PC	3.16
3565	PYE 725/731 800/250V	1.90
3564	PYE 691/697 200+300/350V	2.00
3576	RRI AB23 2500X2/25V	1.48
3588	TCE 3000/3500 1000/70V	0.89
3585	TCE1500 150X2+100/300V	2.35
3587	TCE3000 200+100X2/350V	2.86

MIXED DIALECTRIC CAPACITORS

4270	0.01 600V X5	0.75
4272	0.022 1KV X5	1.95
4273	0.033 1KV	1.40
4274	0.047 600V X5	0.85
4275	0.047 1KV X5	2.47
4276	0.1 600V X5	1.20
4277	0.1 1KV X5	1.98
4278	0.1 1250V X5	2.39
4279	0.1 2KV X1	0.75
4280	0.22 600V X5	1.45
4281	0.22 1KV X1	0.74
4282	0.47 1KV X1	1.02
4283	4700PF 1.5KV X5	1.89
4271	0.01 1KV X5	1.60

SLIDE CONTROLS

4883	100K LIN STD TV	0.55
4884	150K LIN STD TV	0.55
4874	1K LIN STD TV	0.55
4880	22K LIN STD TV	0.55
4881	22K LOG STD TV	0.55
4875	3K3 SEMI LOG STD	0.60
4885	470K LOG STD TV	0.55
4720	470R LG STD	0.99
4719	470R LM STD TV	0.99
4876	4K7 LIN STD TV	0.55
4877	4K7 LOG STD TV	0.55

PRESETS

STANDARD RANGES

VERTICAL STANDARD X 5	0.60
HORIZONTAL STANDARD X 5	0.60
VERTICAL MINI X 5	0.60
HORIXONTAL MINI X 5	0.60

TUNER UNITS

4662	DECCA 30 SERIES MECHANICAL	4.95
4664	ELC 1043/05 EXCH TUNER	6.00
4663	ELC 1043/05 NEW TUNER	8.25
4666	ELC 1043/06 EXCH TUNER	6.00
4665	ELC 1043/06 NEW TUNER	8.25
4972	ELC 2003 EXCH TUNER	12.50
5534	GEC 2100 TYPE REPAIR CHGE	10.25
4675	PHILIPS G8 EXCHANGE TUNER	7.25
4679	RRI RANGER1/2 EXCH TUNER	9.75
4680	RRI 720 NEW TUNER	12.40
4678	RRI RANGER2/3 NEW TUNER	13.15
4668	U321 EXCH TUNER	6.50
4667	U321 TUNER NEW	6.25
4670	U322 EXCHANGE TUNER	6.50
4669	U322 NEW TUNER	7.95
4673	U341 EXCHANGE TUNER	7.25

VALVES

3883	DY802 VALVE	0.75
3932	PCF802 VALVE	0.95
3938	PCL805	1.08
3935	PCL82 VALVE	0.95
3936	PCL84 VALVE	0.85
3937	PCL86 VALVE	0.95
3940	PFL200 VALVE	1.20
3943	PL504 VALVE	1.50
3944	PL508 VALVE	2.06
3945	PL509 VALVE	6.25
3946	PL519	5.95
4870	PL802 VALVE	4.95
3950	PY500A VALVE	2.25
3951	PY801 VALVE	0.95

THORN SPARES

2897	T1590 MAINS TRANSFORMER	9.80
2920	TX10 FOCUS UNIT	7.54
4590	T1600 MAINS TX	7.92
5430	T1690 MAINS TRANSFORMER	9.00
4973	T1690 SLOW MDT. TUN. POT	3.99
2906	T3000/3500 A1 SWITCH	1.68
2904	T3000/3500 MAINS TX	5.00
2908	T3000/3500 METAL CUT OUT	2.34
4587	T3500 100R CONVERG POT	0.85
3277	T3500 200R CONVERG POT	0.56
3278	T3500 500R CONVERG POT	0.56
4585	T3500 50R CONVERG POT	0.65
2905	T3500 5MEG A1 POT	1.17
4589	T3500 SPARK GAP .1/1500	0.51
2907	T3500 THICK FILM VID LOAD	1.55
4563	T38000 MAINS ON/OFF SW.	3.10
4412	T4000 FOCUS CONTROL UNIT	7.60
3273	T6818 220K BRIGHT CTRL	2.18
2909	T8500 FOCUS CONTROL UNIT	2.56
2911	T8500 MAINS CHOKE	17.45
4415	T8500 MAINS TX	12.75
2910	T8500 PLASTIC CUT OUT	3.72
2918	T9000 FOCUS UNIT	4.95
4556	T9000 FR1 THICK FILM	1.65
2919	T9000 OVER VOLT THICK FILM	3.95
4555	T9000 T701 CHOPPER TX	13.75
4982	T9600 0.33 2KV CAP	2.35
2914	T9600 CHOPPER TX T512	8.11
2916	T9600 FOCUS UNIT	2.95
2913	T9600 SWITCH MODE TX T511	9.98
2917	T9800 FOCUS UNIT	5.93
4429	T9800 MAINS CHOKE	11.03
4437	TX10 .0022 2KV	0.25
4658	TX10 100K TUNING POT	0.64
2938	TX10 CHOPPER DRIVER TX	3.27
5427	TX10 SW NONREM CONT.	2.32
2922	TX10 TUNER DRAWER ASSY	1.95
4859	TX9 4" RND 15R SPEAKER	6.95
2937	TX9 INPUT CHOKE L65	12.05
2936	TX9 L64 BILIFAR CHOKE	4.25

DECCA SPARES

4616	DECCA 100 0.01 2KV CAP	0.98
2933	DECCA 100 BEDIGE TX	2.35
2932	DECCA 100 FOCUS CONTROL	2.77
4615	DECCA 100 LINE DRIVE TX	2.25
2928	DECCA 10SER 470K SH+VOL	2.15
4603	DECCA 2230 10R FUSIBLE	0.70
2930	DECCA 2233 PSH PSH SH	5.14
2931	DECCA 2263 PSH PSH SH	4.20
2926	DECCA 30 SER 3R9 RESIS.	0.50
2924	DECCA 30 SER MAINS TX	12.35
2925	DECCA 30 SER 47K SH+VOL	2.45
2939	DECCA 80 470R SH+VOL	2.45

RESISTORS

CARBON
STANDARD RANGES

1/4 WATT X 10	0.29
1/2 WATT X 10	0.29
1 WATT X 10	0.45
2 WATT X 10	0.60

SAFETY CERAMIC
STANDARD RANGES

5 WATT X 5	0.90
7 WATT X 5	0.74
11 WATT X 5	0.89
17 WATT X 5	1.15

OTHER RESISTORS

3279	2M2 H/V FOCUS RESISTOR	0.46
3280	22M H/V FOCUS RESISTOR	1.50
3281	33M H/V FOCUS RESISTOR	1.50
3282	47M H/V FOCUS RESISTOR	1.50
3283	56M H/V FOCUS RESISTOR	1.50

MAINS DROPPERS

3025	MAINS DROPPER RANK A640	1.20
3013	MAINS DROPPER DECCA 80/100	1.60
3016	MAINS DROPPER GEC 2010	0.90
3031	MAINS DROPPER THORN 3600	0.98
3030	MAINS DROPPER THORN 1600	1.45
4910	MAINS DROPPER DECCA 100 2R5	0.82
3034	MAINS DROPPER THORN 9800	1.48
3027	MAINS DROPPER THORN 1400	1.50
3026	MAINS DROPPER RANK A823	1.10
3028	MAINS DROPPER THORN 1300	1.60
3029	MAINS DROPPER THORN 1500	1.75
3018	MAINS DROPPER PHILIPS G8	0.99
3022	MAINS DROPPER PYE 725/731	1.40
3017	MAINS DROPPER PHILIPS 210	0.98
3019	MAINS DROPPER PHILIPS G8 47R	0.65
3033	MAINS DROPPER THORN 8500/8800	0.98
5385	MAINS DROPPER DECCA 80	2.97
5386	MAINS DROPPER DECCA 100	1.88
5533	PYE CT200 PHILIPS 579 DROPPER	3.45

UNIVERSAL CONVERGENCE POTS

5R, 10R, 22R, 20R, 25R, 50R, 75R, 100R, 200R, 250R, 500R 0.48

FIDELITY SPARES

2940	CHOPPER TX FIDELITY CTV14R	4.50
2942	DRIVER TX FIDELITY CTV14R	2.65
2941	FOCUS UNIT FIDELITY CTV14R	0.50
5408	MAINS INPUT CHOKE ZX2000	3.45
5504	MAINS FILTER TX CTV14R	2.95
5505	DRIVER TX ZX3000 404387	2.95
6162	ON/OFF SH FIDELITY CTV14R	2.25
6163	ON/OFF SH FIDELITY CTV14S	1.65

GEC SPARES

2965	GEC 1401 CHOPPER TX	16.56
2964	GEC 1401 INPUT CHOKE	9.63
5531	GEC 1501 MAINS TX	5.25
4758	GEC 2100 3R FUSIBLE RES	1.45
4759	GEC 2110 SH2 2KV CAPS	2.39
2959	GEC 2100 ETC FOCUS VDR	1.60
2958	GEC 2100 THERMAL CUT OUT	0.97
4760	GEC 2110 FOCUS CONTROL	5.98
4771	GEC 2110 LUM. DELAY LINE	1.83
4728	GEC 2110 MAINS CHOKE	10.50
4996	GEC 2110 NEONS	0.20
4751	GEC 2114 VOL+SWITCH CONT	1.98
4656	GEC 22K MULTI TURN POT	0.98

GRUNDIG SPARES

2949	GRUNDIG 5010 FOCUS VDR	3.35
4633	GRUNDIG 5010 CONTROL TX	4.76
2948	GRUNDIG 5010 FOCUS UNIT	3.75
4865	GRUNDIG 5010 L515 CHOKE	1.63
4744	GRUNDIG 5010/6010 LID	2.62
4745	GRUNDIG 5011 LID	2.59
4637	GRUNDIG 5011 SH+SLIDERS	11.69
2952	GRUNDIG 6010 MIXIE MOD	22.50
4630	GRUNDIG 6011 MAINS SH	3.60
4631	GRUNDIG 6110 MAINS SH	4.86
2947	GRUNDIG A6400 MAINS SH	4.95

REMOTE CONTROL UNITS

PLEASE STATE MODEL NUMBER

4311	DECCA 100 NONTEXT RCU	21.50
4314	DECCA 100 (TEST+PREST) RCU	22.28
4310	DECCA 80/100 SERIES RCU	21.76
4315	DECCA 90/100 N/TXT RCU	20.78
4324	GEC 2 FUNCTION RCU	20.25
4325	GEC C2057H/2067H RCU	21.43
4326	GEC TELEMASTER 12 RCU	20.03
4327	GEC TELEMASTER 16 RCU	20.03
4328	GEC TELEMASTER 8 RCU	23.25
4332	GRUNDIG TELEPILOT 12 RCU	30.03
4333	GRUNDIG TELEPILOT 16 RCU	25.05
2955	GRUNDIG TELEPILOT 7	24.95
4334	GRUNDIG TELEPILOT 8 RCU	20.03
4357	KORTING 12 CHANNEL RCU	22.13
4358	KORTING 16 CHANNEL RCU	24.05
4380	PHILIPS G11 NONTEXT RCU	22.52
4378	PHILIPS G11 T/TEXT 8CH RCU	20.78
5409	PHILIPS G11 T/TEXT U/SONIC	25.16
5453	PHILIPS KT3 REMOTE RC4001	16.00
4379	PHILIPS/PYE G11 2 FUNC RCU	18.90
4359	PHILIPS/PYE KT3/KT30	16.13
4385	RBM 16CH NONTEXT RCU	21.95
4386	RBM 8CH NONTEXT RCU	19.20
4387	RBM TEXT&V/DATA RCU	20.78
2980	REMOTE CTRL UNIT PHILIPS G9	9.85
4390	TCE 9000CHAS 2 FUNC RCU	19.20
4398	TCE TX10(9653)+TEXT RCU	24.78
4400	TCE TX10(9670)+PREST RCU	21.78
4397	TCE TX9/TX10	19.20

PUSH BUTTON UNITS

2870	4 WAY DECCA ETC	8.25
2871	6 WAY DECCA	11.78
2873	4 WAY HITACHI ETC	5.50
2875	4 WAY PYE/TCE	10.87
2877	6 WAY GEC 2110	11.25
2878	7 WAY GEC 2112	10.95
2879	6 WAY T3500	2.75
2880	6 WAY PYE 713	15.75
2881	6 WAY T9000	7.25
2882	4 WAY BUSH A823	10.93
2884	6 WAY MOD CVC9	12.85
2885	6 WAY 520 PHILIPS	19.30
2886	6 WAY PHILIPS 550	21.25
2887	T1P SWITCH UNIT PHILIPS G11	27.50
2888	6 WAY PHILIPS G11	11.25
2889	PIANO KEY MOD DECCA 2631	22.48
4935	7 WAY ITT CVC5	12.90
5278	GEC 2136 TAPERED	12.62
5279	ITT 6 WAY +VCR	10.70
5280	6 WAY BUSH T20	13.81

ITT SPARES

2972	ITT CP340 PB ASSY	32.98
4501	ITT CP340 SLIDER ASSY	7.58
4683	ITT CV40 FOCUS UNIT	1.95
5543	ITT CVC20 LINE DRIVE TX	3.05
4571	ITT CVC20 MAINS SWITCH	1.36
4787	ITT CVC25 6N2 2KV CAP	1.35
4786	ITT CVC25 8N2 2KV CAPS	2.15
2970	ITT CVC25 BRIDGE COIL	4.05
4789	ITT CVC25 E/W LOAD COIL	1.92
4567	ITT CVC25/30 MAINS SW.	6.89
2969	ITT CVC32 DRIVER TX	2.55
4568	ITT CVC32 REMOTE MAIN SH	7.67
2971	ITT CVC32 SH MODE TX	5.00
4795	ITT CVC45 ON/OFF SWITCH	2.09
3286	ITT CVC5 1MFD 250V CAP	0.40
4569	ITT CVC5 MAINS SWITCH	1.85
4781	ITT CVC5 SHIFT POT 25R	1.82
4780	ITT CVC5 SLIDER BANK	7.41
2967	ITT CVC5-9 MAINS TX	8.48
4570	ITT CVC9 MAINS SWITCH	5.61

FUSES

STANDARD RANGES

20MM Q/B FUSE X 10	0.66
20MM A/S FUSE X 10	
63MA - 160MA	1.80
200MA - 5A	1.20
1.25" Q/B FUSE X10	
250MA - 800MA	0.95
1A - 5A	0.70
1.25" A/S FUSE X 10	
250MA - 2A	1.50
2.5A - 5A	2.30
PLUG TO P FUSE X 10	
2, 3, 5, 7, 10, 13A	0.95

SERVICE MANUALS

5011	DECCA 101/100	6.00
5047	DECCA 80 CHASIS	6.00
5442	DECCA/TATUNG 120	7.00
5022	GEC C2055H-C2255H	6.00
5023	GEC C2065H-C2265H	4.95
5026	GEC C2110-C2149	6.00
5068	HITACHI CPT2024	5.00
5074	HITACHI CPT2234	5.00
5094	ITT CVC20	4.00
5095	ITT CVC25+30	9.00
5096	ITT CVC40	9.00
5097	ITT CVC45/1	5.00
5513	ITT CVC800/801	5.00
5093	ITT CVC9	4.00
5123	MITSUBISHI CT200B	5.00
5527	PANASONIC TC2205	9.00
5116	PANASONIC TX2234	5.00
5127	PHILIPS G11 CHASSIS	4.00
5126	PHILIPS G8 CHASSIS	6.00
4515	PHILIPS KT3 SERV.	5.00
5135	PHILIPS T8-E	2.00
5136	PHILIPS TX	2.00
5143	PYE 725 731 SER	5.00
5145	REOIFFUSION MK1	3.00
5146	REDIFFUSION MK3	3.00
5147	REDIFFUSION MK4	5.00
5148	REDIFFUSION MK5	4.00
5167	THORN 1500	1.00
5168	THORN 1600	1.50
5171	THORN 1615	3.00
5172	THORN 1690-1691	5.00
5184	THORN 38030	2.00
5187	THORN 3V01	12.00
5188	THORN 3V16	12.00
5178	THORN 9000	6.00
5182	THORN 9800	10.00

RANK RADIO SPARES

4650	RRI T20 SPEAKER	2.36
5624	RRI T24E ON/OFF + VOL SH	2.35
4842	RRI 1122 SH+VOL 22K PULL	3.10
4843	RRI A823 100K TUNER POT	1.78
4847	RRI A823 FOCUS ASSEMBLY	6.03
2998	RRI A823 PLASTIC CAM	0.35
5300	RRI A823ETC RING SPK GAP	0.55
4988	RRI T20 (TYPE) FOCUS ASY	0.60
3001	RRI T20 3K3 SH+VOL CTRL	2.67
4852	RRI T20 9N1 2KV CAP.	1.98
4853	RRI T20 CONTRAST+AFC POT	3.23
3003	RRI T20 E/W CORR COIL	3.29
3000	RRI T20 FOCUS ASSY	5.69
3004	RRI T20 SH MODE TX	11.20
4849	RRI 2718 3K3 SH+VOLUME	3.36

PHILIPS PYE SPARES

4969	PHILIPS 128711 4K7 VOL+SH	4.45
3288	PHILIPS 300 470L VOL+SWITCH	3.25
4449	PHILIPS 570/713 IF MODULE	7.00
5425	PHILIPS CTX-S EHT LEAD	10.11
5418	PHILIPS CTX-S FOCUS UNIT	5.50
4655	PHILIPS G11 100K TUNER POT	0.66
2983	PHILIPS G11 CVC32 B/COIL	1.95
2984	PHILIPS G11 E/W CORR COIL	2.64
2985	PHILIPS G11 FILTER COIL	12.80
2986	PHILIPS G11 FOCUS UNIT	9.15
2987	PHILIPS G11 G2 CONTROL ASSY	7.98
4575	PHILIPS G11 RND SHAFT SH.	2.32
4576	PHILIPS G11 SQ SHAFT SWITCH	2.32
4645	PHILIPS G11 TDA2600 HOLDER	0.65
5284	PHILIPS G8 100K TUN P/SET	0.84
2977	PHILIPS G8 10K COLOUR CTRL	0.98
4525	PHILIPS G8 10K CON POT (550)	0.87
4524	PHILIPS G8 15R CON POT (550)	1.07
2975	PHILIPS G8 2K2 BRIGHT CONTL	2.11
4526	PHILIPS G8 2H A1 POT (550)	3.80
4522	PHILIPS G8 5N1 1500V CAP.	1.88
4523	PHILIPS G8 5R CONV POT (550)	0.64
4858	PHILIPS G8 6×4" 70R SPKR	5.98
2979	PHILIPS G8 EQUALIS COIL	3.20
4503	PHILIPS G8 METAL SH	1.72
2978	PHILIPS G8 RED/GRW SYM COIL	4.63
4504	PHILIPS G8/G11 NON REM SH	1.72
5307	PHILIPS K12 THICK FILM UNIT	14.99
4649	PHILIPS KT3 4X4 SPEAKER	2.85
4566	PHILIPS KT3 MAINS SWITCH	8.60
4907	PHILIPS KT4 THICK FILM UNIT	10.29
4564	PHILIPS T173 MAINS SWITCH	3.45
4648	PHILIPS G11 6X4 SPEAKER	3.85
2992	PYE 169 LINE OSC COIL	3.45
4839	PYE 731 3R3 50W RESISTOR	1.98
4535	PYE 731 47K VOL. SWITCH	5.25
2992	PYE 731 FOCUS UNIT	3.45
5545	PYE 731 L/H 3X 100K PSET	3.20
5546	PYE 731 R/H 3X 100K PSET	3.20
2994	PYE 731 THICK FILM ASSY	1.55
4938	PYE KT2 FOCUS UNIT	2.85
4864	PYE T194/6 SPEAKER	5.05
5556	PHILIPS G11 SHORT SHAFT SH	2.01

THORN VIDEO SPARES (OVER 450 PARTS)

QUOTE THORN PART NUMBER IF POSSIBLE

5561	T3292 BOOSTER	44.62
5562	T3292 CAPSTAN BELT	3.48
5563	T3292 CAPSTAN MOTOR	51.16
5568	T3292 CASSETTE LAMP	1.80
5569	T3292 COUNTER BELT1	0.60
5571	T3292 COUNTER BELT2	0.60
5575	T3292 DRUM MOTOR	47.70
5577	T3292 F/F IDLER	2.02
5582	T3292 GUIDE ROLL. ASSY	11.40
5585	T3292 LOWER DRUM ASY	80.48
5587	T3292 PINCH ROLL. ASSY	11.45
5591	T3292 REWIND IDLER ASSY	7.04
5592	T3292 REWIND RUBBER TYRE	0.60
5621	T3292 UNLDADING BELT	0.78
5622	T3292 UNLDADING IDL ASSY	6.43
5624	T3292 UPP/DRUM KIT+MOD	35.94
5629	T3V00 CAPS MOTOR BELT	0.60
5635	T3V00 COUNTER BELT 1	0.60
5637	T3V00 DRUM MOTOR	49.39
5646	T3V00 PINCH ROLLER ASSY	7.31
5648	T3V00 RECORDING LAMP	2.34
5650	T3V00 SERVICE MANUAL	17.57
5655	T3V00 T/U IDLER ASSY	6.35
5657	T3V00 UPPER DRUM+MOD KIT	35.94
5663	T3V16 PINCH ROLLER ASSY	7.31
5666	T3V00 CAPSTAN MOTOR	51.16
5688	T3V00 TENSION BAND	2.16
5689	T3V00 TIMING GEAR	4.12
5692	T3V00 UNLOADING IDLER ASSY	6.43
5710	T3V01 TENSION BAND	2.16
5716	T3V16 CAPSTAN BENT	3.85
5720	T3V16 CASSETTE LAMP	1.80
5721	T3V16 CHANGE GEAR	0.86
5726	T3V16 DIODE STACK	3.41
5727	T3V16 DRIVE ARM ASSY	4.50
5750	T3V16 SERVICE MANUAL	26.24
5758	T3V16 T/U IDLER ASSY	6.25
5759	T3V16 T/U IDLER ASSY (LA)	8.95
5765	T3V16 UNLOADING IDLER	6.43
5772	T3V22 CAPSTAN MOTOR	51.16
5773	T3V22 CAPSTAN MOTOR BAND	0.60
5774	T3V22 CAPSTAN BELT	3.86
5790	T3V22 F/F IDLER	1.74
5803	T3V22 GUIDE ROLLER ASSY	8.39
5807	T3V22 MICRO SWITCH	4.25
5809	T3V22 PINCH ROLLER ASSY	7.31
5814	T3V22 REWIND IDLER ASSY	7.04
5822	T3V22 SUPP SPOOL CARRIER	4.00
5824	T3V22 TAKE UP IDLER SMALL	6.25
5825	T3V22 TAKE UP IDLER LARGE	8.95
5828	T3V22 TENSION BAND	2.16
5834	T3V22 UPPER DRUM ASSY	35.94
5840	T3V23 BOOSTER	24.71
5844	T3V23 CAPSTAN MOTOR	55.83
5852	T3V23 CONNECT GEAR ASSY	6.56
5856	T3V23 GUIDE ROLLER TYRE	0.60
5862	T3V23 PINCH ROLLER ARM AS	4.10
5868	T3V23 REEL IDLER ASSY	2.87
5869	T3V23 REEL MOTOR ASSY	32.81
5879	T3V23 T/U REEL DISK ASSY	5.17
5880	T3V23 TAKE UP REEL ASSY	2.58
5882	T3V23 UPPER DRUM ASSY	35.94
5885	T3V23 WORM GEAR SPINDLE	5.95
5886	T3V23 WORM GEAR SPROCKET	1.63
5888	T3V24 BRAKE SHOE	0.60
5896	T3V24 CASSETTE LAMP	1.80
5899	T3V24 DEW SENSOR ASSY	9.05
5902	T3V24 F/ERASE HEAD ASSY	10.41
5908	T3V24 LOADING GEAR ASSY	28.91
5909	T3V24 LOADING MOTOR	10.25
5912	T3V24 PINCH RLR LVR ASSY	0.62
5920	T3V24 SERVICE MANUAL	28.50
5945	T3V29/30 BOOSTER	24.71
5946	T3V29/30 BRAKE SHOE	0.67
5951	T3V29/30 CAPSTAN BELT	1.95
5952	T3V29/30 CAPSTAN MOTOR ASSY	36.88
5957	T3V29/30 CASSETTE LAMP	1.65
5962	T3V29/30 EJECT LCK ARM	0.60
5974	T3V29/30 LOADING MOTOR	10.25
5976	T3V29/30 LOHR DRUM ASSY	78.72
5980	T3V29/30 PINCH RLLR ASSY	8.66
5981	T3V29/30 PINCH RLLR SLND	10.75
5985	T3V29/30 REEL MTR ASSY	34.66
5990	T3V29 SERVICE MANUAL	25.85
5991	T3V30 SERVICE MANUAL	15.75
5998	T3V29/30 TAKE UP CLUTCH	0.60
5999	T3V29/30 T/U CLUTCH ASSY	2.78
6001	T3V29/30 T/U LDG RING ASSY	2.73
6003	T3V29/30 T/U SPL IDLER	2.60
6012	T3V31 BOOSTER	32.37
6016	T3V31 CAPSTAN BELT	1.95
6017	T3V31 CASSETTE LAMP	1.71
6027	T3V31 LOADING GEAR ASSY	6.60
6028	T3V31 LONG TRIMMING TOOL	0.93
6030	T3V31 PINCH ROLLER ASSY	8.66
6033	T3V31 SERVICE MANUAL	27.31
6034	T3V31 SERVO TEST JIG	49.94
6038	T3V31 TAKE UP CLUTCH ASSY	2.75
6039	T3V31 T/U LOAD/RING ASSY	2.73
6042	T3V31 UPPER DRUM ASSY	35.94
6044	T3V32 BOOSTER	32.37
6048	T3V32 CAPSTAN BELT	1.95
6053	T3V32 CASS MOTOR ASSY	9.45
6066	T3V32 LOADING GEAR ASSY	6.60
6068	T3V32 PINCH ROLLER ASSY	8.66
6071	T3V32 SERVICE MANUAL	18.65
6072	T3V32 SUPP/LDG RING ASSY	2.58
6081	T3V32 UPPER DRUM ASSY	35.94
6085	T3V35/6 BRAKE PAD X2	0.67
6086	T3V35/6 BRAKE SHOE	0.67
6087	T3V35/6 BRUSH ASSY	2.07
6090	T3V35/6 CAPSTAN MOTOR	23.91
6091	T3V35/6 CASSETTE MOTOR	8.10
6103	T3V35/6 PINCH ROLLER	9.84
6105	T3V35 REMOTE CONTROL	19.43
6107	T3V35/6 SERVICE MANUAL	27.00
6117	T3V35/6 TENSION BRAKE	0.60
6118	T3V35/6 UPPER DRUM ASSY	35.94
6119	T3V40 SERVICE MANUAL	15.00
6158	T3V29/30 UPPER DRM ASSY	35.94

SONY VIDEO

6133	SONY 8000UB FORWARD BELT	1.20
6136	SONY C6UB THREADING BELT	1.20
6138	SONY C6UB CAPSTAN BELT	1.77
6145	SONY C7UB BRAKE ASSEMBLY	1.77
6150	SONY C5UB CAPSTAN MOTOR	38.75
6152	SONY C6UB MK2 REEL MTR	23.00
6154	SONY C7 DC MTR (BHF/1100)	38.75
6155	SONY C7UB REMOTE CONTROL	43.75
6156	SONY C5UB REMOTE CONTROL	20.63
6157	SONY C6UB REMOTE CONTROL	18.13
4953	SONY C5/7 REWIND KIT	5.40
4954	SONY C6 REWIND KIT	5.40
4948	SONY SL-7/SL-T7 BELT KIT	4.00
4944	SONY SLC7/SLJ7 BELT KIT	5.50
4949	SONY SLT 9ME/J9 BELT KIT	4.50

GEC

6173	V4000H UPPER CYLINDER	40.50
6174	V4000H RELAY	4.12
6175	V4000H PINCH ROLLER	7.44
6178	V4000H CAPSTAN MOTOR	38.78
6181	V4000H TAPE SENSOR LAMP	0.79
6185	V4001H PINCH ROLLER	5.81
6192	V4002H UPPER CYLINDER	40.50
6204	V4004 CLUTCH ASSY	11.18
6212	V4100 AUDIO CONTROL	28.13
6253	V4000H SERVICE MANUAL	10.50
6254	V4001H SERVICE MANUAL	8.31
6255	V4002H SERVICE MANUAL	11.08
6256	V4004 SERVICE MANUAL	11.50
6257	V4100 SERVICE MANUAL	8.31

HITACHI VIDEO SPARES

6214	8000 UPPER CYLINDER	38.99
6218	8000 AUDIO CONTROL	23.85
6220	8000 F/FWD REWIND ASSY	0.69
6224	9300E RELAY	3.30
6230	9300E TAPE SENSOR LAMP	0.95
6231	9300E TUNER	18.21
6240	VT33E UPPER CYLINDER	38.99
6244	VT33E CAPSTAN MOTOR	27.72
6249	VT11E F/FWD REWIND ARM	4.85
6252	VT11E CAPSTAN MOTOR	23.63

VIDEO HEADS

SEE FULL LIST FOR COMPARISON CHART

6258	BETA – A VIDEO HEAD	40.50
6259	BETA – B VIDEO HEAD	40.50
6265	VHS – A VIDEO HEAD	33.50
6266	VHS – A VIDEO HEAD	32.50
6274	PHILIPS H1500 VIDEO HEAD	50.95
6275	PHILIPS H1700/2 VIDEO HEAD	66.20
6276	PHILIPS 2020/2 VIDEO HEAD	57.95
6277	PHILIPS 2030 VIDEO HEAD	53.98

GENERAL SPARES

4999	ANTEX BIT 1/8" DIAMETER	1.45
5000	ANTEX BIT 3/16" DIAMETER	1.45
4452	ATTENUATOR 12DB	1.68
4469	ATTENUATOR 18DB	1.37
4451	ATTENUATOR 6DB	1.38
5419	COLOUR CRYSTAL 8.86MHz	0.60
4659	HEAT SINK COMPOUND	1.08
5001	QUICK TEST MAINS CONN	9.30
4700	SERVISOL FOAM CLEANER	1.05
4453	SERVISOL FREEZE-IT	1.15
4724	SERVISOL SW CLEANER	1.05
4516	SERVISOL VIDEO HEAD CLEANER	0.95
4976	SOLDER 0.5 KILO REEL	8.60
4466	SUPER WICK 2MMX1.6M	0.99
4970	TV LOOP AERIAL	0.55
4998	WELLER INST HEAT GUN TIP	0.68

PLEASE ADD £1.25 POST & HANDLING THEN 15% VAT TO TOTAL.

QUICK SAVE TV SPARES

THE COACH HOUSE, MUXTON LANE, TELFORD, SALOP

FULL LIST OF OVER 3000 ITEMS SENT WITH ORDER OR SEND 9" × 4" SAE. PLEASE USE STOCK NUMBER WHEN ORDERING, OR USE SET MAKER'S PART NUMBER. ACCESS AND VISA ACCEPTED. OFFICIAL ORDERS FROM GOVERNMENT OR SCHOOLS WELCOMED. ALL GOODS ARE STOCK ITEMS.

£1 BAKERS DOZEN PACKS

Price per pack is **£1.00.*** Order 12 you may choose another free. Items marked (sh) are not new but guaranteed ok.

1. 5 – 13 amp ring main junction boxes
2. 5 – 13 amp ring main spur boxes
4. 5 – surface mounting light switches
5. 3 – electrical switches intermediate type, will also replace 1 or 2 way switches, white flush mounting
7. 4 – in flex line switches with neons
9. 2 – mains transformers with 6V 1A secondaries
10. 2 – mains transformers with 12V ½A secondaries
11. 1 – extension speaker cabinet for 6½" speaker
13. 12 – glass reed switches
17. 2 – ultrasonic transmitters and 2 receivers with circuit
19. 2 – light dependent resistors
25. 4 – wafer switches – 6p 2 way, 4p 3 way, 2p 6 way, 2p 5 way, 1p 12 way small one hold fixing and good length ¼ spindle your choice
28. 1 – 6 digit counter mains voltage
30. 2 – Nicad battery chargers
31. 1 – key switch with key
33. 2 – aerosol cans of ICI Dry Lubricant
34. 48 – 2 metre lengths colour-coded connecting wire
39. 1 – long and medium wave tuner kit
41. 8 – rocker switch 10 amp mains SPST
45. 1 – 24 hour time switch mains operated
49. 10 – neon valves – make good night lights
50. 2 – 12V DC or 24V AC, 3 CO relays
51. 1 – 12V 2 CO miniature relay very sensitive
52. 1 – 12V 4 CO miniature relay
53. 2 – mains operated relays 3 × 8 amp changeover (s.h.)
54. 10 – rows of 32 gold plated IC sockets (total 320 sockets)
55. 1 – locking mechanism with 2 keys
56. 1 – miniature uniselector with circuit for electric jigsaw puzzle
60. 5 – ferrite rods 4" × 5/16" diameter aerials
61. 1 – Mullard thyristor trigger module
66. 1 – magnetic brake – stops rotation instantly
67. 1 – low pressure 3 level switch can be mouth operated
69. 2 – 25 watt pots 8 ohm
70. 2 – 25 watt pots 1000 ohm
71. 4 – wire wound pots – 18, 33, 50 and 100 ohm your choice
77. 1 – time reminder adjustable 1-60 mins clockwork
85. 1 – mains shaped pole motor ¾" stack – ¼ shaft
89. 1 – mains motor with gear box 1 rev per 24 hours
91. 2 – mains motors with gear box 16 rpm
96. 1 – thermostat for fridge
98. 1 – motorised stud switch (s.h.)
101. 1 – 2½ hours delay switch
102. mains PSU 9V
103. 1 – mains power supply unit – 6V DC
104. 1 – mains power supply unit – 4½V DC
107. 1 – 5" speaker size radio cabinet with handle
111. 2 – musical boxes (less keys)
112. 1 – heating pad 200 watts mains
114. 1 – 1W amplifier Mullard 1172
115. 1 – wall mounting thermostat 24V
118. 1 – teak effect extension 5" speaker cabinet
120. 2 – p.c. boards with 2 amp full wave and 17 other recs
121. 4 – push push switches for table lamps etc.
122. 10 – mtrs twin screened flex white p.v.c. outer
124. 25 – clear plastic lenses 1¾ diameter
127. 4 – pilot bulb lamp metal clip on type
128. 10 – very fine drills for pcbs etc
129. 4 – extra thin screw drivers for instruments
132. 2 – plastic boxes with windows, ideal for interrupted beam switch
134. 10 – model aircraft motor – require no on/off switch, just spin to start
136. 2 – car radio speakers 5" round 4 ohm made for Radiomobile
137. 1 – 6½" 4 ohm 10 watt speaker and 3" tweeter
142. 10 – 4BA spanners 1 end open, other end closed
145. 2 – 4 reed relay kits 3V coil normally open or c/o if magnets added
146. 20 – pilot bulbs 6.5V 3A Philips
154. 1 – 12V drip proof relay – ideal for car jobs
155. 3 – varicap push button tuners with knobs
169. 4 – short wave air spaced trimmers 2-30f
172. 10 – 12V 6W bulbs Philips m.e.s.
178. 3 – oblong amber indicators with liliputs 12V
180. 6 – round amber indicators with neons 240V
181. 100 – p.v.c. grommets ⅜ hole size
182. 1 – short wave tuning condenser 50 pf with ¼" spindle
184. 1 – three gang tuning condenser each section 500 pf with trimmers and good length ¼" spindle
188. 1 – plastic box sloping metal front, 16 × 95mm average depth 45mm
193. 6 – 5 amp 3 pin flush sockets brown
195. 5 – B.C. lampholders brown bakelite threaded entry
196. 1 – in flex simmerstat for electric blanket soldering iron etc.
197. 2 – thermostats, spindle setting – adjustable range for ovens etc.
199. 1 – mains operated solenoid with plunger 1" travel
200. 1 – 10 digit switch pad for telephones etc.
201. 8 – computer keyboard switches with knobs, pcb or vero mounting
206. 20 – mtres 80 ohm, standard type co-ax off white
211. 1 – electric clock mains driven, always right time – not cased
216. 1 – stereo pre-amp Mullard EP9001
232. 2 – 12V solenoids, small with plunger
236. 1 – mains transformer 9V 1 amp secondary C core construction
241. 1 – car door speaker (very flat) 6½" 15 ohm made for Radiomobile
241. 2 – speakers 6" × 4" 4 ohm 5 watt made for Radiomobile
242. 2 – speakers 6" × 4" 16 ohm 5 watt made for Radiomobile
244. 1 – mains motor with gear-box very small, toothed output 1 rpm
245. 4 – standard size pots, ½ meg with dp switch
249. 1 – 13A switched socket on double plate with fused spur for water heater etc.
266. 2 – mains transformers 9V ½A secondary split primary so ok also for 115V
267. 1 – mains transformers 15V 1A secondary p.c.b. mounting
291. 1 – ten turns 3 watt pot ¼ spindle 100 ohm
296. 3 – car cigar lighter socket plugs
298. 2 – 15 amp round pin plugs brown bakelite
300. 1 – mains solenoid with plunger compact type
301. 10 – ceramic magnets Mullard 1" × 3/8 × 5/16
303. 1 – 12 pole 3 way ceramic wave charge switch
304. 1 – stereo amp 2W per channel
305. 1 – tubular dynamic microphone with desk rest
308. 1 – T.V. turret tune (black & white T.V.)
310. 2 – oven thermostats
313. 5 – sub miniature micro switches
316. 1 – round pin kettle plug with moulded on lead

MULLARD UNILEX AMPLIFIERS

We are probably the only firm in the country with these now in stock. Although only four watts per channel, these give superb reproduction. We now offer the 4 Mullard modules – i.e. Mains power unit (EP9002) Pre amp module (EP9001) and two amplifier modules (EP9000) all for **£6.00** plus £2 postage. For prices of modules bought separately see TWO POUNDERS.

CAR STARTER/CHARGER KIT

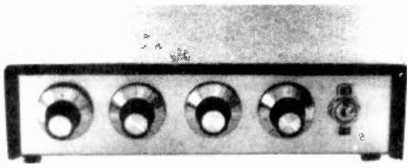
Flat Battery! Don't worry you will start your car in a few minutes with this unit – 250 watt transformer 20 amp rectifiers, case and all parts with data **£16.50** or without case **£15.00** post paid.

Ex-Electricity Board. Guaranteed 12 months.

VENNER TIME SWITCH

Mains operated with 20 amp switch. One on and one off per 24 hrs. repeats daily automatically correcting for the lengthening or shortening day. An expensive time switch but you can have it for only **£2.95** without case, metal case – **£2.95**, adaptor kit to convert this into a normal 24hr time switch but with the added advantage of up to 12 on/offs per 24hrs. This makes an ideal controller for the immersion heater Price of adaptor kit is **£2.30.**

SOUND TO LIGHT UNIT

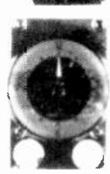


Complete kit of parts of a three channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an attractive two tone metal case and has controls for each channel, and a master on/off. The audio input and output are by ¼" sockets and three panel mounting fuse holders provide thyristor protection. A four pin plug and socket facilitate ease of connecting lamps. Special price is **£14.95** in kit form.

12 volt MOTOR BY SMITHS

Made for use in cars, etc. these are very powerful and easily reversible. Size 3½" long by 3" dia. They have a good length of ¼" spindle –
1/10 hp **£3.45**
1/8 hp **£5.75.** 1/6 hp **£7.50**

25A ELECTRICAL PROGRAMMER



Learn in your sleep. Have radio playing and kettle boiling as you wake – switch on lights to ward off intruders – have a warm house to come home to. You can do all these and more. By a famous maker with 25 amp on/off switch. A beautiful unit at **£2.50**

THIS MONTH'S SNIP

100 Mains Transformers for only **£45.** Tax and carriage paid. Your choice from:– 6 volt 1 amp, 9 volt 1 amp, 12 volt ½ amp. Mix them as you like.

MAKING SUNBEDS?

CHOKE AND STARTER for 6' 100uva tube **£2**, post £1 for 1 or 50p each in quantity.
TUBE HOLDERS Canopy type spring loaded, 4 pairs for £1, 100 pairs **£20,** 1,000 pairs **£150,** post paid.

TANGENTIAL HEATERS

We again have very good stocks of these quiet running instant heat units. They require only a simply case, or could easily be fitted into the bottom of a kitchen unit or book case etc. At present we have stocks of 1.2kw, 2kw, 2.5kw, and 3kw. Prices are **£5** each for the first 3, and **£6.95** for the 3k. Add post £1.50 per heater if not collecting
CONTROL SWITCH enabling full heat, half heat or cold blow, with connection diagram, 50p for 2kw, 75p for 3kw.

FANS & BLOWERS

Woods extractors
5" **£5** + £1.25 post 6" **£6** + £1.50 post
4" × 4" Muffin equipment cooling fan 115V **£2.00**
4" × 4" Muffin equipment cooling fan 230/240V **£5**
5" Plannair extractor **£5.50**
9" Extractor or blower 115V supplied with 230 to 115V adaptor **£9.50** + £2 post.
All above are ex computers but guaranteed 12 months.
10" × 3" Tangential Blower. New. Very quiet – supplied with 230 to 115V adaptor on use two in series to give long blow **£2.00** + £1.50 post or **£4.00** + **£2.00** post for two.

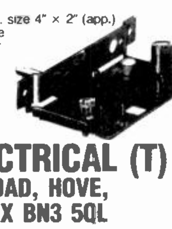
IONISER KIT

Refresh your home, office, shop, work room etc. with a negative ION generator. Makes you feel better and work harder – a complete mains operated kit, case included **£11.95** plus £2.00 post.

TELEPHONE BITS

Master sockets (has surge arrestor – ringing condenser etc) and takes B.T. plug **£3.95**
Extension socket **£2.95**
Dual adaptors (2 from one socket) **£3.95**
Cord terminating with B.T. plug 3 metres **£2.95**
Kit for converting old entry terminal box to new B.T. master socket, complete with 4 core cable, cable clips and 2 BT extension sockets **£11.50**

MINI MONO AMP on p.c.b. size 4" × 2" (app.)



Fitted volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amp. Brand new, perfect condition, offered at the very low price of **£1.50 each, or 13 for £12.00**

J & N BULL ELECTRICAL (T)

128 PORTLAND ROAD, HOVE, BRIGHTON, SUSSEX BN3 5QL

MAIL ORDER TERMS: Cash, P.O. or cheque with order Orders under £20 add £1 service charge. Monthly account orders accepted from schools and public companies. Acces & B/card orders accepted. Brighton 0273 734648. **Bulk orders:** write for quote.

OVER 400 GIFTS YOU CAN CHOOSE FROM

There is a total of over 400 packs in our Baker's dozen range and you become entitled to a large free gift with each dozen pounds you spend on these packs. A classified list of these packs and our latest "News Letter" will be enclosed with your goods, and you will automatically receive our next news letter.

£2 POUNDERS*

2P2 – Wall mounting thermostat, high precision with mercury switch and thermometer
2P3 – Variable and reversible 8-12V psu for model control
2P4 – 24 volt psu with separate channels for stereo made for Mullard UNILEX
2P6 – 100W mains to 115V auto-transformer with voltage tappings
2P8 – Mains motor with gear box and variable speed selector. Series wound so suitable for further speed control
2P9 – Time and set switch. Boxed, glass fronted and with knobs. Controls up to 15 amps. Ideal to program electric heaters
2P10 – 12 volt 5 amp mains transformer – low volt winding on separate bobbin and easy to remove to convert to lower voltages for higher currents
2P12 – Disc or Tape precision motor – has balanced rotor and is reversible 230V mains operator 1500 rpm
2P14 – Mug Stop kit – when thrown emits piercing swawk
2P15 – Interrupted Beam kit for burglar alarms, counters, etc
2P17 – 2 rev per minute mains driven motor with gear box, ideal to operate mirror ball
2P18 – Liquid/gas shut off valve mains solenoid operated
2P19 – Disco switch-motor drives 6 or more 10 amp change over micro switches supplied ready for mains operation
2P20 – 20 metres extension lead, 2 core – ideal most Black and Decker garden tools etc
2P21 – 10 watt amplifier, Mullard module reference 1173
2P22 – Motor driven switch 20 secs on or off after push
2P24 – Clockwork operated 12 hour switch 15A 250V with clutch
2P26 – Counter resettable mains operated 3 digit
2P27 – Goodmans Speaker 6 inch round 8 ohm 12 watt
2P28 – Drill Pump – always useful couples to any make portable drill
2P31 – 4 metres 98 way interconnecting wire easy to strip
2P32 – Hot Wire amp meter – 4½ round surface mounting 0-10A – old but working and definitely a bit of history
2P34 – Solenoid Air Valve mains operated
2P38 – 200 R P M Geared Mains Motor 1" stack quite powerful, definitely large enough to drive a rotating aerial or a tumbler for polishing stones etc.
2P43 – Small type blower or extractor fan, motor inset so very compact, 230V
2P46 – Our famous drill control kit complete and with prepared case
2P47 – Telephone ringing unit reduces mains to 50 volts and changes frequency from 50 hz to 25 hz to give right ringing tone
2P49 – Fire Alarm break glass switch in heavy cast case
2P51 – Stereo Headphone amplifier, with pre-amp
2P55 – Mains motor, extra powerful has 1½" stack and good length of spindle
2P62 – 1 pair Goodlans 15 ohm speakers for Unilox
2P64 – 1 five bladed fan 6½" with mains motor
2P66 – 1 2kw tangential heater 115v easily convertible for 230V
2P67 – 1 12v-0-12v 2 amp mains transformer
2P68 – 1 15v-0-15v 2 amp mains transformer
2P69 – 1 250v-0-250v 60 mA & 6 3v.5A mains transformer + £1 post
2P70 – 1 E.M.I. tape motor two speed and reversible
2P72 – 1 115v Muffin fan 4" × 4" approx
2P75 – 1 2 hour timer, plugs into 13A socket
2P82 – 9v-0-9v 2 amp mains transformer
2P84 – Modem board with press keys for telephone redialler
2P85 – 20v-0-20v ½A Mains transformer
2P88 – Sangamo 24 hr time switch 20 amp S H
2P89 – 120 min. time switch with knob
2P90 – 90 min. time switch with edgewise engraved controller
2P91 – Panel meter size 2½" × 2" scaled power factor
2P95 – 13A socket on satin chrome plate very superior G E C
2P97 – mains transformer 24v 2A upright mounting
2P98 – 20m 4 core telephone cable, white outer
2P99 – 500 hardened pin type staples for telephone cable
2P101 – mains transformer 15v 4A upright mounting
2P105 – capillary type thermostat adjustable for air temperatures with 10A c/o switch
2P107 – membrane keyboard, telephone type superior plug in type
2P108 – mains motor with gear box giving 110rpm
2P109 – 5" wide black adhesive pvc tape 33m, add £1 post if not collecting
2P111 – ITT line output unit
2P112 – 6 volt 200MA Voltage regulator PSU for 13 amp socket
2P113 – 9 volt 200MA Voltage regulator PSU for 13 amp socket
2P114 – 12 volt 200MA Voltage regulator PSU for 13 amp socket
2P116 – FM front end with tuning capacitor and F.M circuitry
2P118 – 30rpm mains motor with gearbox
2P119 – Under carpet switch mat for burglar alarm etc.

£5 POUNDERS*

5P1 12 volt submersible pump complete with a tap which when brought over the basin switches on the pump and when pushed back switches off, an ideal caravan unit
5P2 Sound to light kit complete in case suitable for up to 750 watts.
5P3 Silent sentinel ultra sonic transmitter and receive kit, complete
5P5 250 watt isolating transformer to make your service bench safe, has voltage adj. taps, also as it has a 115v tapping it can be used to safely operate American or other 115v equipment which is often only insulated to 115V Please add £3 postage if you can't collect as this is a heavy item.
5P6 12V alarm bell with heavy 6" gong, suitable for outside if protected from direct rainfall. Ex GPO but in perfect order and guaranteed.
5P15 Uniselector 5 pole 25 way 50 volt coil
5P18 motor driven water pump as fitted to many washing machines
5P20 2 kits, matchbox size, surveillance transmitter and FM receiver
5P23 miniature (appr. 2½" wide) tangential blow heater, 1 2kw
5P24 ¼hp motor, ex computer, 230v, mains operation 1450rpm If not collect add £3 post
5P25 special effects lighting switch Up to 6 channels of lamps can be on or off for varying time periods
5P26 Audax woofer 8" 8 ohm 35 watt
5P27 cartridge player 12v, has high quality stereo amplifier
5P28 gear pump, mains motor driven with inlet and outlet pipe connectors
5P32 large mains operated push or pull solenoid. Heavy so add £1.50 post
5P34 24v 5A toroidal mains transformer
5P35 modem board from telephone auto dialler, complete with keypad and all ICs
5P37 24 hour time switch, 2 on/offs and clockwork reserve, ex. Elec. Board loading up to 50A. Add £1 post
5P41 5" extractor fan, very quiet runner sh, gntd 12 mths
5P45 pack of 6 cooker clock switches
5P48 telephone extension bell in black case, ex-GPO
5P50 box of 20 infra red quartz glass enclosed 360w heating elements
5P51 200w auto transformer 230v to 115v toroidal
5P52 mains transformer 26v 10A upright mounting, add £2 post
5P54 mains motor with gear box, final speed 5rpm
5P58 Amstrad stereo tuner FM and LM and S AM
5P60 DC Muffin type fan 18w to 27v, only 3w
5P61 drill pump mounted on frame, coupled to mains motor
5P62 2½kw tangential blow heater, add £1.50 post if not collecting
FP69 Fluorescent light box for viewing BCB's or can be used for shop window sign

LIGHT CHASER KIT

Motor driven switch bank with connection diagram, used in connection with 4 sets of X-mas lights makes a very eye catching display for home, shop or disco, **only £5** ref 5P56.

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BARCLAYCARD VISA — Access

NEW 1986 CATALOGUE is now available – range of components greatly increased – over 136 pages fully illustrated. Price £1.00 per copy (free upon request with orders over £15). Includes 50p Credit Note, Special Offer Sheets, Order Form and Pre-Paid Envelope. Order your copy now – will be sent within 7 days.

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DIODES VOLUME 2	£9.75
Both volumes	£18.70
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I.C. LIN VOLUME 1	£5.95
I.C. LIN VOLUME 2	£5.99
Both volumes	£9.99
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TRANSISTORS 2N-3N	£5.10
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Idler Kit SLC5.SLC7 (Rewind Kit)	A-670-634-8A	£4.80
SLC6 (Rewind Kit)	A-670-639-1A	£3.06
Video Head SLC9UB	A-676-208-8A	£45.05
SLC5/C6/C7	A-676-212-9A	£43.05
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Power Switch KV General	1-554-820-11	£5.50

Diodes ICs Thyristors Belts Transistors Switches Remote Controls Instruction & Service Manuals

OCTOBER SPECIAL
HELPING HANDS WITH MAGNIFIER
NORMALLY £7.95
ONLY £3.99

SOLDERING SECTION

Soldering Station complete with 30W or 40W Iron (state which)	74.95
XS25 W Iron kit/complete with steel & plug attached	11.00
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Antex 15W iron	5.75
Antex 18W Iron	5.95
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Spare nozzles for Soldersucker	0.65

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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 7.5–75V	64p each*
20W Stud 7.5–75V	£1.35 each*

*Only available while stocks last

ZENER DIODE KIT 400 M/W
55 ZENER DIODES
5 EACH VALUE
£3.50

★ ★ ★ ★ ★ ★ ★ ★ ★ ★

ORYX PORTASOL PORTABLE GAS SOLDERING IRON

Powered by ordinary lighter fuel. 60 mins. cont. use, adj. temp.
10/60W Price £13.90

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ELECTRICAL

13A 3p Fused Plugs	46p
	42p/10
As above – Rubber	78p
	72p/10
2 way 13A 3p ext. socket	2.45
3 way 13A 3p ext. socket	3.25
4 way front fused	4.10
4W front fused + 3m lead	5.75
2W adaptor, fused 13A	1.20
3W adaptor, fused 13A	2.10

12V RECHARGEABLE UNIT

A bank of 10 D type Ni-Cads encapsulated in a black plastic box complete with inlet and outlet sockets (XLR type) and fuse holder. This giving 12V from a very neat and tidy unit. Approx. 245×75×75mm. £5.99 + £1.85 P&P + 15% VAT

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Brand new 3 channel pen recorders complete with charts. Full spec. upon request. Price **£40 + £10 p&p + VAT**.

CERAMIC KIT 50 VOLT
125 CAPACITORS
5 EACH VALUE
£4.75

RESISTORS – CARBON FILM 5%

1/4W 1RO to 10M (E12 Range)	2p each. 15p/10. 75p/100
1/2W 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

H.V. DISC CERAMICS

1KV 1.5nf	.18
8KV 56, 100, 120, 150, 180pf	.30

RESISTOR KITS – each value individually packed

1/4W pack 10 each value E12 – 10R to 1M 610 pieces	5.75
1/4W pack 5 each value E12 – 10R to 1M 305 pieces	3.35
1/2W pack 10 each value E12 – 2R2 to 2M2 730 pieces	7.95
1/2W pack 5 each value E12 – 2R2 to 2M2 365 pieces	4.75
1W pack 5 each value E12 – 2R2 to 1M 353 pieces	15.25
2W pack 5 each value E6 – 10R to 2M2 317 pieces	18.50

RESISTORS – WIREWOUND. Generally 5%

2.5W – 0.22 to 270R – Available in preferred values	0.15
4W – 1R0 to 10K – Available in preferred values	0.18
7W – 0.47R to 22K – Available in preferred values	0.15
11W – 1R0 to 22K – Available in preferred values	0.18
17W –1R0 to 22K – Available in preferred values	0.24

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GEC2010	8R + 15R + 17R + 70R + 63R + 188R	0.95
GEC 2018	10R + 15R + 19R + 70R + 188R	1.15
Philips G8	2.2R + 68 R	0.80
Philips 70	6R + 124R + 84R	0.68
Philips 300	118R + 148R (with link)	0.85
RRI A640	250R + 14R + 156R 50W	1.05
RRI A816	302R + 70R + 6.2R	0.78
Thorn 1500	350R + 20R + 148R + 1.5K + 317R	1.34
Thorn 3000/3500	6R + 1R + 100R Fused	0.93
Thorn 8000	56R + 1K + 47R + 12R	0.95
Thorn 8500	1K5 + 40R + 50R	1.28

Plus Many More. Please enquire.

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	1400	150+100+100+100+150/320V	2.70
	1500	150+150+100/300V	2.00
	3000	1000/63V	0.74
	3500	175/400V+100+100/350V	2.56
	8000	400/350V	2.10
	8000/8500	2500+2500/63V	1.99
	8000	700/250V	2.15
		1000/70V	0.80
	9000	400/400V	3.00
Timer Amp		4700/25V	0.95
DECCA 10/30		400+400/350V	3.20
	1700	200+200+400/350V	3.75
GEC	2047	2048 2083 2084 2104	
		200+200+150+50/300V	2.50
		600/250V	1.85
ITT/KB		200+200+75+25/350V	2.90
		220/100V	1.95
PHILIPS	G8	600/300V	2.20
	G8 G9	600/300V	2.10
	G11	470/250V	1.80
	G9	2200/63V	1.25
EKCO	T148	125+200+100+32/275V	2.65
	691 Series	200+300/350V	2.50
		600/300V	2.20
RANK		300+300/300V	1.75
	A823	2500+2500/30V	1.50
		220/400V	1.85
		600/300V	2.25

UNIVERSAL BATTERY CHARGER

To charge AA, C, D and PP3 Ni-Cads
Price £4.50

Rechargeable Batteries

AA (HP7)	95p	10/ 85p each
C (HP11)	£2.14	10/£1.98 each
D (HP2)	£2.30	10/£2.10 each
PP3	£3.75	10/£3.65 each

Full range of Battery Holders

TELEPHONE SPECIAL

BT App Telephone Plug + 3m Lead	£1.25
BT App Master Socket inc Wiring instrns	£2.85
BT App Secondary Socket	£1.95
4-way plug	30p each
BT 4-Core Cable per metre	15p/m
	£12.00/100m
Cable clips for above	100/75p

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Switch Cleaner	1.24
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FUSES Prices per 10

20mm Quick Blow. 100, 125, 160, 200, 250, 315, 400, 500, 630, 800mA, 1, 1.25, 1.6, 2, 2.5, 3.15, 4, 5, 6.3A. **45p. 20mm Time Delay.** 100, 125, 160, 200mA, 250, 315, 400, 500, 630, 800mA. **90p.** 1, 1.25, 1.6, 2, 2.5, 3.15, 4, 5, 6.3A 70p. 1" Mains. 2, 3, 5, 7, 10, 13A **90p.**

INTEGRATED CIRCUITS. (£) EACH

709	0.35
741	0.25
747	0.70
AN214Q	3.80
AN240P	3.42
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CA358	0.66
CA810QM	1.20
CA3020	2.10
CA3065	1.60
CA3080E	0.68
CA3140E	0.45
HA1366WR	1.59
LA4422	3.20
LC7131	4.90
LC7137	5.40
LM324N	0.45
LM380N8-P	1.15
LM380N14-P	1.80
LM1011N	3.20
LM1458N	0.98
LM3900N	0.85
M51513L	2.30
M51515L	3.18
MC1307P	1.99
MC1327P	1.50
MC1330P	1.60
ML232B	2.10
ML237B	2.30
NE555	0.25
SAA1025	4.00
SN76226DN	1.70
SN76227N	1.10
SN76533N	1.75
STK015	6.20
TA7146P	4.60
TA7203P	2.76
TA7204P	1.50
TA7205AP	1.30
TA7222P	2.32
TAA550	0.50
TAA611A12	3.50
TAA621AX1	3.50
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TDA120A	0.80
AS/S/SB/T/U	0.80
TDA120B	1.30
SA/SQ/UQ	1.30
TBA520	1.50
TBA530	1.20
TBA540	1.64
TDA560C	1.50
TBA810S	1.20
TBA950/2A	3.05
TCA270SA	4.02
TDA1003A	5.50
TDA1004*	4.95
TDA1006A	2.45
TDA1035S	4.50
TDA1170S	1.99
TDA1352A	1.80
TDA2002	1.80
TDA2020	4.00
TDA2030	1.90
TDA2140	2.90
TDA2160	2.50
TDA2522	2.75
TDA2530	2.20
TDA2532	2.80
TDA2560	3.20
UPC57562	1.45
UPC1350C	4.05
UPC1156H	2.75
UPC1182H	2.75
UPC1218H	1.80
UPC1356C2	3.00
UPC2002H	2.78

74LS

74LS00	0.24
74LS01	0.24
74LS02	0.24
74LS03	0.24
74LS04	0.24
74LS05	0.24
74LS08	0.24
74LS09	0.24
74LS10	0.24
74LS11	0.24
74LS12	0.24
74LS13	0.33
74LS14	0.48
74LS15	0.24
74LS19	0.44
74LS20	0.24
74LS21	0.24
74LS22	0.24
74LS24	0.28
74LS26	0.24
74LS27	0.24
74LS28	0.24
74LS30	0.24
74LS32	0.24
74LS33	0.24
74LS37	0.24
74LS38	0.24
74LS40	0.24
74LS42	0.50
74LS47	0.79
74LS48	0.85
74LS51	0.24
74LS55	0.24
74LS73	0.30
74LS74	0.33
74LS75	0.44
74LS76	0.38
74LS83	0.88
74LS85	0.82
74LS86	0.35
74LS90	0.48
74LS91	0.90
74LS92	0.54
74LS93	0.54
74LS95	0.60
74LS96	1.20
74LS107	0.40
74LS109	0.44
74LS112	0.44
74LS113	0.40
74LS114	0.39
74LS122	0.68
74LS123	1.00
74LS124	1.15
74LS126	0.50
74LS132	0.60
74LS135	0.26
74LS136	0.42
74LS138	0.44
74LS139	0.58
74LS145	0.93
74LS147	1.64
74LS148	1.28
74LS151	0.70
74LS153	0.70
74LS155	0.55
74LS157	0.45
74LS158	0.58
74LS160	0.62
74LS161	0.68
74LS162	0.70
74LS163	0.68
74LS164	0.74
74LS165	1.10
74LS166	1.50
74LS168	1.48
74LS170	1.40
74LS173	0.98
74LS174	0.75
74LS175	0.70
74LS190	0.82
74LS192	0.98
74LS193	0.98
74LS194	0.75
74LS195	0.74
74LS196	0.84
74LS197	0.96
74LS221	0.85
74LS240	0.80
74LS241	0.80
74LS242	0.94
74LS243	0.94
74LS244	0.80
74LS245	1.20
74LS247	1.00
74LS251	0.75
74LS257	0.73
74LS258	0.75
74LS259	1.20
74LS266	0.55
74LS237	1.20
74LS279	0.70
74LS283	0.80
74LS353	1.10
74LS365	0.50
74LS366	0.50
74LS367	0.50
74LS368	0.50
74LS373	1.00
74LS374	1.00
74LS375	0.70

CMOS

4000	0.19
4001	0.24
4002	0.24
4006	0.68
4007	0.24
4008	0.59
4009	0.44
4010	0.39
4011	0.23
4012	0.24
4013	0.35
4014	0.58
4015	0.58
4016	0.38
4017	0.54
4018	0.59
4019	0.59
4020	0.78
4021	0.58
4022	0.68
4023	0.30
4024	0.49
4025	0.24
4026	0.89
4027	0.44
4028	0.44
4029	0.73
4030	0.33
4031	1.28
4033	1.25
4034	1.40
4035	0.68
4036	2.48
4038	0.73
4039A	2.70
4040	0.58
4042	0.48
4043	0.42
4044	0.48
4049	0.38
4050	0.34
4051	0.68
4052	0.58
4053	0.58
4066	0.44
4068	0.24
4069	0.24
4070	0.24
4071	0.24
4072	0.24
4073	0.24
4075	0.24
4076	0.68
4077	0.24
4078	0.24
4081	0.24
4082	0.24
4085	0.58
4086	0.58
4089	1.22
4093	0.37
4094	0.70
4095	0.93
4096	0.98
4097	2.65
4098	0.78
4099	0.75
4161	0.96
4162	0.96
4163	0.96
4174	0.96
4175	1.00
4195	0.99
4501	0.38
4502	0.58
4503	0.38
4507	0.45
4508	1.28
4510	0.54
4511	0.54
4512	0.54
4514	1.10
4515	1.20
4516	0.60
4517	2.70
4518	0.48
4520	0.05
4521	1.10
4522	1.20
4526	0.58
4527	0.64
4528	0.68
4531	1.20
4532	0.64
4536	2.50

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VALVES

Enquiries are welcomed for any other valve not listed here.

Type	Price (£)
AZ31	4.50
AZ41	1.98
DAF96	1.00
DF96	0.75
DK96	2.65
DM71	2.95
DY86/87	0.66
DY802	0.95
CV850	2.50
CV4015	2.80
E180F	6.50
EABC80	0.98
EAF42	1.50
EB91	1.30
EBC41	2.00
EBF80	0.75
ECC81	1.00
ECC82	0.90
ECC83	1.00
ECC84	0.80
ECC85	0.95
ECC86	2.80
ECC88	1.25
ECC189	0.85
ECF80	1.20
ECF82	0.85
ECF83	1.90
ECF86	1.70
ECH35	3.75
ECH81	1.40
ECH84	1.50
ECL85	0.75
ECL86	1.75
EF80	0.75
EF86	1.80
EF91	2.00
EF95	1.68
EF183	0.90
EF184	1.00
EH90	0.98
EL34	3.25
EL36	1.96
EL81	6.95
EL84	1.00
EL85	4.75
EL86	0.90
EL509	7.85
EL519	7.95
EM80	0.85
EM84	1.75
EM87	2.55
EY51	0.90
EY86/87	0.65
EY88	0.75
EY500A	2.50
EZ41	2.80
EZ81	0.80
GY501	1.40
GZ32	1.20
KT66(G.E.C.)	18.00
KT77	11.50
KT88(G.E.C.)	19.00

Type	Price (£)
	1.40
PC92	3.00
PC900	1.40
PCC88	0.80
PCC89	0.75
PCC189	0.85
PCF80	0.95
PCF82	0.95
PCF84	0.75
PCF86	1.25
PCF87	0.50
PCF200	1.95
PCF201	1.95
PCF800	1.20
PCF801	1.05
PCF802	1.05
PCF805	2.00
PCF806	1.20
PCF808	1.60
PCL82	1.00
PCL83	2.50
PCL84	1.00
PCL86	0.90
PCL88	2.50
PCL805	1.05
PD500	2.90
PFL200	1.85
PL33	1.50
PL36	1.75
PL82	0.75
PL95	2.00
PL504	1.40
PL508	2.70
PL519/509	5.25
PL802	5.50
PY81/800	1.10
PY82	1.75
PY88	0.80
PY500A	2.20
PY801	0.68
UABC80	0.85
UAF42	1.25
UBC41	3.00
UBC81	1.50
UCC85	0.75
UCF80	1.20
UCH42	2.50
UCH81	2.00
UCL82	1.80
UCL83	1.80
UF41	1.25
UF89	2.50
UL84	1.25
UY85	1.15
2D21	1.60
6AT6	1.25
6AU6	1.00
6C4	1.00
6GH8A	1.20
6J5GT	2.50
6K7G	2.50
6K8G	2.75
6KD6	6.50
6X4	1.50
30FL2	1.70
30FL12	1.60

TRANSISTORS + DIODES

Type	Price (£)
AC127	0.28
AC128	0.30
AC128K	0.34
AC141	0.58
AC141K	0.38
AC142	0.56
AC142K	0.38
AC151	0.45
AC152	0.45
AC153	0.57
AC153K	0.46
AC176	0.30
AC176K	0.38
AC187	0.28
AC187K	0.38
AC188	0.28
AC188K	0.38
ACY22	1.50
AD142	0.88
AD143	1.10
AD149	0.72
AD161/162	1.20
AD162	0.52
AF114	1.20
AF115	2.10
AF116	2.10
AF121	0.56
AF124	0.42
AF125	0.58
AF126	0.58
AF127	0.38
AF139	0.40
AF178	2.28
AF239	0.50
AF279S	1.40
AL100	5.40
AL102	4.40
ASY80	5.20
ASZ17	2.00
AU110	2.80
AUY22	4.40
B40C200	1.03
BA110	0.68
BA115	0.14
BA121	0.40
BA129	0.38
BA148	0.16
BA155	0.12
BA157	0.28
BB105B	0.30
BB105G	0.48
BB110B	0.42
BC107	0.10
A or B	0.12
BC108	0.10
A,B or C	0.13
BC109	0.10
A,B or C	0.14
BC115	0.12
BC116	0.12
BC117	0.22

Type	Price (£)
BC118	0.16
BC119	0.28
BC125	14
BC140	0.27
BC141	0.24
BC142	0.24
BC143	0.26
BC147	0.18
BC147B	0.14
BC148	0.10
BC148B	0.12
BC149	0.10
BC149C	0.14
BC157	0.10
BC158	0.12
BC159	0.12
B/C	0.14
BC160	0.30
BC161	0.30
BC168B	0.20
BC169C	0.12
BC170/A/B/C	0.16
BC171/A/B	0.10
BC172/B/C	0.12
BC177/A/B/C	0.24
BC182/A/B/C	0.10
BC182L	0.12
LA LD LC	0.10
BC183/A/B/C	0.10
BC183L	0.12
LA LB LC	0.10
BC184	0.10
A B CL LC LB	0.10
BC207	0.15
BC212/A/B/C	0.10
BC212L	0.09
LA LB	0.10
BC213/A/B/C	0.10
BC213L	0.10
LA LB LC	0.10
BC237	0.11
BC238	0.12
BC251/A/B	0.14
BC262	0.20
A B	0.28
BC301	0.30
BC302	0.30
BC303	0.30
BC307A	0.18
BC317A	0.12
BC323	0.90
BC327	0.16
BC328	0.16
BC337	0.12
BC338	0.12
BC350A	0.24
BC351	0.16
BC440	0.36
BC441	0.40
BC461	0.58
BC478	0.24

Type	Price (£)
BC516	0.48
BC547	0.12
A or B	0.10
BC548	0.12
A B or C	0.10
BC549	0.10
A or B	0.10
BC550	0.10
A or B	0.10
BC557	0.10
BC558A	0.10
BCY70	0.16
BCZ10	3.21
BCZ11	2.60
BD124P	0.70
BD129	0.90
BD130Y	0.68
BD131	0.36
BD132	0.36
BD135	0.26
BD136	0.26
BD137	0.28
BD138	0.30
BD139	0.30
BD140	0.28
BD142	1.26
BD145	1.82
BD150A	0.72
BD160	1.58
BD165	0.45
BD183	0.70
BD201	0.52
BD202	0.57
BD204	0.50
BD222	0.80
BD225	0.40
BD232	0.45
BD234	0.30
BD235	0.30
BD236	0.38
BD237	0.38
BD410	0.76
BD434	0.58
BD438	0.58
BD439	0.85
BD441	1.00
BD507	1.05
BD520	1.20
BD687	0.88
BD707	0.88
BDX18	1.00
BDX32	1.48
BF115	0.32
BF117	0.50
BF119	0.82
BF120	0.38
BF125	0.42
BF127	0.41
BF154	0.14
BF157	0.46
BF160	0.23
BF167	0.32
BF177	0.42

Type	Price (£)
BF178	0.26
BF180	0.27
BF181	0.27
BF182	0.32
BF183	0.32
BF184	0.30
BF185	0.28
BF194A	0.15
BF195	0.12
BF224J	0.20
BF240	0.30
BF241	0.30
BF244A	0.30
BF257	0.22
BF258	0.26
BF259	0.30
BF262	0.34
BF263	0.38
BF270	0.30
BF271	0.28
BF273	0.22
BF274	0.34
BF294	0.46
BF336	0.32
BF337	0.28
BF338	0.28
BF355	0.37
BF371	0.27
BF450	0.38
BF457	0.36
BFR51	0.36
BFR61	0.32
BFR90	0.86
BFT41	0.68
BFT43	0.86
BFY50	0.22
BFY51	0.22
BFY52	0.22
BFY90	0.80
BFY90S	1.34
BR100	0.25
BR101	0.40
BR103	0.50
BR303	2.75
BRY39	0.50
BRY56	0.42
BSX20	0.30
BSY52	0.35
BSY95A	0.25
BT100A/02	0.90
BT101/300	2.75
BT101/500	3.25
BT102/300	3.60
BT106	1.15
BT116	1.20
BT119	3.30
BT138/600	1.30
BT151/560R	0.90
BTY79/400R	2.80
BU104	1.80
BU105	1.20
BU108	1.75
BU124AE	0.98

Type	Price (£)
BU126	1.40
BU133	1.90
BU204	1.30
BU205	1.30
BU206	1.50
BU208A	1.40
BU326S	1.75
BU407	1.10
BUX80	3.70
BUY20	2.75
BUY69A	2.60
BUY69B	1.98
BY100	0.80
BY103	0.50
BY122	0.60
BY126	0.10
BY127	0.08
BY133	0.06
BY135	0.35
BY164	0.45
BY179	0.56
BY182	0.80
BY184	0.38
BY187	0.65
BY189	6.75
BY198	0.64
BY199	0.72
BY206	0.14
BY207	0.16
BY210/400	0.21
BY210/600	0.24
BY210/800	0.28
BY227	0.22
BY228	0.46
BY238	0.65
BYX10	0.20
BYX36/150	0.40
BYX36/600	0.48
BYX48/300	0.70
BYX55/600	0.30
BYX71/600	1.18
C106D (400V)	0.48
E1222	0.30
E5024	0.30
MCR106/5	1.20
ME0413	0.70
ME6002	0.26
MEU21	0.62
MJ400	0.45
MJ2955	1.00
MJ3000	1.80
MJE340	0.46
MJE520	0.44
MJE2955	1.60
MJE3055	1.40
MPSA05	0.30
MPSA12	0.30
MPSL01	0.34
MPSU05	1.05
MPSU06	1.18
MR502	0.40
MR854	0.88
OA91	0.07

Type	Price (£)
ORP12	0.95
R2008B	1.20
R2010B	1.20
R2540	2.71
TIP30A	0.32
TIP31C	0.39
TIP32	0.35
TIP33A	0.55
TIP34A	0.70
TIP41C	0.42
TIP42	0.44
TIP47	0.42
TIP121	0.63
TIP2955	0.70
TIP3055	0.58
TIS88	0.50
TIS90	0.27
Y728	0.14
Y969	2.80
IN4001	0.04
IN4003	0.05
IN4004	0.05
IN4006/7	0.07
IN4148	0.04
IN5400	0.12
IN5402	0.13
IN5405	0.16
IN5406	0.17
IN5408	0.19
2N2122A	0.34
2N2222	0.30
2N2904A	0.48
2N2926G	0.14
2N3053	0.30
2N3054	0.60
2N3055	0.65
2N3703	0.10
2N3773	2.80
2SB337	1.80
2SC1098	0.84
2SC1172Y	1.70
2SC1173Y	0.88
2SC1279	0.50
2SC1306	0.92
2SC1413A	2.70
2AC1449	0.60
2SC1507	0.60
2SC1678	1.00
2SC1758	0.68
2SC1909	1.20
2SC1923	0.30
2SC1945	2.88
2SC21953	0.70
2SC1957	0.70
2SC1969	2.80
2SC2028	0.73
2SC2029	2.70
2SC2078	1.05
2SC2091	0.70
2SC2098	2.90
2SC2122A	3.20
2SC2314	0.80
2SC2335	1.50

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COVER PHOTO
Our cover photo this month spans the entire fifty years of high-definition TV in the UK. The set in the foreground is a new stereo-sound model from B and O with FST display and provision for satellite TV reception. Of the other sets the most interesting is the mirror-lid console with the light wooden panel above its speaker grill: it's a dual-standard (240/405 lines) EMI set dating from 1936.

The photo was taken at Amberley Chalk Pits Museum near Arundel, West Sussex, a fascinating place to visit – not only for the vintage radio and TV gear. Our thanks to the curator of the radio and communications section, Ron Ham, for his help and the use of the museum as a setting.

INFORMATION WANTED
Can anyone suggest a source of data and/or spares for a 5in. Auritone monochrome receiver?

Fifty Years of TV

The first fifty years of regular high-definition TV broadcasting is an anniversary of note: several organisations are commemorating it in various ways – see Teletopics overpage. The situation back in the early thirties was certainly a fascinating one. TV of sorts had been demonstrated experimentally in several countries during the twenties. The pace of development increased during the early thirties, but it must not be forgotten that this was a period of severe economic depression. It was nevertheless the period when TV moved from the laboratory to experimental transmissions, and it's interesting to speculate as to whether the pace of development would have been faster – and whether the UK would have been the first country to start a regular high-definition TV service – had the economic climate been more favourable. In the USA for example RCA started to transmit experimental all-electronic TV in 1933, with 240 lines. But in the wake of the Wall Street crash it was difficult even for RCA to raise funds. The prospects for TV services and a receiver industry did not look good.

Apart from the UK, the other leading country in the development of TV during the early thirties was Germany. In fact a TV service was officially opened in Berlin on March 22nd, 1935, using an all-electronic 180-line, 25Hz system. It was described as a "regular" service but it's difficult to know exactly what this meant in practice. The 16kW transmitter certainly transmitted regular sound broadcasts. TV transmissions were mainly of film material and although they seem to have taken place for several hours on various days of the week the service was not a regularly scheduled one in the sense that we understand it. In fact it was described in a contemporary report as a "preliminary try-out". There was talk of moving to 240 lines within months, which can hardly have been an incentive to buy sets, and flicker was a problem with the 25Hz field rate.

The 1935 Berlin Radio Show, held on August 16-28th, revealed the pace of TV development in Germany at the time. TV sets made by Telefunken, Loewe, Fernseh, Lorenz, Müller and Tekade were on show in a "Television Street". In addition to the 180-line service there were demonstrations of a 320-line mechanical system and of a 240-line system with interlaced scanning. The Tekade set used a mirror-screw display which was described as "feebly illuminated" in comparison to the other sets that employed c.r.t.s. But political considerations overshadowed the show. A few days before the opening television was by decree placed under the jurisdiction of the Ministry of Air. That put a real damper on things so far as the development of a public broadcasting service was concerned.

Things were also moving fast in the UK. The Baird Company had moved from its primitive 30-line system to a more promising 240-line system, this time with proper sync pulses! But the major leap came with EMI's development of the 405-line system. And so we moved towards November 2nd, 1936, when the BBC started its regular service, initially with 240/405 lines on alternate weeks, going to 405 lines only in February 1936. At the August 1936 Radiolympia exhibition TV sets by Baird, Cossor, Edison, Ferranti, GEC, EMI and Philips had been on show. Hand built of course, as all TV sets were to be for many years to come. It was the beginning of a TV industry however, and it's sad that the UK failed to capitalise on this early start.

Tube technology has been a crucial factor in the development of TV all along. The c.r.t.s of 1936 were most unimpressive by today's standards. Pumping technology was primitive and the light output was poor. It's interesting to observe that the ability of the 405-line system to produce really first-class pictures (in colour too!) became apparent only as tube technology progressed. Observers in 1936 commented that there was little to choose between the picture quality of the 240- and 405-line systems. That can have been only because of the tube technology of the time.

The other side of the coin was the camera pick-up device. If the display tubes of the period failed to do justice to the 405-line system, neither did the Emitron camera tube. But the Emitron was at least the start of a very fruitful line of development. Its light-signal conversion efficiency was low, mainly because of its poor charge storage capacity. A significant improvement came with the Super-Emitron in 1937. With this tube the functions of photoemission and charge storage were separated. The Super-Emitron was so successful that it continued in use for some studio applications till the early sixties. Both these tubes had the curious round bulb with the scanning gun at an angle familiar from photos of early TV broadcasting. The Super-Emitron was superseded by the in-line gun CPS Emitron (orthicon) in the early post-war period. For their part the Baird Company had been hoping to use with the 240-line system a tube developed by Farnsworth. The Farnsworth image dissector lacked storage however, making it unsuitable for camera use – though it was employed for many years as a slide scanner.

The achievement of the EMI team in 1936 was to have developed a complete TV system – camera tube, studio equipment and receivers. The transmitter side was taken on by the Marconi Company, who had developed a suitable v.h.f. transmitter as early as 1932. The Marconi-EMI Television Company was set up in March 1934 to work on all aspects of the final system. In retrospect we can see that television in 1936 was still in a state of rapid technical transition – but then that's been the case ever since!

Teletopics

FIFTY YEARS OF TV BROADCASTING

November 2nd marks the fiftieth anniversary of regular, high-definition TV broadcasting by the BBC: the service was declared open at 3 p.m. on November 2nd 1936 by the Postmaster General. What was available on that epic date would be considered very small beer today however: one transmitter (Ally Pally), about 300 TV receivers out in the field, an hour of programmes in the afternoon and another hour in the evening – with nothing on Sundays. Of the 300 sets in use it's likely that many were in the hands of those professionally involved with TV in one way or another.

To commemorate this fiftieth anniversary the Institution of Electrical Engineers is holding an international conference at its headquarters, Savoy Place, London WC2 on November 13-15th. Over forty papers are to be presented at the conference, which is entitled "The History of Television – from the early days to the present". They will cover progress from the first proposals for television, via the experiments of the 1920s and the subsequent low-definition transmissions, to the realisation of high-definition in the 1930s and all subsequent advances. The Royal Television Society is presenting an audio-visual spectacular called "The Golden Box". This will run for a nine-week period until January 7th. Further details were given in Teletopics last month. The National Museum of Photography, Film and Television is publishing a 36-page book entitled "Television – The First Fifty Years", by Keith Geddes, curator of telecommunications at the Science Museum, and Gordon Bussey, historical advisor to Philips Electronics. The book includes 80 colour and monochrome illustrations and is available for £1·50 (plus 75p postage and packing) from The Shop, National Museum of Photography, Film and Television, Princes View, Bradford, West Yorks BD5 0TR. It will also be available at the Science Museum and at the Commonwealth Institute – where the Royal Television Society's video spectacular is being held. The book's ten chapters cover the ground from early developments between 1873-1936 to the present era of home video, stereo TV sound, satellite TV and so on – a period of "uncertainty as great as in 1936".

SATELLITE TV EQUIPMENT

NEC has introduced a new satellite TV receiver system featuring a single LNB with polariser and a noise figure of 2·3dB maximum. The heart of the system is the new 2022 tuner which offers a maximum of fifty pre-programmable channels. The parameters for all stations currently available via the Eutelsat-1 and Intelsat VA F11 satellites are preset at the factory: new programmes can easily be preset by the user with the keypad. Polarisation is automatically adjusted for the channel selected by information programmed in during the presetting procedure. Throughout the presetting procedure on-screen graphics, in the form of instructions and bar graphs, help the user to tune in each parameter exactly. The new system is designed to be compatible with channels broadcast from any satellites, including DBS birds transmitting B-MAC or D2-MAC signals. NEC has also developed an optional low-cost tracking system which enables the dish to be swung by remote control. The unit comprises an aerial positioner and a rugged actuator using a steel-geared, one-eighth h.p. motor (actuators generally use plastic-geared 1/15th h.p. motors). The new system complements NEC's existing range and will be marketed as a complete package, including the dish aerial, backed by a nationwide installation service. Further details can be obtained from NEC Business Systems (Europe) Ltd., Camden Office, 35 Oval Road, London NW1 7EA. NEC equipment is now available nationally through DER's 369 outlets following a test market operation in London and the south east in recent months.

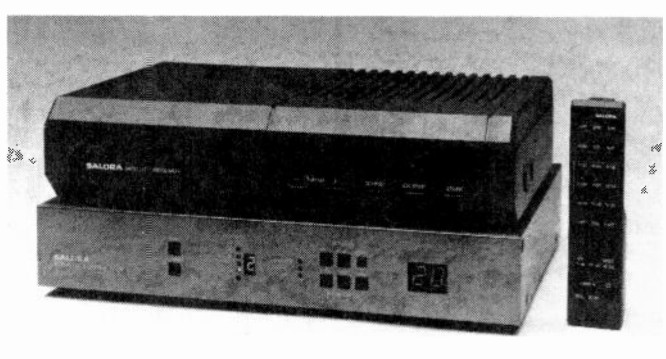
BELtronics Ltd. has introduced an electronically switchable LNB which dispenses with the need for a polarotor: the BEL LNB is activated simply by pressing a button on either the receiver or the hand-held remote control unit. BEL point out that doing away with an electro-mechanical polarotor greatly increases reliability. Details of BELtronics equipment can be obtained from BELtronics (UK) Ltd., Cherry Orchard North, Kembrey Park, Swindon, Wilts SN2 6BL.

A range of satellite TV receiving equipment has been introduced by Rediffusion – the systems have been designed with carry-home packs for DIY customers and feature easy installation. A UK dealer network is currently being set up. Extensive support will be available for dealers appointed as "Rediffusion Satellite Centres". The range consists of the RSR30 receiver, RKU10 LNB and 1·2m, 1·5m or 1·7m dishes which are available with a choice of patio, wall or polar mounting arrangements. For further details apply to Rediffusion Radio Systems Ltd., Satellite Systems Division, Unit 9, Mole Business Park, Randalls Road, Leatherhead, Surrey KT22 7BA.

The range of satellite TV receiving equipment available from Comex Satellite Systems Ltd. in kit form has been considerably extended. A price list with details is available from Comex Systems Ltd., Comet House, Unit 4, Bath Lane, Leicester LE3 5BF.

The London Hilton on Park Lane hotel has been equipped with a satellite TV system which provides a service in all its guest rooms. Eight different services on four channels are available in addition to the national and London regional networks.

The board of Eutelsat has decided to ask Aerospatiale, which is building the second generation of Eutelsat birds (the Eutelsat-2 series), to implement certain modifications. The most important concerns enlargement of the service zone of the high-gain beam, allowing reception via dishes down to 1m. With the modification requested this beam will provide an e.i.r.p. of 47-51dBW over a large part of Western Europe from the Iberian peninsula to Scandinavia or from Italy to Iceland depending on orbital position – the two satellites will be at 3° and 36° E and are due to



The new Salora SRV1150 satellite TV receiver with ACU1160 aerial control unit. Further details next month.

become operational in 1989. All 16 transponders will be able to use the high-gain beam instead of 12 only as in the previous design.

Salora has started a series of one-day satellite TV technical courses for dealers. A 55-page A4 booklet entitled "Satellite Television – Basic Notes for TV Technicians" will be issued to all course members along with a signed and sealed Certificate of Competence. Hands-on experience with TVRO equipment is a feature of the courses. For details apply to John Breeds, Satellite Products Manager, Salora (UK) Ltd., Techno Trading Estate, Swindon, Wilts SN2 6EZ.

GOOD BUSINESS

According to AGB Lek-Trak, the retail research service run by Audits of Great Britain, spending on electrical goods during the first six months of this year rose substantially. Sales of VCRs, which are ten per cent cheaper than a year ago, rose by 44 per cent while CTV sales rose by 24 per cent. It seems that the World Cup and the royal wedding helped sales which have since dropped back though still being ahead of last year.

WORLD'S FIRST LASER PROJECTOR

The world's first laser video projector was on display at the Photokina Exhibition, Cologne – the Spectralight is the only commercially available laser projector. It provides line-free full-colour pictures up to 15m in width from any conventional video source – tape, off-air, satellite or computer. Details are available from Dwight Cavendish Displays Ltd., Bydand Lane, Little Paxton, St. Neots, Cambridgeshire PE19 4ES.

VIDEO EQUIPMENT

Sony has extended its range of 8mm video equipment with the full-feature camcorder Model CCDV100 at £1,600. The CCDV100 has new circuitry and heads to give improved definition and a series of trick features including a seven-colour character generator, a seven-colour screen wipe, a time-lapse switch (eight frames every fifteen seconds), frame recording (one frame in eight to give a strobe/animation effect) and in addition a real-time counter that shows elapsed and remaining tape time. The previous CCDV8AF camcorder has been replaced by the CCD7AF which incorporates a macro facility for close-ups. This one has a suggested price of £1,200. The top-of-the-range EVS700 8mm VCR has been replaced by the EVS600 with a suggested price of £700.

Fuji has introduced a 90 minute 8mm tape, type P5-90. The Fuji range of 8mm videocassettes now comprises the P5-30, P5-60 and P5-90. Special features of the new tape include high-output "Super-fine Metallix" particles, an ultra-smooth tape base, a flexible 3-D binder and a unique four-layer construction.

JVC's latest VCR is the HRD170 which has a suggested price of £379. Features include infra-red remote control, HQ circuitry, power switch-on when a cassette is inserted, instant playback when the tape is rewound to 0000, and backspace editing. A new JVC camcorder, Model GRC9, has been launched in Japan. It's claimed to be the world's smallest VHS camcorder with dimensions of 8·2×4·4×3·7in. and a weight of 1·6lb.

Fuji exhibited a new range of still video equipment at Photokina, including a still video camera which uses a video floppy disc as the recording medium, a high-resolution image sensor with field/frame recording capability, and a still video print system.

Ross Electronics, 49-53 Pancras Road, London NW2 2QB is distributing in the UK the new Trackmate range of video/audio recorder and disc cleaners. The TM261 VHS VCR cleaner uses two vibrating brushes to spread a controlled amount of cleaning fluid and is said to give much better results than pad or tape systems. The price is £12·99.

RISCOMP RANGE EXTENDED

Riscomp Ltd. (51 Poppy Road, Princes Risborough, Bucks HP17 9DB) has announced an addition to its range of security products. The new CA1382 control unit provides an extensive range of facilities with simplified operation. Automatic "system testing" is carried out every time the unit is switched on, an LED indicating correct operation. The entire operation is controlled by a single key-operated on/off switch. Features include a built-in exit and entrance buzzer to give audible warning of the unit's operation, an alarm memory to allow the unit to be set up without annoyance to neighbours, and provision for sounding the alarm by means of a personal attack switch – even though the unit is not switched on. The unit is available for self-assembly at £39·95 plus VAT or fully built and tested at £44·95 plus VAT.

LABGEAR'S NEW SET-TOP AERIAL

The new CM7300 Tri-Star wideband u.h.f. aerial from Labgear Cablevision is the outcome of two years of design and development work. The aerial is of the log-periodic type and has a wide range of adjustments – 360° rotation, 175° side-to-side swivel and 170° tilt. It slips into a compact carton to aid stocking. There's also a version – Model CM7301 Supreme – with integral amplifier for use in weak-signal areas. This provides a gain of about three times.

CATALOGUES

The 1986 VCR Trade Catalogue is now available at £2 from Willow Vale Electronics Ltd., 11 Arkwright Road, Reading, Berks RG2 0LU. Spares for Sharp, Grundig, Ferguson, Philips and other manufacturers' machines are listed. A helpful feature is the exploded views for many popular VCRs to assist with part identification.

Cirkit's Winter 1986 catalogue is now available at £1·20 from Cirkit Distribution, Park Lane, Broxbourne, Herts EN10 7NQ. The catalogue features over 3,000 products for the electronics hobbyist in its 164 pages.

IN BRIEF

The Japanese private research company RHD Corporation has succeeded in making a blue LED using zinc selenide. This is the missing primary colour in the LED range and opens up interesting possiblities for displays . . . Some of the latest Grundig sets employ CTI – colour transient improvement. This is said to enhance the separation of the colour signal to sharpen the colour information in the picture, and has the added bonus that video recordings give better playback . . . Heron Electronics is being wound down – closure is expected by Christmas. Heron has been distributing the York and Ingersoll brands and previously held the Thomson and Crown UK franchises.

The Barefoot Contessa

Les Lawry-Johns

Not long since H.B. decided that our Alsatian Zeb was lonely. She enquired around and located a suitable friend for him in the Medway towns – a three-year-old German Shephard who had had puppies and had been seen to . . . One of her puppies lives a few doors from us and was on heat. It had been sitting on her owner's lap, which by a chain of events led to some problems. Her owner offered to accompany H.B. to pick up our new dog you see. As H.B. was driving, the new dog ("Duchess") sat on the lady's lap during the return journey. The arrival home was spectacular. As Duchess trotted in through the door Zeb caught what he thought was her smell and went mad. There was a monumental struggle, with TV sets toppling over everywhere and me losing my temper over this unseemly mess.

Zeb's sense of smell is more acute than I thought, but it didn't take long for him to realise that his attentions were unwanted. We very nearly have peace now but their boisterous playing seems to continue nearly all day long and completely upsets my dubious ability to think straight. Being of German descent I felt that the new arrival must be a Contessa rather than a Duchess – so Tessa she is. The few customers who came nowadays tend to get a shock when confronted by two such large hounds, but at least their sets are assured of protection.

The Hitachi

A friend of mine lumbered in carrying what appeared to be a 22in. colour set. I saw the name Hitachi and started to make excuses.

"It's my mother-in-law's, Les. Just have a look and see if you can get rid of all that green."

I guessed that the tube was at fault but thought I'd make sure. He left it and in due course I took the back off, expecting to find an ordinary in-line gun tube that needed reactivating. The more I looked at it however the more confused I became. There was a single first anode supply, which is normal. It read correctly. I looked for the red cathode and found two pins marked RK on the left-hand side, two marked GK at the bottom and two marked BK on the right. The voltages on all these pins read the same, so the tube seemed to be at fault – there was brilliant green with very little red or blue.

Not realising what I was up against I looked for a common heater to connect the reactivator to. I checked the GK pins with the set switched off and got the reading I expected. I then looked for a grid pin and found two earthed. So I hooked up to this earth and to the pin marked RK and applied the heater voltage to the GK pins. There was a funny noise and the heater lit brightly. Heater, not heaters. I disconnected the reactivator and tried the set again. The picture came on immediately but was in magenta (red and blue) with no sign of green. Mind you, it looked a lot better than that green picture, but it dawned on me that I'd damaged the green emission. I studied the base more carefully and realised that each gun had its own heater supply, hence two pins marked RK etc. The cathodes are in fact the heaters and I remembered reading in the magazine some years ago about this unusual Hitachi tube. Why hadn't I remembered earlier? It would have needed a new tube anyway . . .

Another One

Shortly after this episode a nice couple came in and said they wanted help with their TV set which they couldn't bring in. I enquired about the make and the nature of the trouble. An Expert they said, the fault being that the top of the picture came down and went back up every few minutes shortly after switching on, the display eventually settling down. Memories of my friend's GEC-Hitachi set came back to me. Remember the elastic band that wasn't successful? I'd eventually had to take out the thick-film field output module and resolder all the contacts. In this way we gained the upper hand. I guessed that the Expert was actually an Hitachi and promised to nip over and solve the problem the following morning – only hoping that I was right.

I went, I was right, and I did it. What a clever boy! Incidentally these sets have the transit screws in the back cover in the same way as the TX9 etc. This makes removal of the cover a bit of a puzzle when you're used to dealing with sets that have been serviced before and don't have the screws fitted.

Sad Tales

Another 26in. ITT colour set fitted with the CVC5 chassis caused me a nightmare the other day. The complaint was intermittent or no colour. I had to call at the house which was well out of town, so I resolved to do it there rather than bring it back to the shop. The colour came on at first. It then went into bars and faded out, leaving a pleasant monochrome picture. I tried another channel. The colour was again present but then vanished as before. Maybe the colour reference oscillator preset R311 was out of adjustment? I tried a new setting, but no luck. I tuned in the channel and the colour briefly appeared. In a nutshell I checked every likely item on the decoder panel. Nothing seemed to be at fault and all the voltages were as expected, changing only when the colour faded. I overrode the colour killer and faint bands remained despite adjustment of R311. I shunted the crystal and adjusted the relevant cores. Nothing doing.

Eventually I took it back to the shop, having struggled through the house and down the garden with this heavy set. Back at the shop I again tried to hold the colour and found that it faded before it reached the decoder. I checked the i.f. panel but this seemed to be in order and correctly aligned. Time was slipping by and so was my patience. I suspected the channel selector unit which can cause signal problems but decided to return the set to the owner with the recommendation that he took it to one of the brighter boys in the neighbourhood. I ran away feeling very ashamed of myself.

Back at the ranch H.B. told me that an acquaintance, an ex-TV engineer, had taken his own life. He'd lost his wife some months earlier and had been very depressed ever since. This completely deflated me and I've yet to recover. I know it happens, but even so . . .

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Spectrum Analyser Project

Peter Richards

It's good practice to examine the spectrum of the signals being received by a customer's aerial system. In simple cases a check with a signal strength meter is sufficient. When faced with a more complicated situation however – for example where there's cross-modulation, interference or poor signal-to-noise performance from an aerial amplifier – a spectrum analyser is the ideal thing to use. This article describes a way of adapting the Philips G11 chassis for use as a spectrum analyser.

The G11 was chosen for several reasons. First there are plenty of these sets that are not fit for further revenue earning use available. Secondly they are very easy to work on. And thirdly they are not too cumbersome. A monochrome receiver was not used because decent sets of this type with varicap tuners are rather rare these days.

Principles

The display is a bit unusual in that it's rotated by 90° with respect to the conventional approach: the frequency is shown vertically while signal amplitude is shown horizontally, from left to right. This was done to keep the circuitry as simple as possible.

To create the display the tube's electron beams scan the whole tube face area in the normal manner but are turned on only as required to show the presence and amplitude of the received signals (see Fig. 1). The tuner is swept through the tuning range by a field scan waveform: as this is done the a.g.c. voltage is monitored to provide an indication of received signal strength. A sawtooth waveform derived from the line output transformer is fed to a comparator stage whose other input is the a.g.c. voltage: when the instantaneous sawtooth voltage is higher than the a.g.c. voltage the screen is blanked out. The length of each horizontal line displayed is thus an indication of the signal strength at that frequency. This should be clear by referring to the block diagram shown in Fig. 2.

Preparation

It's important to give the set a good service before starting on the conversion. Since the button unit, the sound channel and the chrominance section aren't needed however these sections don't matter. A set with a poor tube will work very well as a spectrum analyser since the tube is either on or off and shades of green don't matter!

Plenty has been written about servicing the G11 in this magazine in the past so I won't go over this again. Do however replace the h.t. reservoir capacitor C4029 and the mains plug, and resolder any dry-joints.

Modifying the Chassis

The next thing to do is to reverse the scan direction (doing it this way simplifies the extra circuitry required). This is most easily done by reversing the wires to pins 3 and 4 of plug 2B on the timebase board then rotating the scan coils through 180°. It will be necessary to readjust the purity and convergence after doing this.

There are two other things to do while there's still a picture. These are to shorten the a.g.c. time-constant by changing the value of C450 in the vision selectivity/gain can (U400) from 10μF to 1μF (16V) and to bias the tuner for full gain by connecting a diode (1N4001) in parallel with C5010 (150μF), with its cathode to chassis, and give it some forward bias by connecting a 33kΩ resistor from its anode to the 12V line (tuner pins B and D). Disable the tuner a.g.c. by unsoldering pin 6 of the vision detector can (U600).

We can now prepare the set for the additional circuitry that's to be used with it. There are three steps here. (1) Disconnect the varicap tuning voltage from the tuner by cutting the print to pin G of the tuner. When the modifications have been completed a sweep voltage will be applied to this pin. (2) Remove the luminance delay line. All we need is an unmodulated but controllable raster. (3) Disconnect the signal feed to the sync separator by removing R2035 (1·5kΩ) on the timebase panel. This ensures that both the line and field oscillators can run free without trying to lock to any fleeting glimpses of signal that may appear.

The Sawtooth Generator

The additional circuitry is shown in Fig. 3. We'll now take a detailed look at this, starting with the sawtooth generator. This consists of R1-R4, C1/2, D1/2 and potentiometer P1. The operation of this part of the circuit is not immediately obvious, so a detailed explanation follows – refer to the simplified circuit shown in Fig. 4.

D2 rectifies the -140V line pulses from the line output transformer, producing a -140V supply across C2. R3 is included simply to provide a discharge path at switch off. R1 and R4 provide protection by burning up in the event of either D1 or D2 going short-circuit.

D1 also conducts during the flyback line, when a 33V pulse appears at its anode. Since the other end of C1 is then at -140V the total voltage developed across C1 is 173V. What happens next?

The exponential decay of voltage across a capacitor is given by the formula $V = Vo \exp(-t/CR)$, where Vo is the voltage at time $t = 0$. To see what happens at time $t = 64\mu$sec (one line scan period) we must put in some numbers. The value of R is unfortunately not easy to calculate, since it consists of R2 in parallel with the series of combination of P1 and the voltage across C2/R3. We can take an approximation however by assuming that C2 has no voltage across it and presents no impedance to the discharge of C1 via P1. This approximation is valid because the value of P1 is much larger than that of R2.

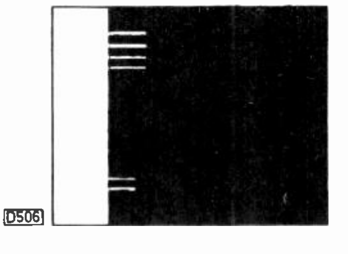


Fig. 1: A typical display, showing four group C/D channels and two group A channels.

This gives a value of 95kΩ for R. Thus at time $t = 64\mu sec$ the voltage across C1 is given by:

$$V = (33 + 140)\exp(-64 \times 10^{-6}/(3\cdot3 \times 10^{-9} \times 95 \times 10^{3}))$$

$$= 173\exp(-0\cdot204) = 141V.$$

Since the negative end of C1 is at −140V, the voltage at the positive end has decreased from 33V to 1V during the 64μsec period – in a manner that's as nearly linear as makes no difference.

This sawtooth waveform is divided by approximately three by P1, so that the voltage at its slider falls from approximately 12V to 0·33V during one line. This reduced amplitude sawtooth is fed via R5 to the base of the buffer transistor Tr1. The output at Tr1's emitter is at a lower impedance level and is subject to a downwards d.c. shift of 0·6V due to Tr1's base-emitter voltage. Diode D3 provides a further 0·6V d.c. shift, ensuring that the voltage at the base of Tr2 is at zero at the end of the sawtooth regardless of component tolerances etc. This zero voltage creates the base line of the display.

The Comparator

Now to the comparator transistor Tr2. The voltage at the emitter of this transistor is virtually constant during a line period and will be at something between zero and 6V depending on signal strength. Thus at some point during the line period Tr2 will turn off – this occurs when the negative-going line-frequency sawtooth at its base falls below the a.g.c. voltage.

With a strong signal the a.g.c. voltage will be high and Tr2 will be cut off for about half the line period. With a weak signal the a.g.c. voltage will be low and as a result Tr2 will be cut off during only the last fraction of the line period. When Tr2 is off Tr3 is on and vice versa. Tr3 provides the output to bias the tube via the video circuitry in the set. It's worth recalling at this point that the line scan is reversed: thus the last part of the line period, during which the tube is biased on, appears at the left of the screen. A strong signal causes long bars while a weak signal produces short bars. This should be clear from Fig.1 and the waveforms shown in Fig. 5. Tr3's output is applied to pin 6 of the luminance/chroma can U6200.

R14, R15 and D6 are included to prevent Tr3 going into saturation, thus improving its turn-off time. When Tr3's collector voltage falls below the voltage at the junction of R14/15 D6 conducts. R14 is then the main component of Tr3's load resistance. The current drive at the base of Tr3 is insufficient to saturate it with a load of 180Ω.

C3 is included to limit the circuit's frequency response, preventing any instability that might otherwise occur. It's generally better to design a circuit to have a definite upper frequency response limit rather than leaving this to stray capacitance and transistor junction capacitance.

Sweep Voltage Amplifier

Producing a sweep voltage for the tuner is very convenient with the G11 chassis since a field sawtooth waveform with an amplitude of 2-7V is available at pin 10 of the TDA2600 field timebase chip. A d.c. amplifier to increase this to 0-25V can be designed using very few components. Tr4, Tr5 and the associated resistors in Fig. 3 are used for this purpose.

Components list

Resistors:	**Presets:**
R1 1·5Ω 0·5W*	P1 470k
R2 120k 1W H.S.	P2 220k
R3 820k	
R4 1·5Ω 0·5W*	**Capacitors:**
R5 10k	C1 3·3n 1·5kV*
R6 100k	C2 4μF 300V
R7 10k	C3 22p 63V
R8 3·3k	Plus 1μF 16V
R9 220k	a.g.c. decoupler.
R10 100k	*LOPT tuning type.
R11 27k	
R12 2·2k	**Diodes:**
R13 10k	D1 BY210
R14 180Ω 1W	D2 BY184
R15 33Ω	D3-6 1N4148
R16 10k	Plus 1N4001
R17 4·7k	tuner bias.
All 0.5W unless otherwise stated. Plus 33k tuner bias resistor.	**Transistors:** Tr1-3 BC184
	Tr4 BC107
*Safety resistors.	Tr5 BF337

Because we are using an emitter-follower buffer (Tr4) to drive one output transistor (Tr5) we can say that the effective input voltage varies from

$$Vin = 2 - (2 \times Vbe) \text{ to } Vin = 7 - (2 \times Vbe),$$

i.e. Vin varies from 0·8V to 5·8V. Let's next consider Tr5's collector voltage (the supply is 33V).

$$Vc = 33 - (Ic \times Rl) = 33 - (\beta \times Ib \times Rl)$$
$$= 33 - ((\beta \times Vin \times Rl)/Rb),$$

where Rb is the circuit value of P2. Since Rl has been chosen as 4·7kΩ, to give a low output impedance and reasonable power dissipation, we can now calculate the ratio β/Rb for Tr5 at Vin = 5·8V, Vc = 0V and Vin = 0·8V, Vc = 25V. Very conveniently β/Rb works out at approximately 0·001 in both cases. Thus for Tr5 Rb is approximately equal to 1,000 × β. The value of Rb can be adjusted (it's P2) to allow for transistors with different gain figures and to adjust for the exact voltage gain required to fill the screen with the segment of the u.h.f. band you want. For a typical transistor, if β = 100 then Rb = 100kΩ, so a 220kΩ preset is used.

The simplicity of this amplifier section is due to the fact that the voltage at pin 10 of the TDA2600 chip has exactly the right order of voltage swing and d.c. shift: this d.c. voltage provides the bias for Tr4/5. Designing a circuit for use with another type of set would almost certainly require a more conventional capacitance-coupled amplifier.

Construction and Setting Up

Since the component count is small I suggest that the extra circuitry is built on two tagboards. Bolt the tagboard with the sawtooth generator circuit to the chassis, next to the line scan panel. Mount the other tagboard containing the remaining components on the left, near the i.f. strip. Layout is not critical provided normal practice is followed over construction.

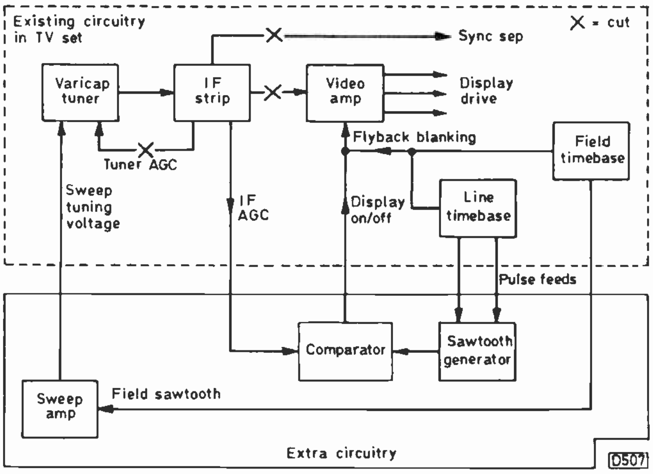


Fig 2: Block diagram of the spectrum analyser.

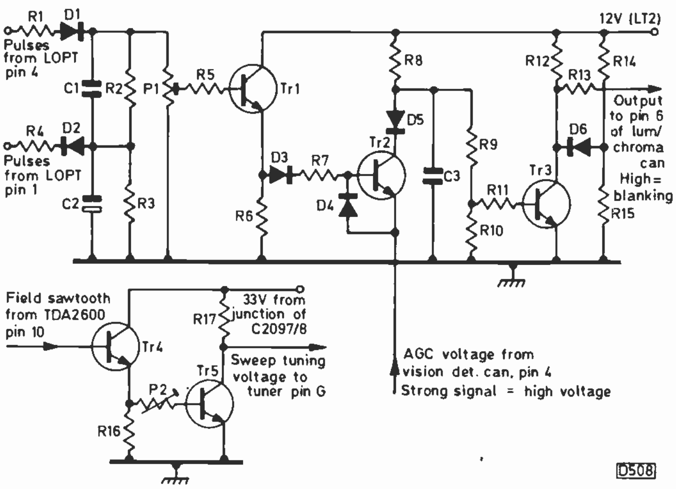


Fig. 3: The additional circuitry used.

Set P1 and P2 to their mid-positions. Remove the aerial and switch on. Adjust P1 to give a margin of white about a inch wide at the left of the screen. Turning P1 towards its "earthy" end illuminates more of the screen and vice versa.

Insert an aerial and apply group A and group C/D signals (together if possible). Adjust P2 to get a good display on the screen. If P2 is set too low the display will be cramped and vice versa. If a combined aerial signal is not available P2 can be roughly set, with an oscilloscope connected to the collector of Tr5, for sufficient drive to Tr5 just to cause saturation.

The horizontal axis can be calibrated if a signal strength meter is available, but experience has shown that this isn't particularly helpful.

Use

The analyser is best used to look for faults that make the use of a signal strength meter difficult.

Cross-modulation shows up as lots of extra frequency components that "don't belong". These are usually clustered around the frequencies of interest. This can be shown to be the case theoretically by taking the Fourier series of all the distorted waves and then finding sums and differences between the frequencies present.

Poor signal-to-noise ratio will show up as a general but even excess level of signal over the whole u.h.f. band, with the wanted signals just about rising above it.

Most striking of all is the way interference shows up, especially intermittent interference. The presence of an unwanted signal immediately draws attention to itself, especially when it comes and goes within a reasonably short time period.

When it's not doing anything else the prototype sits in the workshop fed with a combined signal from our local relay transmitter. This enables us to tell at a glance which stations are on low power or which are simply not working at all.

For the cost of a G11 which would otherwise have gone for scrap this has turned out to be a very worthwhile conversion. Some mathematical explanations of the operation of parts of the circuitry have been included to help anyone who wishes to improve on the design or to convert a different type of set.

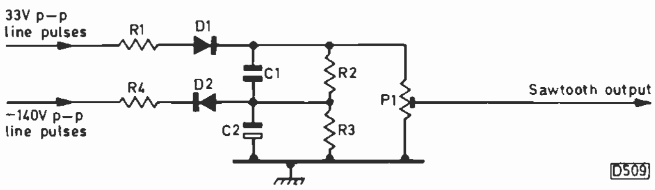


Fig. 4: Sawtooth generator – simplified circuit.

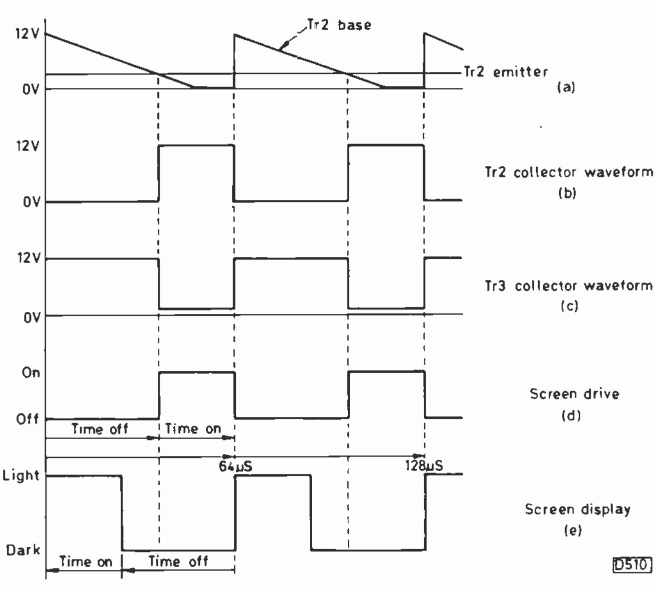


Fig. 5: Spectrum analyser waveforms. Note that as the direction of the line scan has been reversed screen display (e) is the mirror image of the drive (d).

50 Years of TV: the Beginnings

Pat Hawker

As a schoolboy visitor to the 1936 Radiolympia I was one of the 100,000 who filed past a curiously anonymous display of a dozen or so TV screens. They were showing the first transmissions from Alexandra Palace – the start of the public service was not due for another few weeks. I have no idea now whether I saw the Baird 240-line or the Marconi-EMI 405-line system in operation, and we were not encouraged to linger in front of the screens. It all seemed more of a scientific curiosity than the start of what has become the world's most powerful communications medium and the livelihood of hundreds of thousands of people.

A year later, with a special Science Museum exhibition of Scophony large-screen pictures and a more interesting Radiolympia presentation, it became clear even to this west country youth that we were at the start of something even more exciting than the cinema. But with the price tags of 12 and 10in. television receivers approaching the cost of a small car and representing many, many weeks wages few people in the 1930s had much hope of owning their own sets.

Paradoxical Beginnings

That a public service of effective television was launched by the BBC on November 2nd, 1936, ahead of the rest of the world, remains one of the more curious paradoxes of broadcasting history. That the service survived, and that by September 1939 (when it closed for the duration of World War II) it had progressed to the stage where the BBC staff of over 400 people (including some 25 programme producers) was providing, at a revenue cost of some £400,000 a year, daily programmes for about 20,000 receivers in London and the Home Counties, is equally remarkable.

For television had many powerful "enemies". These included the BBC's top people at Broadcasting House, who remained far more interested in "the wireless"; much of the radio manufacturing industry for much the same reasons; and the cinema industry which by and large successfully prevented the showing of cinema films on TV. In addition the public had become disillusioned by the press stories about TV being just around the corner, and by the lamentable failure of Baird's low-definition mechanical system which provided experimental transmissions during the early thirties. Many people still believed that just one more advance would enable them to receive pictures via a simple low-cost add-on unit attached to their radio sets. There was also a certain apathy about the service from Ally Pally, limited as it was to a few hours a day.

Slow Start

During the eighteen months following the start of the service in 1936 fewer than 2,000 sets were sold. It was not until 1938 that monthly sales (some 1,800) began to be even a trickle. There were in fact several scares during 1937 and early 1938 that the BBC was considering closing down the service altogether, as it had done Baird's 30-line service in 1934. The basis of these rumours may have been the known indifference of Sir John Reith, later Lord Reith, the BBC's first director-general, to TV. But Reith left the BBC in June 1938 and was succeeded by F.W. Ogilvie, who promptly installed a TV set in his Hampstead home and showed a keen interest in the fledgling but now expanding service.

The Early Thirties

How did it come about that the UK became the pioneer of "high-definition TV", a term then applied to 180 lines and above?

In the early thirties, due in part to the attempts by the Baird company to convince the public that its crude, dim, unsteady 30-line transmissions on the medium waves provided watchable pictures (true only for dedicated enthusiasts, not for the public at large), the UK fell well behind Germany and the renewed efforts of Dr. Zworykin (now with RCA) to develop a practical iconoscope electronic camera.

Baird's efforts did however have an important effect. They persuaded major firms such as Marconi, EMI and Cossor to initiate research, at first on better mechanical systems, then on electronic systems – despite the limitations of the cathode-ray tubes of the period. In about 1932 EMI sought to interest the BBC in its behind-the-scenes work. The BBC was interested, but was seeking to end its "exclusive" agreement with the Baird company at the earliest possible date.

During the ensuing row Logie Baird lost control of his companies to the Ostrer family, cinema magnates who already controlled Bush Radio. The new management installed Captain West, formerly in charge of BBC research, as technical manager. Baird himself was largely relegated to an experimental laboratory detached from the Crystal Palace laboratories where work was started on a mechanical/electronic 240-line system for v.h.f. (then usually termed "ultra short waves"). This drew considerably on the work being carried out by the Fernseh company in Germany on a 180-line system. In pre-Hitler days Fernseh was closely linked with the Baird company, which was one of its founder members.

With the Baird company successfully blocking the trial of EMI equipment by the BBC, the Baldwin government was persuaded to set up a "Television Committee" in May 1934. This was charged with considering "the development of television and advising the Post-Master General on the relative merits of the several systems and on the conditions under which any public service of Television could be provided". In addition to witnessing demonstrations of the various British mechanical and electronic systems members of the committee visited Germany and the USA to discover the state of the art in those countries.

The committee published its report on January 31st, 1935. It urged the early establishment of a public television service with the definition "not inferior to 240 lines, 25 pictures a second" to be run by the BBC, with the object of serving about 50 per cent of the population via ten v.h.f. transmitters, initially from a London station

An early camera dolly in use at Alexandra Palace. There were only two studios at Ally Pally and the BBC had to concentrate on programme material that could be televised inexpensively – mainly various forms of "cabaret".

using alternately the Baird and Marconi-EMI systems. It was estimated that the cost of setting up and running this service in the period to the end of 1936 would be about £180,000, all of which would come from the existing ten shilling (50p) wireless licence.

EMI's Triumph

That brilliant engineer Alan Blumlein, working at EMI, had initally developed a 243-line interlaced system to compete with the Baird 240-line sequential system. An odd number of lines is essential for an interlaced system and 243 was a convenient number, permitting the use of divide-by-three multivibrators: 243 × 50 represents the line frequency. Divide the line frequency using five divide-by-three multivibrators and you get the field frequency of 50Hz which can be locked to the mains frequency.

To steal a march on the Baird company – or perhaps just from curiosity – Blumlein decided to try an even higher definition. The easiest way was to change one divide-by-three stage into a divide-by-five arrangement. The resultant 3 × 3 × 3 × 3 × 5 provides a 405-line system. He persuaded (Sir) Isaac Shoenberg, head of the EMI team, to take the brave decision to write the higher figure of 405 lines into the EMI specification as a 50-field interlaced system. The Blumlein waveform, with its positive going video modulation and negative-going sync pulses, remained in use in the UK until January 1985!

The acceptance by the BBC of both the Baird 240-line and EMI 405-line systems was not popular with the industry. In practice however the Baird system remained in use for only a few weeks. What really won the day for the 405-line system was the sequential system's greater flicker and the convenience of the electronic camera using the Emitron tube. This had been developed at Hayes by J.D. McGee, independently of RCA's work on the similar iconoscope though in its final form drawing on some of the American work – RCA had a minority share in EMI, and there was a patent-sharing scheme between the two firms. The Baird company had over several years made great play of EMI's American connections whilst saying little about its own link with the German Fernseh company. In an agreement between EMI and Marconi the Chelmsford company became responsible for the development of the v.h.f. transmitters and aerials.

A Political Decision

It's clear however that Britain's early start of a public TV service was not primarily due to a UK technological lead. Indeed at the time when the Television Committee recommended an early start few of the major elements of either the 240-line or the 405-line system had been fully developed, nor had much work been done on receivers. It was instead a political decision, and there are those who believe that the government was influenced by the urgent need to mass-produce more robust cathode-ray tubes and v.h.f. valves and components suitable for the secret work that had already started on radar. In the event the familiarity that all sides of the industry achieved in the use and maintenance of timebases, pulse techniques and the like certainly served the UK well during the war.

The Pre-war Period

Unfortunately the pre-war TV programmes failed, with a few exceptions, to appeal much to the public. As one commentator at the time put it: "The trouble is not with television; it is the comparison with the cinema. The cinema can provide programmes of a standard that television can never hope to attain, even with an army of producers." Remember that there was no way of recording programmes in advance, except on film; that cinema films could not be shown on television; that outside broadcasts of major events were rare; and that there was no television news. Broadcasting hours increased only gradually. Much of the time was devoted to various forms of "cabaret" which could be put on cheaply. There were only two studios at Ally Pally and initially less than a hundred people worked there.

The receiver industry made desperate attempts to get prices down. Picture sizes shrank dramatically when models with five-inch c.r.t.s were introduced: some sets had no sound channel and were intended for use with a separate radio receiver. But the pre-war receivers employed valve circuitry that was destined to remain familiar for many years. The rather dim pictures were due to the use of e.h.t. voltages of around 4kV, provided by potentially lethal mains transformer arrangements – though flyback-e.h.t. was a pre-war development by Blumlein, first taken up and used in the USA after the war. Philips had developed a projection tube with a 25kV unit before the war: it gave large, flat pictures but was never very popular with viewers since one needed to sit in semi-darkness.

Closedown

From an initial total of only some 300 sets in 1936 the number of viewers increased gradually until the time when the service was abruptly closed on September 1st, 1939 – finishing for the duration of the war with a Disney cartoon. By that time some 20,000 sets were in use. The sound transmitter at Ally Pally later fulfilled a wartime role in "bending" German air-navigational beams. Many TV engineers soon found themselves working on radar.

Yes, TV was a British "first". A brave effort that we can recall with pride. But let's not kid ourselves that the entire pre-war service had as much impact on the general public as a single Greta Garbo film in that heyday of the cinema!

An Active Deflector System

Paul Goodwin

There continue to be many homes in the UK without TV, not always by choice. Despite the extensive transmitter network many small communities are without a service. The BBC and the IBA continue to build relay stations, but there's a limit to what they can provide – set by the cost per viewer reached. The situation has become worse with the closedown of the v.h.f. network and has been studied by a City University in London group. This article describes some of their work.

The simplest approach to providing a service for a small, isolated community is to rebroadcast the TV signal with or without a change of frequency. The four channels that can be picked up at a suitable receiving site could be frequency shifted en block to another position in the spectrum or shifted individually. The drawback is that the frequency processing equipment required is likely to be relatively expensive, though the approach does have the advantage of reduction in the possibility of interference with other TV sets. This approach also requires approval from the appropriate authorities. Rebroadcasting on the original channels poses the least technical problems and is inexpensive. The main technical problem is to avoid feedback between the transmitting and receiving parts of the system.

To put theory into practice we set out to design and install a TV enhancement system to provide better reception for a small community. The first problem was to find a community in need of such help. Both the BBC and the IBA keep records of people who have complained of poor reception, and with the help of the BBC Engineering Department we prepared a short list of likely locations. People being people, some of those we approached initially didn't seem to want to co-operate in the exercise. We struck lucky with our third attempt, a valley (Kilcott) in Gloucestershire.

Armed with a signal strength meter, we set off to investigate the levels of signal from the Mendip transmitter available within the confines of the valley. As predicted these were very low. The next step was to find a point with adequate signal as close to the valley as possible. Several were soon identified.

An initial approach to the eleven families resident in the valley went well. It seems that a common problem with such ideas is to get the community to agree to spend money and co-operate with one another. In this case it was agreed with the community that on completion of the scheme each participant would contribute financially to paying back the expenses incurred by the University

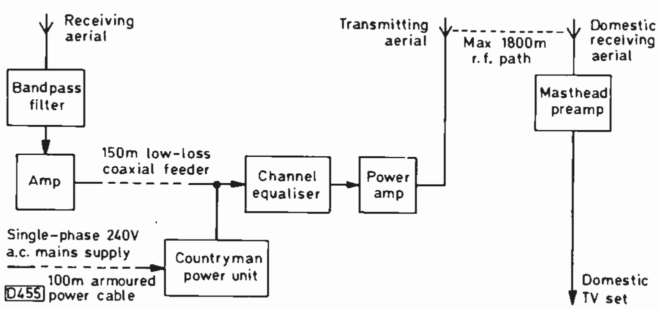


Fig. 1: Block diagram of the system. The receiving and transmission equipment is pole mounted.

group. The initial estimated cost was £1,000 for the equipment, with labour being given free.

The problems to be tackled can be summarised as follows: (1) overall design of the system, (2) design of the active deflector system, (3) arranging for a mains power supply and (4) obtaining planning permission.

Item (1) involves the following: (a) finding a site that provides a good strong signal, (b) finding a suitable transmission site that's shielded from the receiving site to avoid feedback, and (c) deciding on the power supply requirements.

The first step is to find a good location for the receiving aerial. The transmission site had to be in sight of all the dwellings to be served by the system: it ended up some 200m from the receiving site, with high ground between to provide the necessary r.f. isolation. The equipment can be powered from either an a.c. or a d.c. supply. A combination of the two types of supply was used, the d.c. required being derived from the a.c. source.

Equipment

Design of the active deflector system is best tackled by considering first what equipment is available commercially, then designing the final system around a suitable choice. A number of companies manufacture cable TV distribution products and a lot of this can be used in an active deflector system.

Fig. 1 shows the final system. A bandpass filter is used at the input to remove unwanted signals from the Wenvoe transmitter, passing the wanted signals from the Mendip transmitter. This prevents retransmission of signals other than those in the required band, minimising the chance of interference to existing services. The following amplifier, a Wolsey Countryman, boosts the received signals to a level suitable for feeding via a long length of coaxial cable to the transmitting site. As a guide, the picture displayed by a receiver connected to the end of the cable should be noise free. If this is not the case the active deflection transmitter will not have an adequate input.

The purpose of the equaliser is to provide matched outputs on all four channels so that the transmitting aerial gives a uniform output. A Wolsey Amethyst amplifier provides the system's transmission power, boosting the signal to a suitable level to drive the Jaybeam transmitting aerial.

A normal domestic TV aerial can be used for reception, but for transmission as high a quality as possible aerial should be used. In choosing the transmitting aerial the extent of the area to be covered has to be considered: the aerial must provide the required beamwidth. If a very wide beamwidth is required it may be necessay to use more than one aerial. The beamwidth should not be wider than necessary.

The greatest distance to be covered was 1,800m, but the receiving sites were very nearly in a straight line. Each domestic site was equipped with a normal, high-gain aerial and a high-power preamplifier.

The results obtained at all the domestic sites were encouraging. After initial tests it was up to the individual householders to install suitable receiving equipment – this work was undertaken by a local dealer. Because of the narrow transmission beamwidth, receiving aerial alignment was found to be more critical than for normal TV reception.

Mains power supply arrangements ended up as a compromise between cost and versatility. A 240V a.c. mains supply is taken to the transmission site, where most of the equipment is located. A discrete a.c. to d.c. power unit provides a d.c. output which is fed to the receiving site via the coaxial cable.

Receiving Aerial Alignment

Aligning the receiving aerial for maximum signal was more of a logistical than a technical problem. Because of the limited funds available all the test equipment had been borrowed from the university and was mains powered. Thus some members of the group aligned the aerial at the receiving site while others monitored the results at the transmitting site. Communication between the groups was by two-way amateur radio transceivers working at 144MHz. Without these or an alternative means of communication installation of the system would have been virtually impossible, especially testing the system and positioning the transmitting aerial with its narrow beamwidth. The two groups were licensed to use the transceivers: if CB radio is used normal conditions on owners and users apply.

Legal Aspects

Planning permission and wayleave agreements should be investigated before any financial commitment is made or any technical details are finalised. It's quite likely that the equipment will be installed on the land of someone who doesn't benefit from the system. The receiving aerial has to be erected in an area of good signal strength, so anyone living there will be receiving satisfactory TV signals. Participants in the scheme will therefore have to convince the landowner of the need for the installation and the passage of the cables across his land. A wayleave agreement is necessary where cables pass across other party's land.

Provision of the electricity by the Area Board will be subject to the same provisions though the legalities will this time almost certainly be looked after by the Board.

Planning permission has to be obtained from the local council and can be a frustrating business. The plans for the system described here took quite a few months to gain final approval: they had to be submitted several times with minor changes each time.

Before installing the system a provisional licence has to be obtained from the Home Office. This allows test and development but doesn't cover the operation of the system. An operational licence will be granted only after the system has been tested by the appropriate authority to check that it doesn't produce spurious signals that will cause interference to others. The approval procedure follows the application for an operational licence.

Acknowledgments are due to the residents of Kilcott for their support in getting the scheme off the ground, to Prof. A.J. Ellison of The City University (London) for his support of the project, to Tony Newman of The City University (London) for his help, to the BBC and the IBA for their technical advice, and to the members of the study group – Pete Knock, Steve Parker, Simon Watkins, Ken Rix, Martin Hawkins, Gary Morton, Barry Gibb, John Victor and Finbar Matthews.

Ferguson's Monochrome Monitors

J. LeJeune

The MM0 series of monochrome monitors is a relatively new product from Thorn EMI Ferguson. At a superficial glance one might assume that it uses a stripped-down TV chassis, but this would be a totally erroneous impression. Closer inspection reveals a careful and ingenious design that provides a more than adequate specification. In fact these monitors are purpose built and feature dynamic focusing, a 25MHz video bandwidth, picture geometry better than two per cent, an 80 characters per line resolution, 50/60Hz field timebase operation with automatic height adjustment between standards, and flywheel line sync. The range of 12in. (29cm) screen monitors is available with four different types of screen as follows:

MM02: Medium persistence P31 green phosphor.
MM06: Medium to long persistence LM amber phosphor.
MM07: Medium to long persistence P39 green/yellow phosphor.
MM08: Standard white screen.

The plastic cabinet contains two PCBs plus, of course, the c.r.t. The main PCB is mounted vertically to the left of the c.r.t. when viewed from the rear of the set. It contains the power supply, deflection and signal processing stages. A smaller PCB incorporates the c.r.t. socket plus the video amplifier and output stages. There are only two user controls, contrast and brightness – the power on-off switch is combined with the brightness control.

Regulated Power Supply

Fig. 1 shows the power supply circuit. Mains isolation is provided by a double-wound transformer which is protected by a thermal cut-out. This disconnects the primary winding under fault conditions. The secondary winding is protected by a 2A fuse. The single-pole on-off switch is in series with the output from the bridge rectifier which produces about 16·5V across its reservoir capacitor C31.

The following regulator circuit is a conventional series type which uses a TIP42 pnp transistor (TR11) as the series element. Note that the regulated output is a negative one, −12V with respect to chassis. This approach seems to have been adopted to simplify the video and sync processing arrangements. A green LED connected across the supply and mounted on the front panel gives an indication that the monitor is operative.

The use of a negative 12V rail makes some of the circuitry look a bit puzzling at first glance – for example the d.c. supply to the line output transistor is applied to its emitter. Additional positive supplies are provided by the line output transformer in the usual manner. The 15V boost supply is also used for some of the video and sync circuits. A 60V rail is used by the field output stage and the video output transistor (the c.r.t.'s grid is biased at −70V). There are also 400V and −245V supplies associated with the tube's first anode, focus and brightness control requirements, and of course the e.h.t. (12kV).

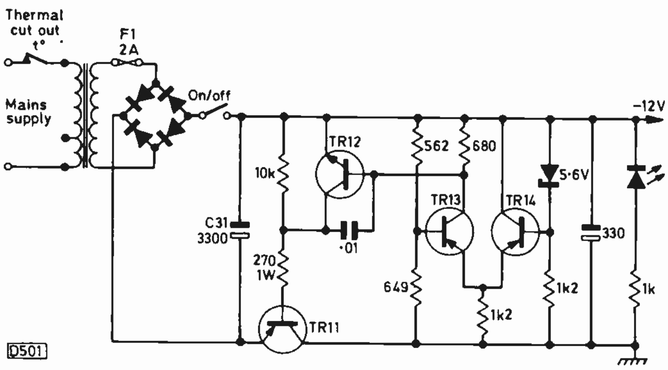


Fig. 1: The regulated power supply circuit.

Input Signal Processing

The MM0 series will accept a composite 1V peak-to-peak video signal or a 5V p-p TTL-sourced signal with composite or separate sync pulses of either polarity. The composite video input signal is expected to be positive-going.

The video/sync inputs are applied to the monitor via a 6-pin DIN socket. Fig. 2 shows the associated circuitry. Pin 5 of the socket is returned to chassis via an 82Ω resistor: this can be used to terminate the input line and also allows the monitor to be used in a rudimentary "loop-through" arrangement when more than one VDU is to be driven from the same video source.

Composite video arriving at pin 4 is limited by zener diode D4 and then a.c. coupled via C1 to the base of the emitter-follower TR1. The signal developed across its emitter load resistor R4 is coupled to the emitter of the following common-base transistor TR2 via the contrast control RV5 and R6. Pin 6 of SK1 is used for TTL-level video, which is limited by D9 and fed directly to the emitter of TR2 via R1. TR2's common-base configuration provides a low input impedance. With a 1V composite video input, operation of the contrast control varies the division ratio of the chain RV5/R6/R9. With a TTL input rather less control is available – less control is required. The division ratio this time is provided by R1, R6 and RV5 to the low impedance of TR1's emitter which virtually earths the bottom end of the divider chain. The amplified video appearing at the collector of TR2 is buffered by TR3 and coupled to the c.r.t. base board via R15 and C2, with TR4 acting as a black-level clamp. The main purpose of TR1/2/3 and the associated circuitry can therefore be said to consist of adjusting the input to provide a level suitable for feeding to the main video amplifier on the c.r.t. base board.

The circuitry in the lower part of Fig. 2 is used to provide a sync pulse input for pin 5 of the TDA2579 timebase generator chip. The negative-going sync pulse input for this chip is developed across R25.

TR6 is used to provide clean sync pulses when a composite video signal is applied to pin 4 of SK1. With no input at its emitter (via D28) TR6 is forward biased via R23. The time-constant of C1 and R21 is large and results in TR6 being shut off by D28 when a negative-going sync pulse is present. As a result a clean negative-going sync pulse of approximately 1V p-p is developed across R25. The design of the circuit allows for wide tolerances in video input levels.

Pin 1 of SK1 is intended for line or composite sync

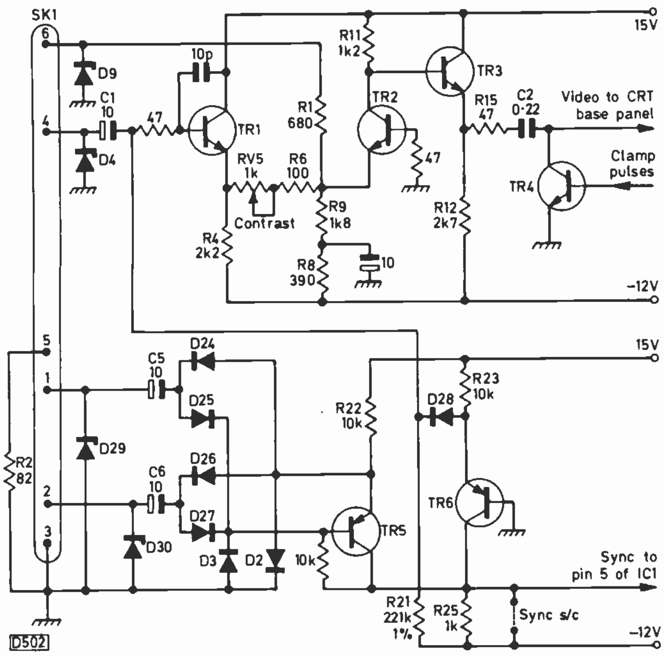


Fig. 2: The video and sync processing circuitry.

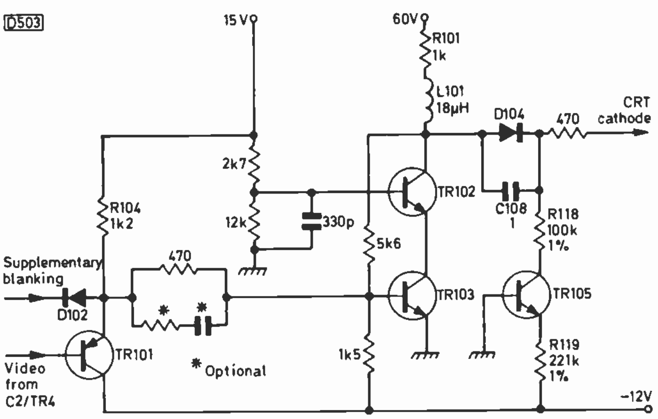


Fig. 3: The video amplifier and beam limiter circuits.

signals and pin 2 for a field sync pulse input but either pin will accept positive- or negative-going composite, field or line sync pulse inputs. As before 5·6V zener diodes provide input limiting. TR5 operates in a similar manner to TR6, being forward biased by R22 in the absence of a sync pulse input. Negative-going input sync pulses are routed to the emitter of TR5 via D24 and/or D26. Positive-going input sync pulses are routed to TR5's base via D25 and/or D27. D2 and D3 provide d.c. restoration following a.c. coupling via C5 and C6. Input sync pulses switch off TR5 to produce clean pulses across R25.

CRT Base Panel Circuitry

Fig. 3 shows the video amplifier/output circuit mounted on the c.r.t. base panel – mounting these circuits on the base panel ensures very short connection paths to the c.r.t., minimising the stray inductance and capacitance effects that can degrade the frequency response. The input from TR3 is fed to the base of the emitter-follower TR101 which drives the cascode output pair TR102/3. Use of a cascode output stage gives a high gain/bandwidth product. Load resistor R101 has a comparatively low value and the inclusion of the peaking coil L101 sharpens the transient response to ensure crisp definition. The amplifier has a bandwidth of 25MHz with rise and fall times of under 20nsec.

Beam limiting and c.r.t. grid flyback blanking circuits are also mounted on the c.r.t. base panel. With low signal voltages extra flyback blanking is applied to the video amplifier via D102. The beam limiter circuit comprises D104, TR105, C108, R118 and R119. TR105 acts as a current source for the c.r.t.'s cathode, the close-tolerance resistor R119 setting the maximum current level. If this level is exceeded D104 becomes reverse biased and the voltage at the c.r.t.'s cathode moves positively, thus reducing the beam current.

Timebase Generator Chip

As previously mentioned, a TDA2579 chip takes care of the sync and timebase generator functions. This sophisticated device processes the incoming sync signals, generates and synchronises the line and field drive waveforms, and provides the sandcastle pulse used for blanking and black-level clamping. Field lock at 50 or 60Hz is automatic, the tolerance of the system being wide enough to handle both field frequencies. Two phase-locked loops operate in the line section. One locks the line oscillator to the incoming sync pulses, the other stabilising the horizontal position of the display (line phase) by comparing the timing of the line flyback and line drive pulses. Adjustment of the line drive timing is achieved by pulse-width modulation within the i.c.

Field Output Stage

The field output stage circuit is shown in Fig. 4. Transistor TR17 is driven by pin 1 of the TDA2579 chip via R59. It acts as a class A amplifier, loaded by R65, with a positive-going sawtooth drive at its base. The scan coils are driven via R68 and D20, with C43 providing a.c. coupling. Emitter-follower TR18 is used to provide a low-impedance charging path for C43 during the flyback. The basic circuit operation is as follows: C43 is discharged via the scan coils, D20, R68 and TR17 during the forward scan, being quickly charged via the scan coils, TR18 and R69 from the 15V rail to produce the flyback. R71 is connected in series with C43 to produce for feedback purposes a signal proportional to scan current flow. The linearity control RV74 is connected across R71, which also provides height feedback via RV75. D.C. feedback via R72 sets the mid-point voltage of the output stage. The waveform developed at the junction of R33 and R32 is used as the field-frequency drive to the dynamic focus circuit.

Line Timebase

The line drive output appears at pin 11 of the TDA2579 chip. Fig. 5 shows the following circuitry – the line driver and output stages. After limiting by D22 the line drive output from the TDA2579 chip is a.c. coupled to the base of the line driver transistor TR20 by C46. This transistor is in turn a.c. coupled by C47 to the base of the Darlington line output transistor TR21 (BU806) which also incorporates a shunt efficiency diode.

The line output stage itself is conventional, but note that the −12V supply from the regulator is applied to emitters of TR20 and TR21. D8 is the boost diode which charges C14 to provide a 15V supply, with smoothing by R36 and C3. TR21's supply is in effect 27V since it's connected across the 15V and −12V rails. Most of the apparent complexity in the output stage is due to the various supplies it produces. D11 charges C15 to provide a 60V line. The e.h.t. rectifier D10 is integral with the transformer – this ensures reliability and freedom from corona. D7 charges C13 to 400V while D6 charges C12 to −245V. The focus, brightness control and first anode voltages are obtained from the resistors connected across these two supplies. This wide range voltage source permits a common chassis to be used to drive the various types of c.r.t. employed in the MM0 range.

The only unusual feature of the line output stage is the winding between pins 3 and 7 of the transformer and diode D12. This circuit is incorporated to eliminate kinking of the scan due to distortion introduced by transition delay between the conduction of the line output transistor and the efficiency diode. D12 is in effect a second efficiency diode whose conduction period is greater because of the inductance in series with it.

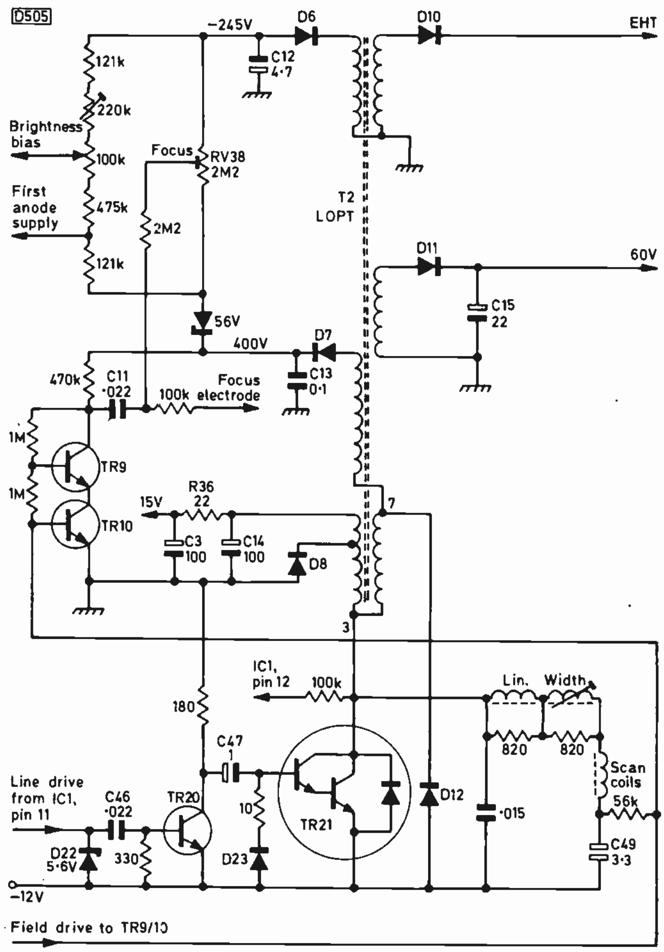


Fig. 5: The line driver, line output and dynamic focusing drive circuits.

Dynamic Focusing

Dynamic focusing is employed to take full advantage of the video amplifier's 25MHz bandwidth. It ensures that the diameter of the scanning spot is maintained over the whole screen area. The dynamic focus drive transistors TR9/10 are fed with a field-frequency signal from the junction of R33/32 and a line-frequency signal taken from the junction of the line scan coils and the coupling capacitor C49. Their output is coupled to the tube's focus electrode by C11. The focus voltage is thus modulated at both line and field frequency, preserving sharp focus over the entire screen area. No adjustments are required in the circuit.

In Conclusion

All the c.r.t.s used are of the 90° narrow-neck type. With an average consumption of only 30W and a weight of 12lb the MM0 series of monitors represent an interesting diversification by Ferguson into the computer and security market. Servicing and adjustment of these monitors should present no problems for the TV service engineer while a conservatively-rated design should ensure long-term reliability.

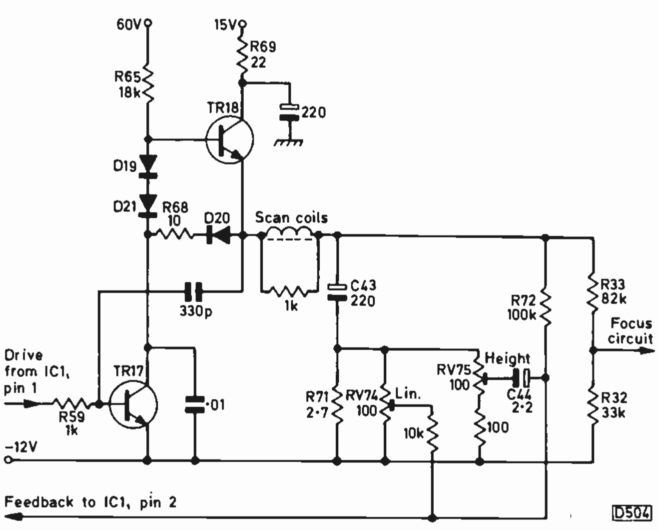


Fig. 4: The field output stage circuit.

TV Fault Finding

Reports from Larry Ingram, Hugh Allison, Alan Shaw, Philip Blundell, Eng. Tech., J. R. Armagh and Hugh MacMullen

Hitachi NP8CQ Chassis

The raster was barely visible, with no signal content. Touching the c.r.t. base restored the picture so the base panel was removed, the pins tightened, joints checked etc. then refitted. It was now impossible to get a raster – except for a very dim effort at maximum brightness and contrast. When the main chassis was pulled back to check the interconnecting leads we found that a normal raster could be obtained by tapping the vertical video panel. This was checked for dry-joints etc. and we next found that the raster was on until the panel was disturbed when it went off. Surely we must be getting warm? The panel was again checked and it then seemed to be even more difficult to get the raster to go, though the set was obviously still faulty. Connecting the scope or meter to the video panel was usually enough to clear the fault.

After much effort we realised that the line pulse feed to the video panel disappeared when the fault came on. The fault flatly refused to put in an appearance with the set in the service position, i.e. hung up by its plastic strap. It was no longer responsive to flexing or tapping and would appear only when it was good and ready. The line pulse feed is not in the form of copper print but consists of a sleeved lead from the line output panel to the rear corner of the main panel, at D711, then on to the video panel via connection B3. Resoldering this lead's joints cleared the fault – even though they appeared to be sound. **L.I.**

ITT Digi-3 Chassis

I've had quite a few of these sets through the workshop recently, all of them failing to tune in a station due to the frequency divider chip in the CMR can being faulty. When the i.c. has been replaced most of the sets have had sound but no picture, just a blank raster. Normal service is resumed when the contrast is turned up. **P.B.**

Ferguson TX100 Chassis

Issue no. 26 of *Ferguson Feedback* has an interesting tip. Don't fit a TDA4600 chopper control chip in this chassis in place of a TDA4600-2. If you do the set will trip when switched to standby. The TDA4600-2 will work in earlier Ferguson chassis without problems. **P.B.**

GEC C2290

Tripping was the problem with this set – the HM7103 voltage sensing unit was convinced that there was a fault, but where? Flexing the panel cured the fault and it turned out that there was a crack in the print by pin 1 of the line output transformer. **P.B.**

GEC C2290

For hum on the sound and a ripple on the picture check for dry-joints at C1603. It's on the sub-board that stands up at the left-hand side. **P.B.**

Grundig GSC100 Chassis

Reduced height with foldover at the centre of the screen can be a tricky fault on these sets. First check the 18·5V supply (+D) which will probably be low. If so check R626 (3·3Ω), C628 (2,200μF) etc. – note that in one case I had the trouble was due to the fuse in this supply, Si627. If the +D supply is correct check the voltage at pin C of the line output transformer – this should be 49V. If this voltage is low the excess e.h.t. protection circuit is operating and this avenue should be explored. **P.B.**

ITT CVC1200 Series Chassis

Excessive height was the problem with one of these sets but an initial check on the supplies and the height control circuit proved fruitless. The voltages around the TDA2653A field timebase chip were correct but it was noticed that there was no voltage drop across R417. The associated resistor (R416, 68kΩ) in this potential divider was open-circuit. **P.B.**

Ferguson Stereo TX9 and TX10

We've come across several of these sets with a faint whistle on sound. In each case C1104 (1μF) on panel PC1536 was missing and fitting it cured the fault. In one case the capacitor had been fitted but a wire link connecting C1104 to earth was missing. **A.S.**

Ferguson TX90 Chassis

As with all portables, it's worth making a visual inspection of the PCB for cracks, particularly around heavy components such as the line output transformer. The majority of dead TX90s seem to be due to rough handling by their owners, resulting in hairline cracks at the lower edge of the panel. **A.S.**

Ferguson 9901 Chassis

This up-dated version of the 9000 chassis can suffer from teletext and flyback lines at the top of the picture when the e.h.t. is set correctly. Increasing the value of R431 from 180Ω to about 390Ω will provide a cure. This resistor is connected in series with W402 in the field oscillator circuit. **A.S.**

Hitachi NP8CQ Chassis

There was weak colour on the lower part of the test card, but only on channels 52 and 56 – the lower channels were all right. When a red raster at the channel 52 frequency was fed in a static hum bar was seen to be present. It seemed to affect the higher varicap tuning voltages only. The culprit turned out to be the 54V supply reservoir capacitor C910 (22μF). **J.R.A.**

Vega 342

Several of these small Russian portables have come my way with the following fault: either the field hold control will not pull in a locked picture and/or it will lock at half field frequency. It's very rare for the value of a capacitor to increase, but that's what happens here. C2 on the timebase board, the larger of the two boards at the bottom, changes value from 0·1μF (the marking is actually in Russian) to about 0·2μF. As a quick check it's possible to restore lock by decreasing the value of the timing resistor, though the linearity suffers. **H.A.**

Panasonic TC2203 (U1 Chassis)

This set had an appetite for field output transistors, with the safety resistor R442 going open-circuit. The fault would occur when the set had been running for about an hour and was caused by the output stage bias diode D403 going short-circuit when hot. It immediately recovered to become a diode once more when the set was switched off. **H.MacM.**

Philips G8 Chassis

We've had problems with two of these sets recently. The first had no line output and checking back we found that the voltage at the collector of the BC147 trigger amplifier transistor Tr5514 was over 100V instead of 2·7V. The cause was an invisible dry-joint at this point (plenty of solder). The second set had the combined i.f./decoder panel, the problem being uncontrollable brightness. R3215 (1·8MΩ) on the combined panel can go open-circuit to cause this fault but was o.k. on this occasion. We eventually traced the cause to D5544 (OA91) in the beam limiter circuit on the line scan unit. The diode read 800Ω both ways, rendering the beam limiting inoperative. **H.MacM.**

Philips K30 Chassis

The fault with this set was no sound after about half an hour. This was eventually traced to an open-circuit winding on the chopper transformer – at pins 3 and 4. When the transformer was removed the never soldered Lumex wire (self-fluxing) was exposed. **H.MacM.**

VCR Clinic

Reports from Steve Beeching, T. Eng., Paul Hardy, Philip Blundell, Eng. Tech., Andrew Benham, Steve Illidge, Les Grogan, Richard Roscoe and William G. Lockitt, Eng. Tech.

The Beeching Report

Looking back over our job sheets for the last few months I see that certain repairs crop up every so often on a regular basis. Most VCR faults are random however. Here's a selection of typical faults dealt with over the past month.

Most common faults are due to mechanical wear. Lots of **Hitachi VT11** idler pulleys and some **VT33**s with the same problem. In the **Sanyo VTC5000** series replace the idlers and change the value of the resistor (R3049) in series with the reel motor drive from 2·2Ω to 1Ω – it stands up on the top left-hand corner of the PCB, beneath a heatsink. And don't forget the AL switch. It's a good idea to stock some Sharp idler pulleys as they fit Saishos and Amstrads – these need replacement every eighteen months.

I still get **Mitsubishi** machines with unsecured tape guides although it's not difficult to reset them – unless it's the HS700 portable. One HS700 gave the same symptoms although the fault was a broken PG delay adjuster, probably due to the side panel being hit.

A couple of **Grundig VS200s** produced a surprise. They would suddenly stop during play and for no apparent reason unthread. The problem was traced to the pinch roller bearings which were seizing. Lubrication provided a temporary cure but they must be replaced.

An old **JVC HR4100** portable kept blowing fuses. The power supply bridge rectifier was open-circuit, as was one of the two charge regulators and a 15V zener diode across the charge output. This diode is not always shown on the circuit diagram. After the power unit had been repaired fuses still blew due to a short-circuit on the 12V line within the machine. This was eventually traced to the operations panel where some idiot had interchanged connectors 51/53 and 31/33, with the result that the tape counter put a short on the power supply at 0000.

An **Hitachi VT64** would go into a lock-out condition when a cassette had been inserted and then removed. Unless the top cover was taken off that is. It would then function normally. The start sensor optotransistor was only just turning fully on from the cassette lamp. Replacing the transistor put matters right.

An **NEC PVC746** would go into rewind when powered. The cause was a low level end sensor oscillator.

If a **Grundig VS series** machine starts to thread up then stops, remove the plastic dust cover from the brake solenoid switch and give the contacts a clean. Then throw it away – not the machine, the dust cover.

Toshiba V71s are giving us problems due to erratic operation of the mode cam switches. Symptoms range from silly things to playing fast – the latter is due to the threading motor switching off before the threading sequence has been completed, with the result that the pinch roller has not contacted the capstan shaft fully. A modified cam switch is being supplied.

A **Sharp VC388** had no functions at all. The power supply was being held off. It was soon spotted that Q5002, a 5V regulator, had been running very hot and had failed. The very fine double-sided print was just holding on. A replacement also got very hot – due to the microcomputer chip I5002 failing and drawing excessive current. After replacing this chip all was well, but it seems rather short-sighted of Sharp to fit a regulator transistor on a PCB with such fine print that it suffers in the event of a failure.

If the clock in a **Sanyo VTC5000** resets to zero or jumps digits after a timer recording when the machine is switched back on, decoupling capacitor C3308 has gone high-impedance. Replace it with one of a higher value, say 10μF. **S.B.**

Philips VR2020

This machine would occasionally stop playing a tape. The tape would then unthread and the machine would go into what appeared to be standby, though the controls on the front wouldn't do anything – it was necessary to disconnect the mains supply for a few seconds (this resets the microcomputer i.c.). After this the machine was usable until the next failure.

After a while it became apparent that the head drum speed was varying. This was noticeable with the machine switched on in the stop mode – the audio pitch produced by the rotation of the head was varying. The voltage at pin

10 of module U280 (head servo/oscillator) was then found to be varying. As a result the d.c. conditions in the motor drive amplifier and hence the speed of the drum motor were varying. The cause was dirty contacts in the relay associated with pin 10 of the module – there are two relays selected in accordance with machine status. Fitting a new relay restored normal operation.

I've since been told that these relays (1001 and 1002) give a fair bit of trouble. Interesting that the fault managed to inhibit all the front panel controls! **P.H.**

Philips VR6460 and Clones

Creasing tapes was the complaint with this one. Sure enough when the customer's tape was played a line of bright "dropouts" was displayed. The only snag was that the same "dropouts" could be seen during a recording – and on any other machines playing in the workshop at the time. The interference was coming from the head drum motor. Fitting a replacement cured the problem. **P.B.**

Sony SLC7

As a newcomer to Sony VCRs I found this one rather baffling. The symptoms were no sound or picture in the play, E-E or record modes, but if play and pause were selected you got E-E displayed! I started by tracing where the E-E signals had gone. There was no TU reg 12V supply as the PB+DUB 12V line was not going to 0V in the E-E mode. This latter line was traced back to the AS3 board where Q423 was found to be leaky. **P.B.**

Philips VR6520/Panasonic NV370

For no cassette tray or threading motor drive check whether R1101 on the power transformer panel is open-circuit. **P.B.**

Sanyo VTC9300

The fault with this machine was that the servo lost lock on playback, whether the cassette was recorded by the machine or another one. The machine's recordings played back perfectly on a Sony SLC7. This repair was a favour for a friend who didn't want to spend money on a manual ("it's eight years old, so if it needs money spent on it I'd rather buy a new one . . ."). I'd no circuit details, but Steve Beeching provided details of the servo test points in his report in the November 1983 Clinic.

The waveform at TP104, derived from the off-tape control pulses, was jittery on playack. The capstan was cleaned and lubricated but this produced no improvement – so the fault wasn't the same as Steve's! A new set of belts was fitted and every pulley was cleaned. Still no better. I was ready to admit defeat and was just filling in the form to join the Foreign Legion when an idea struck me. Thirty seconds later I had a perfectly locked servo and a machine that was good for another eight years. In case anyone else encounters this problem, start by degaussing the control head. **A.B.**

Akai VS1

This machine wouldn't operate at all – even the red power-on indicator wasn't lit. A quick check revealed that the sensor lamp was open-circuit. Replacing this enabled the machine to be switched on but the front loading mechanism wouldn't take the cassette into the machine. We turned our attention to the loading motor drive chip IC4 on the mechacon panel. The supply voltages to pins 7 and 8 were present and the voltages at pins 5 and 6 would vary slightly as the cassette was gently pushed into the machine, but there was no output to drive the motor. The problem remained when IC4 (BA6109) had been replaced. We then found that the eject motor had failed – this had probably damaged IC4. When both these items had been replaced the cassette would load, but some machines don't know when to call it a day. It took new fast forward/rewind/play idlers to finish the job. **S.I.**

Hitachi VT33

With this machine the cassette would load but the tape wouldn't lace. A complete cure was provided by replacing IC902 (M54543L) which combines the forward and reverse switching arrangement for the front loading motor. It's mounted on the system control board. **S.I.**

Sharp VC9300

Every couple of weeks or so this machine would blow the 2·5A fuse (F9001). When we had finally ruled out any mains supply problems an educated guess was called for. The 13V rail is protected by a crowbar arrangement – thyristor Q903 and zener diode D901 on the mechacon panel. Replacing these components appears to have cured the problem (touch wood). **L.G.**

Toshiba V65

A brand new Toshiba V65 straight from the box made a nasty clonking noise in fast forward and rewind. On stripping down the reel drive gear train we found a tiny blob of glue or varnish stuck in the teeth of the take-up reel gearing. Luckily no damage had been done and we were able to scrape the teeth clean with one of our "Walkman special" screwdrivers.

These machines are well designed from the point of view of access but there's one problem. The main board is on the top of the machine and hinges up out of the way in a similar manner to many other VCRs. It's held down by two clips and two screws. Around one of these screws there's a crimped tag on a short lead connected to an earth line on the board. So when the board is lifted up this lead goes with it and, as we know to our cost, the floating tag can and will touch PCB tracks, causing additional problems if the machine is powered. Presumably this lead was an afterthought. Whatever the story the moral is clear: if you have to work on one of these machines with the main board raised, remove the lead or cover the tag with tape. **R.R.**

Panasonic NV2000

The problem with this machine was that you couldn't tune the sound and picture in together – in addition there was no sound if a prerecorded tape was played. C4019 (0·33μF) turned out to be open-circuit. **W.G.L.**

Ferguson 3V29

The fault was no fast forward/cue and rewind/review. When stop was pressed a loop of tape was left. Circuit protector CP2 in the reel drive circuit was open-circuit. Note that in some machines a resistor (R48) is used in this position. **W.G.L.**

Test Report: The Telelift

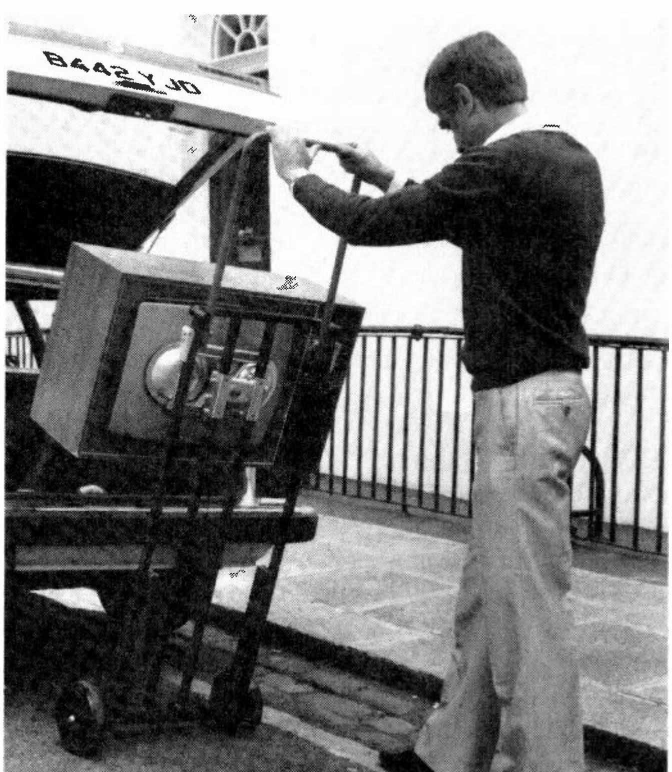
Eugene Trundle

Although the monster colour TV sets of the late sixties and early seventies are no longer with us colour TV sets with screen sizes above 50cm can still present a transportation problem. It's dangerous to attempt to lift or carry one alone, though there seems to be little alternative in the field where the need to uplift a set and take it back for workshop attention becomes obvious only on site. Even when the need for two pairs of hands can be foreseen, i.e. in the case of delivery or collection of a large set, it's expensive and often inconvenient to raise a temporary assistant, while enlisting the help of the customer can be risky from several points of view. In snowy or rainy weather, or where stairs are involved, one or both carriers may slip, with disastrous results.

As several readers of this magazine can testify, the result of back injury sustained in attempts to lift and carry large TV sets can be permanent incapacity. At the very least there is the likelihood of hand injury and damage to the set and the customer's doorways.

The Telelift provides a solution to these problems. It was developed in Australia and extensively tested there, and is now available in the UK. Basically it consists of a pair of very strong 15cm diameter suction pads which grip the glass faceplate of the picture tube and enable the set to be manoeuvred about on a wheeled frame broadly similar to a porter's hand truck (see accompanying photograph).

The suction pads are mounted on a strong plate which can be rotated. This plate is fixed to a vertical slider and has an automatic locking device to enable it to be locked at any height. The set is thus prevented from downwards movement and is held at any required height.



The Telelift in use.

The truck's frame and slidebars are made of square-section steel tube. At the bottom there are tough plastic shock-absorbing wheels and fold-away arms; at the top there's a fold-down extension handle for easy operation up and down steps. The bottom section of the frame incorporates spring-loaded slides to ease stair climbing and prevent damage to carpets or stair noses.

The first step in use is to centre the suction pads on the TV screen and to flip a pair of levers to seal the pads down. The truck and set can then be laid on the floor horizontally for easy removal of any stand and to slide the set to a convenient position lower down the frame – also if necessary to rotate the set through 90° for maximum clearance through doorways. The handle and fold-out feet are next extended. After lifting the truck and TV set to the upright position they can be wheeled off to the van or wherever.

When ascending stairs the stair-climber slides remain stationary on the nose of the step as the loaded truck is pulled up. As the wheels roll over the nose of the step the slide-bars are rapidly retracted ready for the next step. When descending stairs the slides act as skids.

Evaluation

We had the use of a Telelift for several weeks, during which it had spells with field engineers and delivery men. It was deliberately given a rough time so that any weaknesses would show up – none did.

The idea of the sucker-grippers is at first sight an alarming one, and customer's reactions varied. We soon gained full confidence in the sucker action – provided you see the rear steel disc pull in to the rubber disc a perfect seal has been made. We've been told that none of over half a million sets carried to date in this way has been dropped. The suckers are designed for use with the faceplates of conventional (1R) and FST (2R etc.) tubes and won't work with Sony Trinitron tubes – or the flat glass faceplates used on monitor-style sets (most of these can be easily moved however). We found that dirty, chipped and nicotine-stained faceplates presented no problems and that the most weighty of sets can be tackled with confidence.

The maximum lift height of 1·05m (41·5in.) is just adequate to raise a large set to our workbenches. The fold-out handle extension proved to be very useful for extra control and confidence in this situation. After a little bit of practice we found ourselves almost throwing the set and truck about . . .

The stair-climbing feature works well. Only with large sets and very tight staircases was any trouble experienced. In such a situation even two people would have to manipulate the set carefully over banister posts and around corners. The suckers apparently work well on any smooth, flat surface so that the truck can also be used to transport white goods such as fridges and washing machines. We didn't get the opportunity to try this however, and would want to experiment first in case the very thin metal sheets used these days in the manufacture of such appliances might be distorted by the sucker action.

When folded up the truck fits easily across the back of an average estate car. Alternatively it can be stowed in the front passenger compartment and safety-belted in. With a larger delivery van it could be clipped into heavy Terry-Clips high on an inside wall and out of the way.

Conclusion

If used sensibly and within the above mentioned constraints regarding sucker-pad action and screen types there's no risk that I can see in the use of this truck. It appears to be very strong, sturdy, well designed and constructed. The life of the plastic wheels is a bit difficult to predict (spares are available from Courier Handtrucks) but the rest of the ensemble gives me the impression that it will last for many years. Perhaps the only "lifespan" part is the 5mm diameter elastic which springs the stair climbers, but this is commonly available.

At first sight £139 plus VAT and carriage may look like a lot of money for what could be regarded as a glorified railway porter's truck. Examination and use of the Telelift soon convince one otherwise however. I consider that it is good value for money, representing less than the trade price of one respectable colour TV set. It should repay its cost in man hours over a few months – and provide much more if you are at all accident prone. More seriously, the cost of a damaged back is incalculable and the hassle of litigation – whether between customer and company or disabled employee and firm – is immense.

I can highly recommend the Telelift to everyone involved in field servicing and the collection/delivery of TV sets. It's available from SEME Ltd., Units 2E and 2F, Saxby Road Industrial Estate, Melton Mowbray, Leicestershire LE13 1BS (066 465 392) or Courier Handtrucks, 59 Earl's Court Road, London W8 6EE (01 937 1996).

Long-distance Television

Roger Bunney

Sporadic E conditions were relatively active during the first half of August. Sadly there was a decline towards the end of the month. Auroras provided signals in the northern part of the UK on several days later in the month, and there was just a hint of a tropospheric lift mid-month. The composite SpE log for August 1986 is as follows:

5/8/86 TVE (Spain) chs. E2, 3, 4; TVE-2 ch. E2; RTP (Portugal) E3; RAI (Italy) IA, B; +PTT (Switzerland) E2, 3; TDF C+ (Canal Plus, France) L3; TVR (Rumania) R2; TSS (USSR) R1, 2; JRT (Yugoslavia) E3; NRK (Norway) E2, 3.
6/8/86 TVP (Poland) R1; TSS R1, 2, 3; CST (Czechoslovakia) R2; NRK E2; RAI IA; JRT E3; RTP E3; TVE E2, 3, 4.
7/8/86 TSS R1; NRK E4; TVE E4.
8/8/86 TVE E2, 3; NRK E3.
9/8/86 RAI IA, B; TVE E2, 3, 4; TVE-2 E2.
10/8/86 RAI IA; ORF (Austria) E3; +PTT E2; TVE E2, 3, 4.
11/8/86 TVE E2, 3; DFF (East Germany) E4; CST R1; TVP R1; TSS R1, 2; SR (Sweden) E2, 3; NRK E2, 3, 4.
12/8/86 TVP R1, 2, 3; TSS R1, 2; SR E2, 3; DFF E4; NRK E3; DR (Denmark) E3; RAI IA.
13/8/86 TSS R1, 2, 3, 4; YLE (Finland) E3; SR E3, 4; NRK E2, 3; +PTT E3; RUV (Iceland) E3, 4; TVE E2; TVE-2 E2.
14/8/86 TSS R1, 2, 3, 4; DR E3; SR E2, 3, 4; NRK E2, 3; DFF E4; TVR R2; CST R1; ORF E2a; RAI IA, B; MTV (Hungary) R2; RUV E4.
15/8/86 SR E3; DR E4; ARD (West Germany) E4; TVE-2 E2.
16/8/86 NRK E4.
17/8/86 RAI IA; TVE E2, 3, 4; TVE-2 E2; RTP E3; TDF C+ L3.
19/8/86 SR E4; DFF E4; TVP R1; TVE E2, 3, 4.
22/8/86 SR E2; TVP R1; TSS R1, 2.
23/8/86 TVE E2.
25/8/86 CST R1; TVE E3, 4.
26/8/86 +PTT E2; RAI IB.
27/8/86 TVE E2, 3, 4; RTP E3; RAI IA, B; JRT E3; MTV R1, 2; CST R1; TVP R1; TSS R1, 2.
28/8/86 DR E3; SR E3; NRK E3.
31/8/86 TVP R1, 2.
1/9/86 TSS R1.
4/9/86 Unidentified signals on ch. R1.

The days during which Auroras produced reception in Scotland (Aberdeen) were as follows: 21st, 24th, 29th and 30th. On the first two days unidentified NRK signals were received in chs. E2 and E3. The 29th and 30th produced NRK signals in chs. E2, 3 and 4, also TSS ch. R1 on the 30th.

A small tropospheric lift was noted here on the south coast on the 11th/12th. Many French u.h.f. signals were received including TV5 on ch. 38 and TV6 on ch. 60.

I was on holiday at Ventnor, Isle of Wight for part of the month. The location was excellent for DX-TV, being several hundred feet above sea level with a clear path to the south. Reception from France was very good – in Band III and at u.h.f. I was using the previously reviewed Tandy system L/I dual-standard receiver and the Band I/III array described in the July column (Fig. 1 page 460) plus a ten-element add-on wideband u.h.f. array – the Antiference/Tandy TC10/W. The results obtained with both SpE and Tropospheric reception proved the wideband capability of the aerial system and in Band III the directivity was up to expectations.

My thanks to Bill Cotterill (Tipton), Tim Anderson (St. Leonards), Dave Shirley (Hastings), Cyril Willis (Downham Market), Dave Moller (Birmingham), Simon Hamer (Powys) and Iain Menzies (Aberdeen) for sending in reception reports to supplement my own loggings.

During the month I received an interesting tape showing a scrambled BBC-1 test transmission from Crystal Palace. This has been confirmed as a successful test for decoder operation – see later.

News Items

UK: A British Standard (BS6527) has been published defining the maximum permitted levels of r.f. radiation from electronic office and data processing equipment. These levels are 32μV/m at a distance of 30m for class A equipment (used in an industrial/commercial environment) and 32μV/m at a distance of 3m for class B equipment (used in a domestic environment). There's increasing concern over radiation from digital equipment – as I know from my own experience. One grey area is where industrial/office buildings are close to domestic property.

A study of the Ministry of Defence's use of the frequency spectrum, initially in the 470-3,400MHz band, is to be undertaken.

France: Some enthusiasts have noted recently that the "CENEX-BCH" test card identification (a network card from the Buttes Chaumont Tower in south Paris) has been changed to "CENACO ROMAINVILLE". This is a new networking centre at the Romainville Fort, Aux Lilas, one of the Paris "gateways". "Cenaco" stands for "centre national de communication".

Scandinavia: A new SR-1 (Sweden) transmitter is in operation at Visby, on ch. E39 with 1,000kW e.r.p. – the Visby ch. E5 transmitter continues in use. A 1,000kW e.r.p. transmitter with the identification "GULEN" is in operation in Norway, on ch. E29 – transmissions are at present intermittent.

Italy: A 300km, 2GHz single-hop microwave link is now in operation between Monte Pierfadne on the mainland and Monte Soro, Sicily. It operates in parallel with the Monte Famarie-Monte Soro link to provide improved service reliability during abnormal tropospheric conditions.

Australia: Coverage of the SBS (Special Broadcasting Service) has been extended to Tasmania and Western Australia, using 300kW e.r.p. u.h.f. transmitters fed via satellite. Network feeds at Brisbane, Canberra and Melbourne using signals from the same satellite are at present being tested. The Perth feed is received and delayed by two hours in winter and three hours in summer, via direct control from Sydney. A single administration for ABC and SBS is to take effect from January 1st next.

Tunisia: The ch. E4 transmitter at Ramada in the south operates at 40kW e.r.p. The choice of channel was mainly to avoid interference in Libya.

Satellite TV: During late August scrambled audio/video BBC-1 transmissions from Crystal Palace ch. 26 were noted. The encryption tests at 0130 hours, using colour bars, appear to consist of superimposed sinewaves at line and field rate: the audio was digitally encrypted. The suggestion is that these tests relate to the possibility of an eventual scrambled BBC DBS service.

The ch. E34 signal currently being received in Nicosia from the south east, consisting of the Soviet first programme, is thought to originate from a military camp taking a feed from a Gorizont downlink.

Hungary has started to relay Sky Channel programmes to hotels and tourist centres. This is the first time that a commercial W. European channel has been distributed within an Eastern Bloc country – though it's not intended for local consumption.

Publications

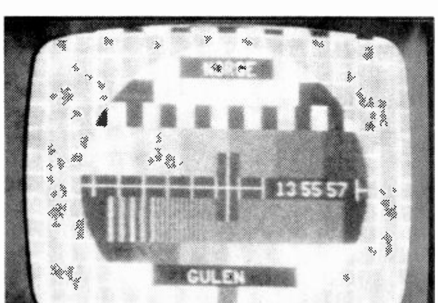
The DX-TV newsletter *Screen Europe* is now in its second edition. It's perhaps the nearest thing we'll get to a TV-DXers' club, giving news, shots of test cards, hints and tips, reviews, reception logs and so on. For more information and a sample write to Dave Shirley at 93 Alfred Road, Hastings, E. Sussex TN35 5HZ, including a 17p stamp and a stamped s.a.e.

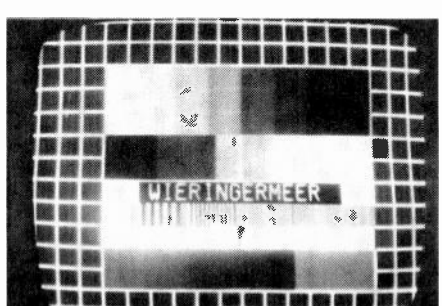
An error crept into the September column when it was suggested that the new edition of my DX-TV book will not be published until late 1987. Not so! Proofs have now been seen and checked and the book, entitled *A TV-DXer's Handbook*, should be available from Bernard Babani (Publishing) Ltd., The Grampians, Shepherds Bush Road, London W6 7NF by the end of this October.

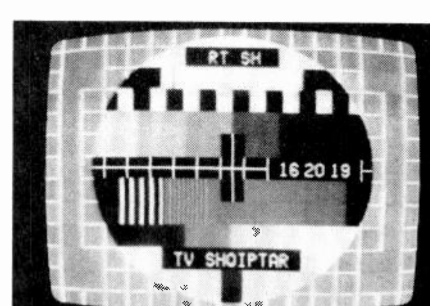
The Way We Were . . .

I was fortunate recently in obtaining some further vintage copies of *Practical Television*, as this magazine was known in its earlier days. Significant at this time when we are marking fifty years of high-definition TV is the fact that issue 1, volume 1 (April 1950) gave details of the Brussels Treaty Organisation (now the EBU) meeting in London when France, Luxembourg, Holland and the UK discussed the possible unification of TV standards. The pre-war standards were 405 lines (UK) and 450 lines (France). The UK announced its intention to continue with 405 lines (and did so for another 35 years!) while France decided on 819 lines. Holland rejected both these standards. At a conference in Zurich France had agreed to maintain a 405-line capability (to assist programme exchanges) for a further ten years while signifying its intention to adopt the 819-line standard. Other countries favoured a 625-line standard.

The October/November 1955 issues of *Practical Television* featured a two-part article on DX-TV by B.L. Morley. Part 1 covered propagation (Sporadic E and tropospheric), transmission standards and receiver circuits and mentioned a 5,000-mile DX haul between TV station PRF-3 at Sao Paula, Brazil and Halifax, Nova Scotia, also Grand Rapids, Michigan. The second part of the article provided more detail on the transmission standards then current. The French were using two systems, with 441 lines in Band I and 819 lines in Band III. The 441-line standard had double-sideband, positive-going vision. Mention was also made of two Russian transmitters, at Leningrad and Moscow – presumably transmitting in Band I. Basic circuitry was given for a dual-standard receiver, with video and line frequency switching, apparently based mainly on government surplus R1355 receivers and RF26 and RF27 front end units. The article concluded with notes on aerial systems, suggesting a four-element, horizontally polarised array for general use. The UK, low-definition Paris and Italian Turin transmitters







Left: Tropospheric reception of NRK (Norway) ch. E29 in Holland. Centre: The FUBK test pattern in use by NOS (Holland). Right: Albanian PM5534 test pattern received in Holland on ch. IC via SpE. Photographs courtesy Ryn Muntjewerff.

were using vertical polarisation, all other European transmitters using horizontal polarisation.

I'd be interested to hear from any readers with experience of early (pre-1960) DX-TV.

405-line Corner

I'm pleased to be able to report that our Dorset reader's request for a 405-line signal source has been met – a Glasgow TV firm was able to oblige. R. Lord of East Grinstead, Sussex, has the following equipment looking for a good home: (1) a Model C Radar video/sync generator, working when stored and easy to service; (2) a Taylor Model 20A circuit analyser with h.f. probe – it works as a signal tracer, audio analyser, a.c./d.c. tester and low/high resistance speaker tester (!); (3) a Decca projection TV receiver less cabinet – in three units, power supply, receiver and projection. Collection would have to be arranged. We'll pass any requests on.

Fringe Electronics VHF Head Amplifiers

Most aerial amplifiers nowadays are wideband types, covering either 470-860MHz or 40-860MHz. The Fringe Electronics range includes both wideband and narrow-band types however. There are models covering Band I (40-70MHz), Band II (88-108MHz) and Band III (170-230MHz). I decided to try out the latest Band I and Band III amplifiers which were tested for gain, stability and their bandpass characteristics – in these days of PMR, cordless phones, radio amateurs etc., high-strength out-of-band signals can cause severe overloading, making reduced/nil gain outside the frequencies required a sought-after characteristic.

The amplifiers have a stout, reusable, polythene mast-mounting strap. Internally the amplifier board is retained by two self-tapping screws, with a very efficient coaxial cable connection arrangement that gives a wide pressure contact area for the coaxial braid. Both units operate at 12V d.c., 8-10mA. On test they performed well, displaying complete stability under both terminated and unterminated input conditions. The noise figure is given as 1·9dB – earlier models had a rather higher noise figure. No equipment was available to measure this, but subjectively the results with weak signals confirm the improvement.

The voltage gain of both units at frequencies within and outside the normal TV broadcast bands was measured. Fringe provided typical measurements at spot frequencies – of particular interest were the 144MHz amateur band readings. For Model VHF1220-1, covering 40-70MHz, Fringe quote a gain of 20dB with ±1dB ripple, a noise figure of less than 1·9dB, and out-of-band gain figures of 3dB at 100MHz and −5dB at 144MHz. The gain figures I obtained were as follows: 40MHz 22dB; 45MHz 22·5dB; 50MHz 23dB; 55MHz 23dB; 60MHz 22·5dB; 65MHz 21dB; 70MHz 17dB; 75MHz 15dB; 80MHz 13·5dB; 85MHz 11·5dB; 90MHz 10·5dB; 95MHz 8·5dB; 100MHz 7dB; 105MHz 7dB; 110MHz 7dB.

The voltage gain across CCIR Band I, covering chs. E2-4, was over 20dB with a slight fall off towards the top end of ch. E4. The gain variation of 3dB within this band was considered to be acceptable. To achieve the desired bandpass characteristic the amplifier uses a simple bandpass filter at the input and two collector tuned coils. The slow fall off at the higher end of the bandwidth is a bonus for DX-TV use, since it provides a useful degree of gain over chs. R3-5 and IC.

For Model VHF1220-3, covering 175-230MHz, Fringe again quote a gain figure of 20dB ±1dB ripple and a noise figure of less than 1·9dB. The gain at 100MHz is given as −11dB and at 144MHz 7dB. My figures are as follows: 155MHz 13dB; 160MHz 15dB; 165MHz 16·5dB; 170MHz 18dB; 175MHz 18dB; 180MHz 18dB; 185MHz 16·5dB; 190MHz 16·5dB; 195MHz 16dB; 200MHz 15dB; 205MHz 14·5dB; 210MHz 15·5dB; 215MHz 16·5dB; 220MHz 17·5dB; 225MHz 19dB; 230MHz 20dB; 240MHz 15·75dB; 250MHz 3dB; 260MHz −6dB.

Within the 175-230MHz spectrum (chs. E5-12) the voltage gain showed a variation of some 5·5dB between minimum and maximum. "Useful" gain at 144MHz, rising through the PMR/Marine band, is perhaps excessive: I would have liked less gain below 170MHz to minimise the possibility of cross-modulation/overloading from potential sources of interference outside the TV band. Bipolar transistor tuners are still widely used in domestic TV sets, and will overload with the slightest encouragement! This design employs simple bandpass filtering at the input and a single collector tuned coil.

Both amplifiers have a 70mV (37dBmV) output capability.

For the last two years I've been using the earlier VHF1220-3 head amplifier which has proved to be reliable and stable. Fringe also produce a wideband v.h.f. amplifier covering 40-230MHz. The quoted typical gain is 20dB with a noise figure of 1·9dB. Many thanks to Fringe Electronics Ltd, 50 Mansfield Road, Clipstone, Mansfield, Notts NG21 9EQ (0623 643 802) for providing two random sample amplifiers for test. They have commented that the results I obtained were disappointing: the test set-ups used by Fringe and myself were not identical.

ECONOMIC DEVICES, PO BOX 228, TELFORD TF2 8QP

15/80H	3.30	2SA940	1.81	2SC535	0.79	AF180	0.55	BA656	8.99	BC560C	0.14	BDX63A	1.96	BFY52	0.27	BYX71-350	1.40
15/85R	3.30	2SA940-2	2.14	2SC536	0.41	AF181	0.53	BA7100	10.85	BC635	0.36	BDY20	1.21	BFY79	0.49	BYX94	0.16
16039	0.79	2SA950	0.72	2SC537	0.54	AF186	0.53	BA841A	28.98	BC636	0.42	BDY81	1.18	BFY90	0.61	BYY56	1.20
16181	1.04	2SA951	1.26	2SC605L	1.16	AF239	0.43	BA843	3.96	BC637	0.24	BF115	0.40	BLY49	2.20	BZY93C30	1.86
16182	1.04	2SA966-Y	1.16	2SC620	1.46	AF279	0.88	BA854	5.76	BC639	0.20	BF117	0.66	BR00	0.22	BZY88 RANGE	0.10
16334	0.98	2SA999	1.36	2SC643A	1.54	AL113	1.36	BAV18	0.21	BC640	0.24	BF118	0.67	BR01	0.75	BZX61 RANGE	0.18
16335	0.94	2SB774	1.15	2SC668	0.67	AN115	3.98	BAV19	0.11	BC879	0.39	BF121	0.25	BR03	0.75	BZX79 RANGE	0.10
16446	0.98	2SB185	1.13	2SC681	4.40	AN155	1.89	BAV20	0.31	BC880	0.31	BF123	0.21	BR03	1.26	C106D	0.46
16600	1.38	2SB375	3.87	2SC682	1.88	AN206	2.58	BAV21	0.34	BCX34	0.40	BF127	0.13	BRC116	0.67	C106M	0.76
16802	1.27	2SB400	0.40	2SC684	1.65	AN208	3.55	BAW62	0.19	BCY70	0.30	BF137	0.29	BRC300	2.01	C1129	0.58
17052	5.61	2SB405	1.03	2SC693	0.63	AN210	2.28	BAX12	0.44	BCY71	0.21	BF153	0.58	BRC5296	0.77	CA3046	2.06
17053	5.61	2SB407	3.24	2SC710	0.69	AN211	3.25	BAX13	0.11	BCY72	0.20	BF154	0.26	BRC6109	0.83	CA3089	0.83
17074	9.30	2SB449B	6.98	2SC711A	0.50	AN214Q	2.75	BAX16	0.11	BD115	0.46	BF157	0.33	BRC82	1.08	CA3090AQ	3.25
17089	5.35	2SB511	2.50	2SC717	1.28	AN231	14.65	BC107	0.13	BD116	0.70	BF158	0.18	BRC83	2.19	CA3094	2.20
17127	3.51	2SB54	1.39	2SC734	1.43	AN234	5.92	BC107A	0.11	BD124	1.31	BF159	0.18	BRC84	2.08	CA3131EM	3.12
17376	1.58	2SB546	3.75	2SC761-Y	0.95	AN236	3.78	BC107B	0.18	BD124P+KIT	0.69	BF160	0.31	BRX44	0.60	CBF16848N-071	1.56
17523	1.32	2SB56	2.80	2SC783	3.98	AN239	6.95	BC108	0.15	BD131	0.42	BF167	0.38	BRX49	0.53	CD4001	0.38
17524	1.32	2SB618A	2.22	2SC790Y	1.64	AN240P	1.52	BC108B	0.15	BD132	0.42	BF173	0.34	BRY39	0.69	CD4002	0.27
1N4001	0.06	2SB631	3.25	2SC828	0.28	AN241	1.71	BC109	0.12	BD133	0.53	BF177	0.35	BSS38	0.87	CD4008	1.35
1N4002	0.06	2SB643	0.61	2SC867A	3.05	AN245	4.49	BC109B	0.15	BD135	0.36	BF178	0.40	BSTBD140G	5.25	CD4011	0.29
1N4003	0.06	2SB669	3.67	2SC876	0.96	AN253	2.97	BC109C	0.12	BD136	0.26	BF179	0.36	BSTC0246	7.25	CD4012	0.24
1N4004	0.06	2SB681	3.96	2SC930	0.54	AN260	3.85	BC113	0.14	BD137	0.36	BF180	0.36	BSTC0233	7.25	CD4013	0.47
1N4005	0.08	2SB695	1.98	2SC935	4.13	AN262	1.98	BC119	0.36	BD138	0.46	BF181	0.32	BSTCC0143	3.07	CD4016	0.46
1N4006	0.08	2SB75	1.04	2SC936	8.66	AN272	7.92	BC126	0.23	BD139	0.34	BF182	0.34	BSTD1043	2.85	CD4017	0.82
1N4007	0.07	2SB774	0.72	2SC940	4.68	AN281	6.65	BC132	0.14	BD140	0.37	BF183	0.39	BSV57B	3.49	CD4020	1.23
1N4148	0.04	2SB819	0.89	2SD1128	2.90	AN295	5.52	BC135	0.14	BD144	1.70	BF184	0.43	BSW68	0.60	CD4021	0.39
1N4448	0.05	2SC1034	6.75	2SD1138	1.07	AN301	5.55	BC137	0.18	BD150	1.25	BF185	0.39	BSX19	1.29	CD4023	0.28
1N5401	0.14	2SC1050	5.06	2SD1273	1.25	AN302	3.99	BC138	0.34	BD157	0.67	BF194	0.14	BSX20	0.34	CD4025	0.64
1N5402	0.15	2SC1096	1.16	2SD1453	0.75	AN303	4.39	BC139	0.28	BD160	1.60	BF195	0.14	BSY52	0.50	CD4028	0.84
1N5403	0.16	2SC1104	3.98	2SD152K	2.64	AN305	9.47	BC140	0.45	BD163	0.71	BF196	0.17	BSY79	0.51	CD4040B	0.85
1N5404	0.15	2SC1106	4.54	2SD198	3.87	AN315	2.46	BC141	0.34	BD165	0.62	BF197	0.16	BT100A	1.61	CD4047	1.06
1N5408	0.35	2SC1114	6.75	2SD234	0.49	AN316	5.53	BC142	0.34	BD166	0.42	BF198	0.17	BT106	1.55	CD4049	0.46
1N914	0.04	2SC1116	4.95	2SD235	0.60	AN318	6.27	BC143	0.33	BD168	0.73	BF199	0.17	BT108	1.45	CD4052	0.75
IR3403	5.00	2SC1124	1.26	2SD24	2.29	AN320	5.47	BC147	0.08	BD175	0.60	BF200	0.37	BT119	1.76	CD4066	0.38
1S1555	0.20	2SC1129	0.34	2SD257	2.94	AN321	2.25	BC148A	0.10	BD179	0.49	BF218	0.36	BT120	2.17	CD4069	0.29
1S44	0.10	2SC1131	0.50	2SD292	2.59	AN322	5.85	BC148B	0.13	BD181	0.99	BF224	0.17	BT121	2.48	CD4070	0.66
1S5012A	0.81	2SC1158	3.33	2SD313	2.59	AN331	4.59	BC148C	0.11	BD182	0.99	BF237	0.65	BT123	1.98	CD4081	0.35
1S921	0.10	2SC1162	1.05	2SD325D	1.95	AN337	5.37	BC149	0.11	BD183	0.99	BF240	0.17	TBA970	3.06	CD4093	0.72
2N1303	0.38	2SC1172	2.22	2SD348	16.13	AN340P	1.17	BC149B	0.13	BD184	1.21	BF241	0.17	BT151-800R	1.15	CD4511	1.10
2N2219A	0.40	2SC1195	3.26	2SD350	5.20	AN355	5.98	BC153	0.14	BD187	0.53	BF245	0.50	BTT6018	2.42	CD4528	2.04
2N2222	0.38	2SC1212A	1.97	2SD350A	2.80	AN362	1.75	BC154	0.14	BD189	0.69	BF245A	0.52	BTT8124	4.89	CD4556	1.47
2N2646	0.80	2SC1213	0.89	2SD353	7.50	AN370	3.95	BC159	0.36	BD190	0.69	BF245B	0.49	BU106	2.48	CR02AM-8	1.55
2N2904	0.36	2SC1226	1.46	2SD389	2.41	AN5010	5.70	BC160	0.40	BD201	0.53	BF246A	2.52	BU108	1.50	CV12E	3.07
2N2905	0.43	2SC1293	0.90	2SD401	2.55	AN5111	2.92	BC161	0.28	BD202	0.60	BF255	0.20	BU109	2.65	CX095D	3.14
2N2906	0.38	2SC1306	1.98	2SD414	1.98	AN5120N	4.50	BC168	0.36	BD203	0.50	BF256	0.28	BU110	5.69	CX104	9.64
2N2926	0.15	2SC1316	4.10	2SD471	2.13	AN5132	4.39	BC169C	0.16	BD204	0.61	BF256LB	0.42	BU111Y	4.16	CX108	10.50
2N3053	0.27	2SC1317	0.87	2SD560	2.95	AN5250	3.98	BC170	0.16	BD207	1.79	BF256LC	0.42	BU125	2.48	CX109	7.86
2N3054	0.99	2SC1364	0.49	2SD588A	2.36	AN5435	3.08	BC171	0.11	BD208	2.34	BF257	0.34	BU126	1.55	CX130	8.76
2N3055	0.61	2SC1383	1.20	2SD600	3.25	AN5610	7.43	BC172	0.13	BD222	0.49	BF258	0.36	BU137	9.25	CX134	11.04
2N3442	1.56	2SC1391	2.45	2SD601R	0.65	AN5612	4.12	BC172B	0.27	BD225	0.49	BF259	0.34	BU205	1.08	CX136	11.49
2N3702	0.14	2SC1398	0.94	2SD613	1.03	AN5613	4.63	BC173	0.17	BD228	0.63	BF262	0.57	BU206	1.27	CX139	11.83
2N3703	0.14	2SC1413A	3.05	2SD621	12.85	AN5630	3.95	BC174B	0.27	BD229	1.05	BF263	0.57	BU207	1.65	CX157	4.84
2N3705	0.16	2SC1446	1.25	2SD636	0.55	AN5701N	1.66	BC177	0.20	BD232	0.50	BF271	0.34	BU208	1.12	CX158	4.10
2N3706	0.14	2SC1447	2.07	2SD639-R	0.85	AN6250	2.95	BC178	0.26	BD234	0.42	BF273	0.20	BU208/02	1.97	CX177	6.75
2N3707	0.16	2SC1475	0.37	2SD655	0.98	AN6300	7.00	BC179	0.26	BD237	0.47	BF274	0.20	BU208A	1.12	CX187	5.26
2N3711	0.11	2SC1505	1.00	2SD657	2.85	AN6310	8.74	BC182	0.09	BD238	0.39	BF324	0.35	BU208D	1.95	CX755	12.95
2N3771	2.04	2SC1514	1.41	2SD661A	0.80	AN6320N	4.28	BC182L	0.10	BD239	0.45	BF336	0.33	BU209	1.93	CX885A	6.85
2N3772	1.71	2SC1573Q	1.25	2SD731	2.45	AN6340	11.00	BC182LB	0.14	BD240	0.37	BF337	0.40	BU226	2.95	DEC1	2.20
2N3773	2.29	2SC1578	8.74	2SD773	0.33	AN6341	5.98	BC183L	0.11	BD241	0.39	BF338	0.44	BU326	2.00	DEC2	2.20
2N3819	0.42	2SC1583	1.17	2SD811	5.54	AN6342	1.61	BC183LB	0.26	BD242	0.39	BF355	0.49	BU326A	2.20	DS3486N	4.33
2N3823	1.17	2SC1617	3.89	2SD823	1.98	AN6363	16.00	BC184	0.13	BD243A	0.37	BF362	0.66	BU326S	2.20	DS3487N	4.33
2N3904	0.62	2SC675	1.41	2SD837	1.56	AN6371	9.24	BC184L	0.14	BD243C	0.79	BF363	0.60	BU406	1.49	E1222	0.40
2N3908	0.62	2SC1678	1.98	2SD841	3.65	AN6387	7.95	BC184LB	0.26	BD244	0.51	BF371	0.50	BU406D	1.79	E5024	0.28
2N4101	1.33	2SC1741	1.25	2SD856	2.25	AN6531	1.95	BC186	0.27	BD244C	0.79	BF391	0.25	BU407	0.82	E5386	0.25
2N4240	3.30	2SC1810	1.70	2SD857Q	1.84	AN6551	1.35	BC187	0.28	BD245C	0.99	BF417	0.84	BU407D	1.09	E9003	0.46
2N4444	1.73	2SC1815	0.66	2SD882	1.50	AN6552	0.68	BC204	0.16	BD246C	0.89	BF418	1.87	BU412	9.15	E9005	0.50
2N5293	0.50	2SC1826	0.65	2SD894	1.50	AN6610	2.40	BC207	0.14	BD253	1.05	BF422	0.29	BU426A	1.67	ESM310BP	4.15
2N5294	0.50	2SC1829	2.22	2SD898	5.45	AN6677	8.95	BC212	0.11	BD278A	0.80	BF423	0.52	BU500	1.95	FND500	5.78
2N5296	0.49	2SC1875	5.19	2SK105H	2.15	AN7111	1.45	BC212B	0.26	BD317	2.60	BF450	0.35	BU508A	1.75	GC374	1.65
2N5297	0.50	2SC1881K	2.98	2SK152	2.95	AN7114E	5.94	BC213L	0.10	BD318	2.85	BF451	0.29	BU536	5.80	GD243	4.95
2N5298	0.61	2SC1893	3.02	2SK34	0.76	AN7115	2.55	BC213LB	0.15	BD375	0.42	BF457	0.41	BU608	2.65	GF758	0.84
2N5771	1.18	2SC1906	0.98	2SK41	1.07	AN7120	4.65	BC214	0.10	BD380	0.76	BF458	0.39	BU705	4.07	GH3F	1.82
2N6109	1.58	2SC1921	1.37	2SK79	2.98	AN7145	2.80	BC214LB	0.26	BD410	0.52	BF459	0.52	BU806	1.79	HA11215	4.50
2N6130	0.72	2SC1923	1.07	40408	0.50	AN7146	4.35	BC225	0.40	BD433	0.47	BF460	1.56	BU807	0.80	HA11211	2.53
2N6133	1.25	2SC1929	2.25	40594	1.53	AN7151	2.26	BC237	0.10	BD434	0.49	BF469	0.31	BU826A	2.15	HA11225	4.29
2N6180	0.95	2SC1942	5.70	40636	1.43	AN7156	2.85	BC237BJ	0.12	BD435	0.49	BF470	0.55	BUW84	1.39	HA11226	8.71
2N6292	1.65	2SC1945	4.53	4EX581	0.80	AN7158	6.75	BC238	0.10	BD436	0.60	BF471	0.31	BUX84	1.00	HA11229	2.88
2N696	0.43	2SC1959	0.45	741	0.30	AN7218	1.64	BC238A	0.13	BD437	0.49	BF472	0.33	BUX85	1.10	HA11235	2.48
2N698	0.43	2SC1957	1.09	7805-T022	0.63	AN7223	4.25	BC238B	0.13	BD438	0.40	BF479	0.61	BUY69A	2.04	HA11124	5.25
2SA1006	1.50	2SC1953	1.93	7806	0.73	AU107	3.50	BC239	0.12	BD441	1.42	BF480	1.38	BY126	0.13	HA11244	2.82
2SA1011	1.65	2SC1962	1.93	7808	0.85	AU110	2.25	BC239B	0.25	BD442	0.66	BF491	1.99	BY127	0.13	HA11251	4.47
2SA1015	0.49	2SC1969	3.10	7812-T022	1.16	AU113	5.25	BC251A	0.31	BD509	1.42	BF495	0.64	BY133	0.11	HA1125	4.29
2SA1012	1.25	2SC1983	8.35	7815	0.64	AY105K	2.08	BC294	0.50	BD510	1.07	BF496	0.43	BY164	0.47	HA1137W	2.87
2SA1020Y	0.86	2SC1985	1.55	7818	0.92	AY106	1.09	BC300	0.35	BD519	1.50	BF509	0.41	BY176	0.52	HA1138	5.03
2SA1027R	0.45	2SC2009	0.34	7824	0.64	BA524	8.21	BC301	0.45	BD529	1.32	BF523	0.24	BY179	0.62	HA11414	5.65
2SA473	0.75	2SC2029	2.33	7905	0.80	B250	2.65	BC302	0.53	BD530	1.18	BF532	0.45	BY182	1.05	HA1144	7.87
2SA766S	4.95	2SC2028	2.11	9368	10.70	B40	1.55	BC303	1.04	BD533	0.67	BF596	0.18	BY184	0.47	HA1156	1.16
2SC1173Y	1.25	2SC2063	0.99	AA133	0.12	BA130	0.14	BC307	0.18	BD534	0.53	BF597	0.27	BY187	0.77	HA1160	4.78
2SC1474	1.25	2SC2078	0.95	AC133	0.12	BA1310	1.98	BC307A	0.14	BD535	0.79	BF694	0.22	BY189	1.79	HA1166	5.25
2SC1509	1.35	2SC2073	1.54	AC123K	0.43	BA1320	1.38	BC308	0.18	BD536	0.61	BF757	0.59	BY198	1.62	HA1166X	5.36
2SD1391RL	3.95	2SC2085-Q	1.40	AC127	0.27	BA1322	3.95	BC308A	0.11	BD537	0.74	BF759	0.47	BY201/2	1.50	HA1167	5.36
2SA1095	4.10	2SC2091	1.30	AC128	0.34	BA1330	2.75	BC309	0.17	BD538	1.45	BF761	1.05	BY203/20	0.59	HA11706	9.50
2SA1103	6.55	2SC2141	1.86	AC138	0.24	BA145	0.19	BC317A	0.13	BD544B	0.83	BF762	0.75	BY207	0.22	HA11705	8.00
2SA329	0.40	2SC2166	1.98	AC141	0.29	BA148	0.33	BC327	0.15	BD598	1.25	BF869	0.47	BY208	0.46	HA11703	4.95
2SA351	1.17	2SC2216	0.69	AC142K	0.44	BA154	0.40	BC328	0.11	BD677	0.53	BF870	0.30	BY210-400	0.18	HA11701	4.56
2SA489	1.17	2SC2233	2.20	AC151	0.28	BA155	0.12	BC337	0.09	BD679	0.57	BF959	0.42	BY210-600	0.27	HA11710	9.50
2SA490	2.25	2SC2236	1.65	AC176	0.30	BA156	0.05	BC338	0.34	BD680	0.76	BF960	0.69	BY210-800	0.34	HA11713	8.13
2SA493	2.25	2SC2278	1.25	AC179	0.28	BA159	0.15	BC368	0.24	BD681	1.48	BF970	0.69	BY218	1.64	HA11711	20.16
2SA562	0.57	2SC2314	2.17	AC183	0.72	BA182	0.24	BC440	1.09	BD696	2.47	BFR39	0.44	BY223	1.23	HA11715	8.13
2SA564	0.58	2SC2335-KI	10.41	AC187	0.39	BA222	1.66	BC441	0.44	BD699	3.49	BFR61	0.50	BY224-600	1.88	HA11714	7.76
2SA614	4.88	2SC2551	1.26	AC187K	0.43	BA302	1.24	BC454	0.36	BD700	3.70	BFR62	0.50	BY225-100	1.13	HA11716	13.10
2SA628	1.14	2SC2565	3.72	AC188	0.25	BA311	1.32	BC460	0.42	BD707	1.06	BFR79	0.29	BY226	0.25	HA11725	18.26
2SA639S	1.50	2SC2570	1.85	AC188-01	0.49	BA312	0.97	BC461	0.47	BD709	1.12	BFR81	1.65	BY227	0.49	HA11725MP	16.00
2SA659	0.49	2SC2577	1.75	AC188K	0.43	BA313	0.76	BC462	1.15	BD710	0.80	BFR86	1.08	BY228	0.60	HA117555P	6.23
2SA673	1.27	2SC2578	6.75	AC193K	0.65	BA317	0.08	BC463	0.64	BD809	0.85	BFR89	1.63	BY229-1000	1.12	HA11781	8.90
2SA684	1.61	2SC2671	1.99	AC194K	0.65	BA318	0.09	BC477	0.37	BD810	0.69	BFR90A	1.30	BY229-600	0.92	HA1180	5.15
2SA697	0.82	2SC2826	2.07	AD140	1.06	BA328	4.77	BC478	0.32	BD879	0.74	BFT42	0.43	BY255	0.69	HA1196	7.43
2SA699	1.75	2SC288A	1.85	AD143	1.41	BA333	1.37	BC479	0.41	BD880	0.79	BFT43	0.43	BY295-600	1.03	HA13001	6.25
2SA715	0.95	2SC3153	5.26	AD145	1.60	BA335	6.27	BC532	0.28	BD895	2.31	BFT84	0.40	BY298	0.20	HA1306	2.26
2SA747	8.26	2SC372	1.40	AD161	0.56	BA5102A	3.78	BC546	0.17	BD899	2.48	BFW10	0.60	BY299	0.60	HA1338	7.50
2SA748	1.36	2SC373	1.16	AD162	0.45	BA511	2.92	BC547	0.10	BD901	0.79	BFX29	0.34	BY407	0.84	HA1339	2.33
2SA817	0.65	2SC383	1.33	AD262	1.25	BA514	2.20	BC548	0.10	BD902	0.84	BFX84	0.37	BY409	1.49	HA13402	7.87
2SA818	1.82	2SC388	0.50	AF114	2.47	BA521	2.52	BC549	0.10	BDW83C	1.56	BFX85	0.41	BY448	0.69	HA13342	2.65
2SA835	2.50	2SC394V	0.81	AF115	1.24	BA524	8.94	BC550	0.40	BDW84C	1.56	BFX86	0.36	BY713	1.10	HA13365	4.02
2SA836	0.89	2SC403C	0.39	AF118	1.20	BA526	7.98	BC556	0.16	BDX32	1.75	BFX87	0.55	BYW19/1000	0.69	HA1366WR	1.86
2SA844	0.35	2SC41	2.19	AF127	0.50	BA527	2.98	BC557	0.10	BDX53A	4.93	BFX88	0.34	BYW56	0.34	HA1367	4.32
2SA872	0.70	2SC458	0.39	AF139	0.53	BA532	1.56	BC558	0.10	BDX53B	3.35	BFX89	0.44	BYX10	0.29	HA1368R	2.45
2SA884	2.15	2SC495	0.92	AF178	1.45	BA536	2.95	BC559	0.10	BDX54B	2.16	BFY50	0.32	BYX55-600	0.19	HA1368	1.90
2SA937R	0.97	2SC515A	2.85	AF179	0.55	BA6209	4.75	BC559B	0.11	BDX62A	2.15	BFY51	0.50	BYX71-600	1.25	HA1370	3.71

IF YOU DON'T SEE IT LISTED ASK FOR QUOTE. GIVE MAKE MODEL LOCATION. REMEMBER TO ADD 0.60p POST & HANDLING. ADD 15% VAT TO TOTAL

TEL 0902 712083 TELEX 338490

HA1374	4.80
HA1377	4.98
HA1389R	2.05
HA1389	2.39
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HA1394	3.95
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HISH1002	9.50
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DC72	0.44
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SG613	8.75
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SKE2G3/04	1.05
SKE4F1/06	0.73

SKE4F2/08	1.24
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SN76708	4.86
SN76709N	25.54
SN76707N	5.11
SN76705N	1.34
SN76730	5.36
SN76810N	0.60
SN76832N	3.25
SN94041	5.54
SN94042	4.35
SP8385	0.55
SPS5384	1.98
ST1702L	0.99
STA401	6.76
STA441C	2.75
STA471C	7.56
STK0029	5.54
STK0039	5.35
STK0040	12.00
STK0050	7.67
STK0080	9.16
STK011	5.08
STK013	9.25
STK014	9.80
STK015	7.75
STK016	6.94
STK022	5.25
STK025	12.50
STK031	12.95
STK040	9.40
STK043	13.44
STK054	7.13
STK058	18.25
STK077	7.67
STK078	8.52
STK080	16.50
STK082	11.86
STK086	13.59
STK1039	5.75
STK2110	7.33
STK2145	16.25
STK2230	7.70
STK2240	14.40
STK2250	18.95

STK3042	11.05
STK3044	5.75
STK4019	4.50
STK430	11.75
STK433	4.95
STK4332	8.25
STK435	5.94
STK4352	12.25
STK436	7.21
STK437	7.80
STK4372	3.85
STK439	8.31
STK441	11.28
STK443	10.29
STK457	13.45
STK460	14.83
STK461	9.68
STK463	11.53
STK466	11.77
STK4833	16.95
STK501	6.32
STK502	5.74
STK5314	9.48
STK5730	3.95
STK7216	12.67
STK772	6.95
STR1096	5.20
STR4090	11.98
STR440	7.85
STR441	6.50
STR451	4.95
STR453	8.16
STR454	7.50
STR6020	8.31
T6029V	5.75
T6035V	0.73
T6036	0.67
T6037	2.11
T6044V	0.97
T6045	1.20
T6049	1.45
T6052V	0.87
T6058	3.08
T6059	0.65
T9003V	1.25
T9005V	2.38
T9011V	0.49
T9013V	7.96
T9014V	2.60
T9016	1.02
T9019W	1.98
T9034V	1.45
T9035V	2.33
T9051	7.45
T9054V	1.15
T9057V	0.70
T9062V	0.49
T9064	1.51
TA6002	4.35
TA7027	4.80
TA7050	1.74
TA7051	1.74
TA7054	2.55
TA7060AP	0.71
TA7061AP	1.27
TA7069	3.13
TA7070P	1.83
TA7072P	2.57
TA7073P	5.86
TA7074P	1.98
TA7076P	7.80
TA7089P	3.10
TA7092P	8.65
TA7093P	3.99
TA7102P	5.88
TA7108P	1.61
TA7109	3.71
TA7122B/P	0.92
TA7124P	2.34
TA7129P	1.50
TA7130P	1.27
TA7136AP	1.27
TA7137P	0.98
TA7141AP	3.87
TA7146	2.50
TA7146P	4.23
TA7148P	1.67
TA7149P	3.26
TA7152P	1.91
TA7153P	7.47
TA7161P	5.45
TA7162P	3.25
TA7169	9.54
TA7172P	1.41
TA7176P	2.48
TA7193AP	6.67
TA7193P	5.50
TA7201P	2.71
TA7203P	2.18
TA7204P	2.16
TA7205P	1.38
TA7206P	6.35
TA7207P	3.34
TA7208P	2.15
TA7210P	3.58
TA7214P	3.63
TA7215P	2.58
TA7217AP	1.45
TA7222	1.95
TA7226	3.57
TA7227P	2.81
TA7229P	4.45
TA7230P	4.98
TA7232P	6.60
TA7233P	6.95
TA7240AP	7.83
TA7245P	7.50
TA7270	7.50
TA7310P	2.15

TA7312P	2.45
TA7313AP	1.50
TA7314	5.94
TA7323P	3.15
TA7325P	1.15
TA7339P	1.60
TA7340P	5.06
TA7607AP	13.90
TA7609	3.28
TA7611AP	4.80
TA7616P	5.25
TA7622AP	8.94
TA7628P	5.98
TA7629P	7.50
TA7630P	2.98
TA7640AP	1.55
TA7672P	2.25
TA7676P	2.81
TA7726P	10.25
TAA320A	1.27
TAA350A	6.45
TAA570	1.74
TAA621AX1	4.85
TAA621A12	2.14
TAA661B	2.62
TAA691	8.58
TAA700	3.75
TAA930	4.87
TAA970	2.83
TAA110	2.52
TAG232-600	0.73
TAG626-600	1.06
TBA120AS	1.24
TBA120SB	1.05
TBA120T	0.95
TBA120U	2.50
TBA120A	1.05
TBA1440	2.03
TBA1441	1.62
TBA1440G	5.20
TBA1441	2.80
TBA240A	3.99
TBA395	1.10
TBA395Q	1.10
TBA396	2.90
TBA400	2.39
TBA440P	2.45
TBA480Q	1.30
TBA500P	6.58
TBA510	2.11
TBA520	1.84
TBA520Q	1.68
TBA530	1.30
TBA530	1.30
TBA540	1.15
TBA540Q	1.15
TBA560C	1.40
TBA560CQ	1.60
TBA570Q	1.60
TBA570A	1.71
TBA641A12	4.13
TBA641B72	3.03
TBA651	1.76
TBA673	2.60
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TBA720	1.55
TBA730	3.55
TBA750Q	2.90
TBA760	1.71
TBA800	1.20
TBA810S	1.61
TBA810T	1.50
TBA810AS	1.00
TBA820	1.52
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TBA920	1.89
TBA920Q	2.31
TBA940	1.87
TBA950	1.84
TBA970	3.56
TBA990	1.82
TBA990Q	1.68
TC4001BP	3.25
TC4011BP	3.50
TC4013BP	3.75
TC4016BP	3.15
TC4053BP	4.34
TC4069	2.25
TC4071BP	2.76
TC4081BP	3.25
TC40H000	1.98
TC4514BP	4.15
TC9002BP	13.10
TCA270Q	1.71
TCA270S	2.15
TCA270SQ	1.65
TCA290A	2.39
TCA420A	2.16
TCA440	2.25
TCA530	2.24
TCA640	7.36
TCA650	2.04
TCA660B	3.30
TCA730	3.81
TCA750	2.25
TCA800Q	6.95
TCA830S	2.38
TCA890	5.44
TCA900	2.04
TCA910	1.65
TCA940	1.80
TCA940E	2.93
TCE330	3.89
TCEP100Q	10.25
TCEP100	9.61
TD3406AP	3.98
TD3F800R	3.92
TD3F900H	4.16

TD62105P	2.50
TD62104P	2.50
TD62706P	4.50
TDA1001B	2.31
TDA1003A	2.25
TDA1005A	2.22
TDA1006A	2.11
TDA1010AF	4.25
TDA1011	2.98
TDA1010	1.15
TDA1011A	3.25
TDA1028	2.45
TDA1034B	2.42
TDA1035S	2.95
TDA1035T	2.55
TDA1037	1.98
TDA1037D	2.05
TDA1044	2.62
TDA1047	4.10
TDA1059B	0.98
TDA1054M	1.21
TDA1060	2.60
TDA1082	3.25
TDA1151	1.22
TDA1170S	2.25
TDA1190	2.11
TDA1190Z	3.96
TDA1200	1.50
TDA1235	3.88
TDA1236	4.30
TDA1270	3.55
TDA1327A	1.33
TDA1412	1.05
TDA1420	2.55
TDA1440	3.45
TDA1470	3.16
TDA1470P	4.25
TDA1506	7.45
TDA1510	5.90
TDA1512	2.98
TDA1515	16.60
TDA1559	3.15
TDA1670	4.48
TDA1770	6.85
TDA1905	1.76
TDA1908	2.87
TDA1940	1.95
TDA1950	4.75
TDA2005	5.08
TDA2006	1.55
TDA2004	2.27
TDA2002	0.90
TDA2003	1.75
TDA2010	1.85
TDA2020	2.77
TDA2030	1.99
TDA2140	1.59
TDA2150	6.20
TDA2151	2.07
TDA2160	4.01
TDA2161	1.85
TDA2170	3.45
TDA2190	4.95
TDA2270	4.65
TDA2510	7.85
TDA2520	2.37
TDA2522	3.46
TDA2524	4.50
TDA2521	3.71
TDA2525	3.90
TDA2532	2.50
TDA2530	2.70
TDA2541	2.48
TDA2540	2.15
TDA2545Q	5.94
TDA2560	2.17
TDA2575A	0.50
TDA2571AQ	3.60
TDA2576A	2.85
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TDA2578A	4.95
TDA2576A+K	12.35
TDA2581	2.25
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TDA2594	3.26
TDA2593	2.47
TDA2591Q	0.83
TDA2595	3.65
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TDA2611AQ	2.98
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TDA3300B	6.98
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TDA3506	7.98
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TDA3500	4.25
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TDA3520	9.71
TDA3540	6.99
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TDA3560	5.25
TDA3571Q	2.97
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TDA3650	7.50
TDA3652	5.44
TDA3651AQ	2.96
TDA3651	3.30
TDA3651A	2.75
TDA3950	3.40
TDA4050B	3.95
TDA4280	7.20
TDA4290	4.47
TDA4400	2.27
TDA4420	4.02
TDA4422	8.32
TDA4427S	9.00
TDA4431	2.27
TDA4440	2.87
TDA4442	4.75
TDA4500	6.30
TDA4600	2.84
TDA4610	4.80
TDA4620	4.78
TDA5500	4.78
TDA5700	2.60
TDA7270S	2.25
TDA8190	3.47
TDA9403	3.15
TDA9503	2.92
TDA9513	5.44
TDB1033	6.68
TDE1081	6.61
TE626	1.49
TEA1002	3.47
TEA1009	1.86
TEA1014	3.30
TEA1020SP	8.21
TIC106C	0.61
TIC106M	0.77
TIC116Y100	2.07
TIC44	0.72
TIC45	0.77
TIC47	0.35
TIP120	1.06
TIP110	0.53
TIP112E	0.85
TIP112	0.88
TIP117	0.95
TIP121	0.87
TIP126	0.73
TIP132	1.40
TIP137	1.50
TIP29	0.84
TIP2955	0.95
TIP29A	0.46
TIP29B	0.63
TIP29C	0.40
TIP29D	0.75
TIP3055	0.75
TIP30A	0.41
TIP30C	0.16
TIP31A	0.34
TIP31B	0.38
TIP31C	0.50
TIP32A	0.53
TIP32B	0.69
TIP32C	0.40
TIP33	0.85
TIP33A	1.05
TIP33C	0.80
TIP34	3.54
TIP41A	0.49
TIP41B	0.65
TIP41C	0.49
TIP42A	0.49
TIP42B	0.53
TIP42C	0.53
TIP47	0.65
TIP48	0.92
TIP49	3.61
TIP55A	3.65
TIS43	1.43
TIS90	0.28
TL011CP	1.55
TL072	2.85
TL494CN	6.74
TLD72CP	2.55
TMP4320	15.00
TMS1024NLL	11.25
TMS1025N	16.95
TMS3720ANS	19.50
TMS3748NS	14.95
TMS3755	13.65
TMS3894NL	19.25
MS5102NLL	6.25

TUA2000	8.98
TV106	1.86
TY6010B	2.97
U05G	1.14
ULN2204	11.45
UPA53C	4.94
UPC1003	5.95
UPC1009C	6.32
UPC1025H	2.90
UPC1026C	1.24
UPC1028H	2.00
UPC1020H	2.77
UPC1032H	0.62
UPC1042C	8.95
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UPC1158	5.84
UPC1161C	4.50
UPC1182H	1.82
UPC1186H	1.05
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UPC1185H	2.94
UPC1188	6.95
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UPC1212C	1.72
UPC1225H	3.25
UPC1230	5.24
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UPC1277H	5.85
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UPC1350C	1.40
UPC1353	7.85
UPC1355C	2.13
UPC1363	4.20
UPC1362	2.98
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UPC566H	2.95
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UPC575C2	2.40
UPC576H	2.58
UPC577H	1.25
UPC578C	7.35
UPC580C	4.13
UPC587C2	1.34
UPC592H	2.15
UPC595	2.95
UPC596	1.98
UPD1514C	8.95
UPD2819C	4.98
UPD4013B	4.00
UPD4066B	4.95
UPD553-164	19.25
UPD8049C-1	10.85
X0007TA	4.68
X0022CE	5.75
X0029CE	7.09
X0031CE	4.95
X0035TA	5.98
X0040TA	4.50
X0042CE	4.35
X0043CE	2.75
X0056CE	5.11
X0057GE	6.00
X0062CE	6.52
X0065CE	6.25
X0074GE	10.00
X0077GE	15.96
X0079CE	4.95
X0092CE	4.95
X0096CE	5.98
X0109CE	11.25
X0113CE	2.07
X0195CE	7.50
X0204CE	8.74
X0261CE	8.75
X1222AF	3.63
IX0111CE	2.95
Y969	0.82
TDA3310	2.15
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Vintage TV: The Cossor 1210

Chas E. Miller

In view of TV's fiftieth anniversary it's appropriate that this vintage TV piece should take a look at a pre-war receiver design. We're not going back quite as far as 1936, but the Cossor set featured in this article is representative of the approach of pre-war TV receiver designers. They were working before any set patterns had been established, which meant that circuitry could be and often was highly individualistic.

At around the time of the Munich crisis in 1938 the backroom boys of A.C. Cossor Ltd. were preparing to launch on the British market a large combined television and radio receiver to be known as Model 1210. It's interesting to speculate as to whether this odd set would have seen the light of day had Neville Chamberlain not won that year of grace for Britain. In the event the 1210 was in steady production by March 1939.

The 1210 was housed in a large console cabinet of impressive proportions and weight. The radio/TV sound chassis, which was quite independent of the vision receiver unit, was mounted at the top, slightly angled. The c.r.t. aperture was roughly central, with three control knobs beneath it. At the bottom there was a large and handsome speaker grill. The c.r.t. was mounted just above the "vision chassis", which in fact comprised both the vision receiver proper and the timebases. The power supply chassis, which incorporated the audio output triode, was mounted at the bottom of the cabinet, behind the loudspeaker. An extra amplifier unit was available for fringe reception. When fitted it sat beside the power pack – sets so equipped had the suffix A after the model number. It was possible to fit the amplifier to a standard 1210, but this was not recommended by the manufacturers in case instability problems arose.

Receiver Circuitry

We'll look at the radio/TV sound chassis first. This employed a most unusual feature in the pre-war era, a series heater chain. Cossor's explanation for this was that it avoided the need for cables carrying a heavy a.c. (as would have been required for the usual parallel-operated valves), with the consequent danger of hum radiation. This seems fair enough since the equivalent 4V heater valves of the day would have required around 4A compared with the 200mA taken by the Cossor 202 series valves that were used. A separate 80V winding on one of the two mains trnsformers supplied this heater chain.

The circuitry used in the sound chassis consisted basically of a four-valve superhet radio receiver, with an r.f. amplifier, a triode-hexode frequency changer, an i.f. amplifier stage and a double-diode-triode which provided detection, a.g.c. delay and audio amplification. It worked on the long, medium and short waves plus the television sound band. The tuning was operative on all bands but, as the makers were at pains to explain, was restricted to a very small part of the dial for TV reception with u.s.w. (the ultra-short waves as they were known).

The Cossor 202VP r.f. amplifier valve was transformer coupled to the hexode section of the Cossor 202STH frequency changer valve, whose triode section worked as a conventional local oscillator. The i.f. was 465kHz and the transformers used are of considerable interest. Extra windings were fitted in both the i.f. transformers so that they acted as variable-bandwidth devices. The sense in which these coils were connected was determined by a switch ganged to the manual tone control: as this control was rotated to its h.f. setting the bandwidth increased. With u.s.w. selected an even greater bandwidth increase took place to enable the set to take advantage of the higher quality TV sound – and also to provide a measure of protection against tuning drift in this band. Delayed a.g.c. was applied to the r.f. amplifier, frequency changer and i.f. amplifier valves, the delay voltage being obtained from a negative bias line provided by the power supply unit. The Cossor 2XP audio output triode, mounted on the power supply chassis, is a directly heated valve and thus requires grid instead of cathode bias – hence the negative bias supply. It provided some 2·5W of audio power to the speaker.

The power supply for the sound chassis was separate from that for the rest of the set, with its own mains transformer, rectifier, smoothing arrangements, etc. This arrangement permitted the other power supply circuit to be switched off when radio only was being received.

Another superhet receiver, this time with seven valves, was used for the vision signal. The aerial signal was transformer coupled to the Cossor 4TSP (all Cossor valves again) r.f. amplifier valve whose output was resistance/capacitance/inductance coupled to the grid of the 4THA (later 41STH) triode-hexode frequency changer. Simple single-inductance couplings were used between the frequency changer and the first (4TSP) i.f. amplifier valve and between this valve and the second (4TPB) i.f. amplifier valve. The second i.f. amplifier was transformer coupled to the detector however, in order to provide feeds for the two anodes of the DDL4 double-diode valve used in this stage as a balanced, full-wave rectifier.

The i.f. was centred at approximately 7MHz, the first and second tuning coils being stagger-tuned at 5·75MHz and 8MHz respectively. The third coupling, to the detector, was fixed tuned. The two i.f. amplifier valves used were identical electrically but while the 4TSP has a top-cap anode the 4TPB has a top-cap grid. By a crafty arrangement of the two types it's possible to couple one to the other using very short leads.

The demodulator's load resistor had a value of only 2kΩ to preserve the h.f. response at the grid of the 41MPT video output pentode. This stage again had a 2kΩ load, plus a small choke to improve the h.f. performance. The load resistor was split into two sections however, 500Ω and 1·5kΩ, with the drive to the c.r.t. taken from the tap. Grid drive was used, with d.c. connection throughout the video circuitry. An interference limiter was also incorporated in the video amplifier's anode circuitry. This used another DDL4 double-diode, the two sections being operated in parallel. When the interference limiter diodes conducted they shunted the brightness control which set the c.r.t.'s cathode bias. Thus a positive-going interference spike would result in a positive-going pulse being applied to the c.r.t.'s cathode.

The optional preamplifier employed three r.f. amplifier pentodes (MS/PEN, MS/PENB, MS/PEN) which also had

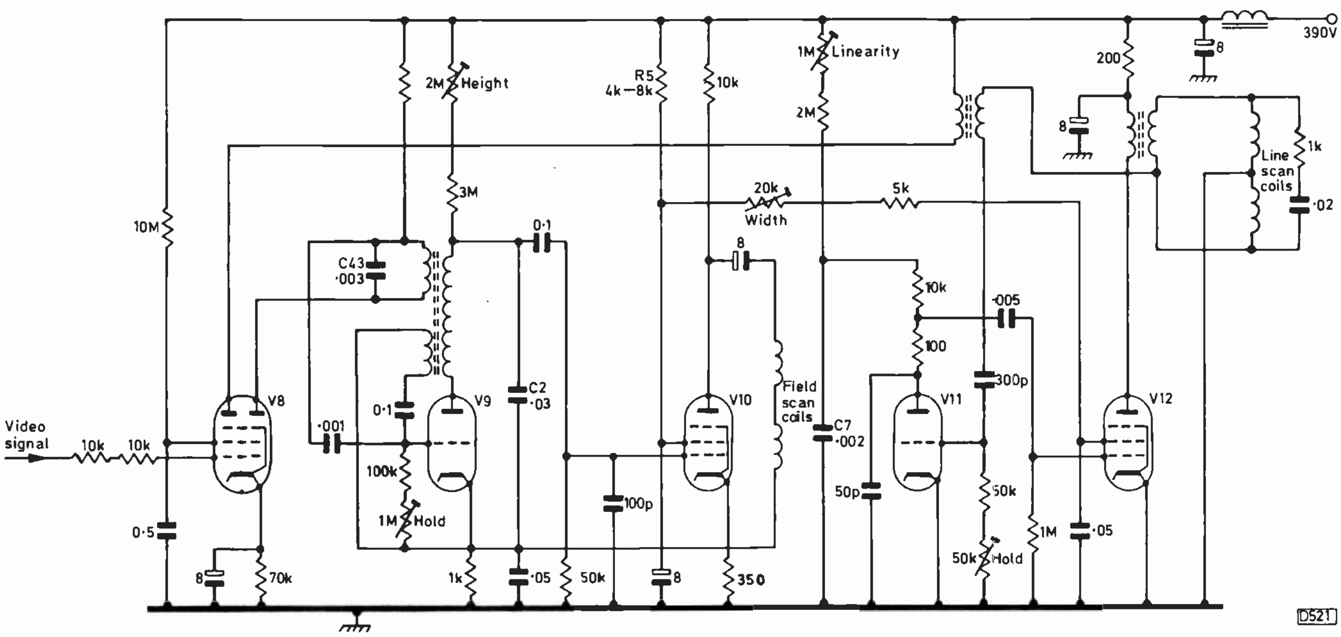

Fig. 1: The timebase circuitry used in the Cossor Model 1210.

the alternate top cap grid/anode arrangement to ensure short couplings. Cossor's favourite *RC* coupling was much in evidence, which is not too good from the point of view of gain but does ensure stable operation. Readers familiar with the radar receiver type 1355 will recognise the similarities.

The Timebases

The Cossor engineers really came into their own with the timebases. To start with they designed a special pentode (type 4TSA) with two anodes to act as the sync separator. It received its input from the vision detector via two 10kΩ stand-off resistors and was biased at its cathode by a combination of 70kΩ and 8μF. Both anodes were transformer loaded. The timebase circuitry is shown in Fig. 1.

We'll look at the field timebase first. V9 (41MTL) is used as a straightforward blocking oscillator except that the sync pulses are injected via a third winding on the transformer – the winding fed by the sync separator. C43 across this winding bypasses the brief line pulses. C2 is charged via the height control network to produce the field sawtooth, being discharged when V9 conducts. This sawtooth is *RC* coupled to the 41MPT field output pentode V10 which is again *RC* coupled to the scan coils. Overall feedback to linearise the scan is introduced by returning the scan coils to the cathode of V9.

The line timebase is rather more odd since this time the Cossor engineers for some reason decided not to use a blocking oscillator. The 41MTL triode (V11) is used as a discharge valve with the sync pulses applied to its grid via a transformer driven by V8's other anode. To make the circuit run free V11 is also driven by feedback from the line output transformer. The sawtooth line drive is *RC* coupled to the 42MPT line output valve V12 which is transformer coupled to the coils. The control in the sawtooth charging circuit is used for linearity rather than width adjustment. Control of width is effected by varying V12's screen grid voltage. In early models R5 alone was used for this purpose. It consisted of a fixed resistor that was clipped into something like an outsize fuseholder on the top deck of the timebase chassis. The value could be varied between 4kΩ and 8kΩ, each extra 1kΩ reducing the width by about a quarter of an inch. Some later models had a variable control. The field output pentode's screen grid was fed from the same point so that the amplitude of the scans was kept in step.

TV Power Supply

Mention has already been made of the power supply unit, in connection with the radio/TV sound side. For TV operation a second mains transformer was switched into circuit to provide seven separate secondary voltages. One was used solely to power a "vision on" lamp on the radio chassis. A winding giving 4V at 12A supplied the heaters of the valves in the vision unit. This heavy current being rather too much for normal plugs and sockets, heavy screw terminals were provided for the heater wiring connections. The 451U h.t. rectifier had 390V applied to its two anodes while its heater requirement was 4V at 3·5A. The SU2150 e.h.t. rectifier was also fed from this transformer, the e.h.t. winding providing some 4·5kV for this rectifier's anode – it's heater took 1·15A at 2V. The final winding provided a heater supply for the optional preamplifier.

Focusing System

The 1210's focus control system was distinctly unusual for the period. A permanent magnet was used instead of the then prevalent electromagnets. In fact the physical arrangement of the magnet was in many respects similar to those used in the sets of twenty or so years later. The assembly incorporated shift plates for picture centring, while on the c.r.t. neck there was a sleeve reminiscent of the closed-loop line linearity devices that were popular in the sixties. In this case however the sleeve was made of iron and provided coarse control over the tube's focusing. Fine focus was achieved by a control which varied the e.h.t. voltage slightly. This was done by returning the earthy end of the e.h.t. winding on the mains transformer to chassis via a 1MΩ resistor which was shunted by a 250kΩ potentiometer giving fine focus adjustment. I must admit to having misgivings about the idea of applying high voltages to the terminals of a control meant for viewer use, but the system was apparently not as fatal in use as one might fear. I wonder what *Which?* would have had to say about this sort of thing?!

Letters

EDUCATION AND TRAINING

I would like to take issue with you over your editorial in the September issue – you may well have stirred up a hornet's nest! To suggest that service engineers got by and progressed from monochrome TV through colour to video, and made the transition from thermionics to solid-state, without formal training is far from the truth. From personal experience extending over the whole of this period I can state that many manufacturers and educational establishments responded to such needs, often before they arose. What I know to have been fact here in Kent is almost certainly true for the rest of the country. Even today many senior service engineers "traipse back to the halls of learning", and the good establishments around are often in the forefront of such training.

How do the educators obtain their learning? Simply by keeping in touch with the thinking at the R and D establishments of the broadcasters and manufacturers. You would probably be surprised at the number of college lecturers who spend a significant part of their "holiday" in this way.

I agree that the concept of apprenticeship has changed considerably over the years. But then that's in the nature of a dynamic industry. I don't think many time-serving engineers felt at the time that their apprenticeship was the "be all and end all". Many I have known personally went on to obtain higher qualifications in their own time, often degrees, then took their place in R and D.

Your comment that a simple analogy, good diagram and a few brief sentences are often good enough to obtain an initial understanding is an over simplification of the situation. Probably one of the best introductions to the way in which computers work is in the "Ladybird Book" series. I don't really think you would suggest that this would qualify a skilled TV engineer to start servicing home computers however! Today's servicing problems tend to be particularly obscure: the long-term reliability of domestic electronic equipment has just about removed the "stock fault" from the scene – even repetitive faults occur infrequently enough to make them more difficult to clear.

It may be that the formal apprenticeship has all but disappeared. I contend that this started to happen 25 years or so ago. Continual retraining is slowly taking its place. New training techniques are being used. I think it's rather neat to use a self-learning video package to teach one to service a videorecorder!

On the subject of names for units I'm to some extent in agreement with you. The hoary old Hz instead of c/s is just about to come in useful however. A common compound unit in the satellite communications field is Watts per Herz (W/Hz): although this is perhaps less descriptive than the alternative Watts per cycle per second it's certainly simpler to use.

Geoff Lewis,
Canterbury, Kent.

Editorial comment: There's no doubt that organisations, including manufacturers and the rental firms, have done a very great deal to help with essential training. But there are many, especially those who run their own businesses, who have had to figure things out their own way. It can be done – but the industry couldn't have coped with the public's servicing needs without the formal training so many have received.

THE INTEL CTV6000

In the August issue you asked about Intel colour receivers. A large number of these sets, Model CTV6000, were imported into Ireland by Garwood Electrical, a firm that's no longer trading.

The chassis is conventional, using a v.h.f./u.h.f. tuner, SAWF i.f. strip, TDA1170 field timebase and BU208A line timebase. A 14in. Toshiba Blackstrip tube is used. The power supply is a switch-mode type of the Siemens self-oscillating variety, very similar to that used in the Rank T20 series chassis. This gives rise to most of the problems in these sets – particularly as components are not identified on the panels. Whilst the poor quality circuit I've seen shows a thyristor-controlled BU326S chopper transistor in all the sets I've come across there's a transistor-controlled chopper. A BC177 and a BD329 on a small sub-panel can both go short-circuit, taking out the chopper transistor and causing the 1A fuse to blow violently. The BD329 can be replaced by a TIP41A or any similar power transistor. Check all the diodes in the vicinity of this panel – the BY299s are not above suspicion. Incidentally the power supply can be run unplugged from the main horizontal chassis.

The only decoder faults we've encountered have been loss of one primary colour due to the 220kΩ resistor in the base circuit of the relevant BF470 output transistor going open-circuit (the RGB output stages are of the type that uses a pair of pnp/npn transistors).

Low or varying brightness can be caused by poor wiper contact in the first anode preset control on the tube's base panel. Set this for around 420V.

Eamonn Galvin,
Ovens, Co. Cork.

DISH ALIGNMENT

I'd like to comment on this matter of setting up a satellite TVRO (see August article and letters last month). The method of using the sun to find due south at 1200 GMT is basically correct – if qualified by the fact that sundial time is not accurate. The time when the sun is due south must be looked up in an Almanac for the date in question. This time can vary by up to about fifteen minutes either way from 1200 GMT depending on the time of year. It would result in an error of about ±4° in the polar position of the dish if not taken into account, more than the difference mentioned for Carlisle and Liverpool. Astronomers refer to this effect as the Equation of Time. It's caused by the irregular way in which the earth moves around the sun. This due south time, called Transit Time, can for example be found in a current edition of *The Handbook of the British Astronomical Association* – it's given under data for the sun.

Robin Gray, B.Eng.,
Nottingham.

LOOKING BACK

Some time ago you published an article by someone who had in the early days constructed a television receiver using a VCR97 c.r.t. In 1950 I also made my first television set, using the *Wireless World* design which I adapted for use with the green-phosphor VCR97 tube. It worked well, bringing in pictures from Sutton Coldfield, but the results were much better when the Holme Moss transmitter started up. I still have the EF50s, EF55s. EA50s and the original speaker – which is still going strong.

But let me go back 25 years before that – to 1925! I vividly remember listening with my dad to a series of lectures given by Sir Oliver Lodge, using the first one-valve receiver I made. The aerial was slung around four kitchen ceiling hooks that were normally used to hold the washing line. Sir Oliver thought out tuning as we know it today, but his lectures usually ended up in the realms of spiritualism. He was a grand old man.

Then there was Captain P. P. Eckersley, the BBC's first Chief Engineer, who used to give many bright and breezy lectures. I well recall his catch-phrase "don't do it". This referred to the bugbear of oscillation: many listeners used to push up the reaction coil (or condenser sometimes) too far, causing squeaks and whistles for miles around! Happy days!

H. Owens,
North Ferriby, N. Humberside.

FIDELITY ZX3000 CHASSIS

I would like to pass on a tip that we've found most useful over the years when servicing switch-mode power supply units.

In your article on the Fidelity ZX3000 chassis (September) you mention lifting one end of R97 to isolate the line output stage. If you then connect a 60W, 240V lamp between the supply side of R97 and chassis you will be able to prove that the power supply is fully operational.

It's worth noting that, like many others, this particular power supply will produce a very low h.t. at the secondary winding of the chopper transformer under no-load conditions. The reason for this is that the feedback winding on the primary side of the supply then alters the operating conditions of the TDA4600 control chip. This in turn alters the mark-space ratio of the drive waveform so that the on time of the BU426 chopper transistor is reduced.

Another component well worth checking when all else fails is the h.t. rectifier D13. It's not unheard of for this to go short-circuit, so check the line output transistor as well.

Repeated failure of the line output transistor is another nasty that can rapidly produce baldness and alcoholic disorders. If you look at the left of the chassis, between the heatsink and the line output transformer, you'll see a choke that occasionally becomes dry-jointed, carbonising the track beneath and effectively blowing the line output transistor as the e.h.t. rises.

As the first paragraph of your article suggests, the ZX3000 is to be found in many models. But don't fall into the trap of thinking that the PCBs are interchangeable. The white label that is so prominent on the c.r.t. base (front cover, September) is the identifying code that Fidelity use. It works something like this. There are apparently about ten different control panels and c.r.t. bases etc. which have to be matched together with the main panel – Fidelity at one time supplied a matrix that provided a check on which panels match each other.

Tom Carnie,
Newhaven, Edinburgh.

Experiences with the G11 and TX9

John W. Cheshire

A young couple brought their 22in. Philips set – G11 chassis – into the workshop. The female spokesperson related how it had died suddenly during the previous evening whilst an old western movie was on. It obviously couldn't take the strain of all those people shooting one another I thought.

On examination I found that the 1A h.t. fuse was open-circuit. A few checks in the line output stage then revealed that one of the EW modulator diodes, D3133, had gone short-circuit – as often happens in these sets. A replacement was fitted and nothing else seemed to be amiss – the line output transistor read perfectly. As a precaution I checked the h.t. voltage before replacing the fuse. This read correctly at 157V so a new fuse was fitted and we switched on again. Pop went the fuse, just as the e.h.t. was starting to rustle up. This time the line output transistor was found to be leaky, though the EW modulator diode was still intact. Suspect line output stage components were again checked but everything was o.k.

Several of these sets have come in recently requiring replacement line output transformers. The symptom is usually no results with the power supply tripping erratically – as indicated by the over-voltage glow switch. I concluded that the problems I'd got this time could be a variation on the same theme and since we'd now got a good stock of G11 line output transformers fitting a replacement seemed the best action to take.

The transformer and BU208A were replaced, along with the line generator i.c. just to be sure. The fuse lasted as long as the previous one. This time the line output transistor was short-circuit – and we were rapidly running out of replacements.

In desperation I finally resorted to what should have been done in the first place. I hooked up the power supply to a 100W lamp load and, without replacing the fuse, monitored the voltage. At switch on the lamp flickered violently in sympathy with the voltage across it – this oscillated between 157V and 270V as the over-voltage switch came into play. Despite replacing many defective 470μF h.t. reservoir capacitors in these sets in the past I'd been caught out once again.

Replacement of the errant electrolytic along with a new BU208A and fuse finally brought the set back into operation – though the picture was suffering from severe EW distortion. This was cleared by replacing the EW modulator driver transistor T2150 – the BD238 on the large heatsink next to plug two on the timebase panel. The general rule with this fault is first to check L3134 on the line scan panel for dry-joints: if this item is innocent the driver transistor is usually at fault.

The original line output transformer was replaced and, so I thought, the job finally wrapped up.

TX9 Problems

Shortly after the prolonged tussle with the G11 I was called out to revive a TX9 portable. Nowadays it seems that the smaller the set the more likely it is that the customer will call us out to see to it.

In this case the chopper transistor (panel PC1044) had failed, due to R165 (connected to pin 4 of the TDA4600 chopper control chip) reading over 500kΩ instead of 300kΩ. The set worked once these items had been replaced but the picture was shifted somewhat. The owner commented that the picture had been like this for some time though he'd continued to watch it! This fault almost always seems to be due to the pulse feedback resistor R217 (220kΩ) being high in value. Replacement once again produced the good quality picture we expect from these nice little sets.

Return of the G11

Next day the G11 returned – much to our dismay. This time the field linearity at the bottom of the screen was jumping, due to C2083 (15μF) being open-circuit – this electrolytic is at the bottom right of the TDA2600 field timebase chip's heatsink. It would seem that the heat dries it up.

Predicament

Sets that return with a totally unconnected fault very shortly after we've carried out a repair regularly put us in an awkward predicament. To save losing custom we quite often repair the subsequent fault free of charge. Doing so is easier than trying to convince the customer of the coincidence. A long soak test would obviously be ideal, but this is impossible with call out jobs and would result in the loss of our "same-day service".

The Operation of Electric Motors

Part 4

Mike Phelan

Before going into the repair of d.c motors we'll examine the different ways of winding the armature and of connecting the windings to the commutator.

If we take the tripolar motor as an example a glance at Fig. 1 will show that there is only one possible way in which the windings can be connected. For most of the motor's period of rotation two of the windings will be connected in series across the supply while the third will be in parallel with these two windings. The parallel winding thus takes the bulk of the current. For the remaining period of rotation two windings will be connected in parallel across the supply while the third is shorted out by one of the brushes. The duration of these two states is determined by the brush width and the commutator gaps. It can be seen that the current demand varies considerably as the motor rotates, though the back-e.m.f. developed and the inductance of the windings tend to smooth this. Clearly more than three poles are required for AV applications.

If we use the same method of connecting the windings of a seven-pole motor (see Fig. 2), at any one time the windings will fall into two groups of three, the windings in each group being in series while the groups are in parallel. This is known as lap winding and offers the maximum impedance, other things being equal. It's suitable therefore for motors operating with high supply voltages.

The alternative way of connecting the windings is the wave-winding method, see Fig. 3. In this case the two ends of each winding are connected to commutator segments nearly half a turn apart. This effectively places each winding in turn across the supply, which is ideal for low-voltage motors. With a tripolar armature there's no difference between lap and wave winding of course. As the number of poles is increased the impedance difference becomes more marked.

Ideally the windings would lie in armature slots diametrically opposite each other. In practice this would lead to the end turns piling up around the shaft (see Fig. 4) so that the winding span is less.

Armatures are wound by machine. For those with laminated cores there are basically two methods. The windings are wound either directly on the core (Fig. 5) or on a former and then fitted to the core. The latter approach provides a better balanced – both mechanically and electrically – armature because with direct winding the last windings to be put on have more wire than the first ones. Partial compensation for this can be achieved by reducing the number of turns, but this solution is far from perfect.

It's not uncommon for the commutator to have half the number of segments as there are poles. This is made possible by connecting the windings in the usual way but bringing each alternate junction out to a commutator segment. The converse is also possible – twice the number of segments, with each slot carrying two windings.

Mechanical balance can be achieved by drilling or otherwise lightening the armature core.

The majority of the electric motors used in VCRs use preformed windings encapsulated in plastic. The armature has no core and rotates in a narrow annular gap between the outer polepiece and the cylindrical magnet. Because of the proximity of the windings to the magnet poles this method of construction is very efficient.

Servicing DC Motors

Due to the very nature of these motors most problems encountered concern the brushes or the commutator. Symptoms vary, but common ones are listed in Table 1.

Shorted segments is the most common problem. Metallic dust from the brushes collects in the spaces between the segments, effectively shorting out the windings. This can be checked by using a scope to monitor the ripple across the motor. With a defective motor the ripple will be excessive – half a volt or so – and uneven. It's important that there is no significant load on the motor when this test is made, as the load will increase the ripple. Another symptom is that after disconnecting the motor from the

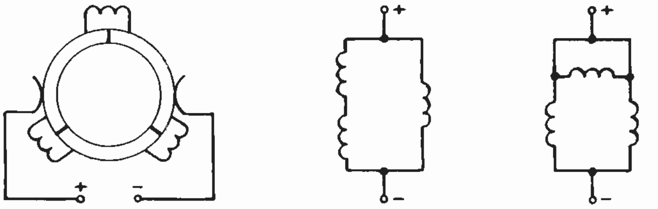

Fig. 1: The tripolar armature. (a) Winding arrangement, (b) and (c) equivalent circuits with no winding shorted and with one winding shorted respectively by the brushgear.

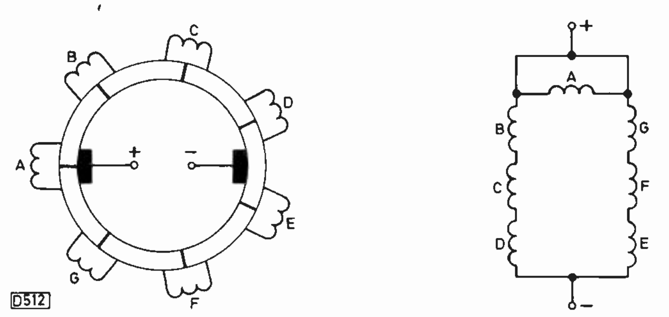

Fig. 2: Lap winding.

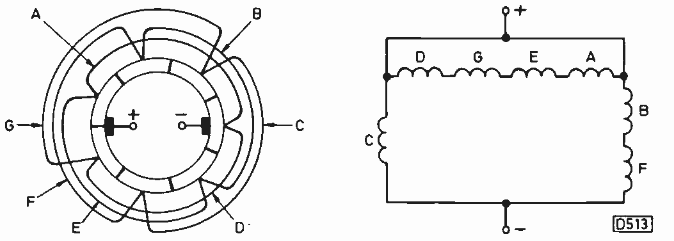

Fig. 3: Wave winding.

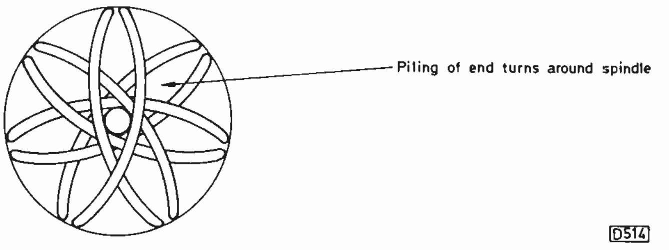

Fig. 4: A winding span of more than 180°.

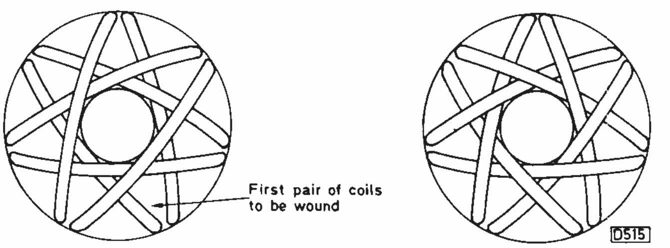

Fig. 5: Comparison between direct and former windings.

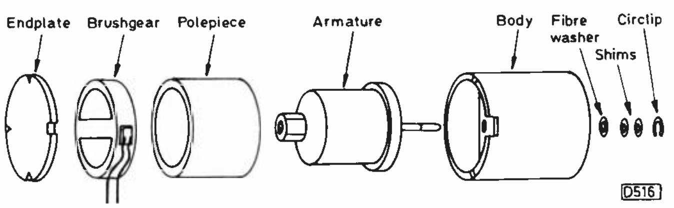

Fig. 6: JVC drum/capstan motor assembly.

supply it will not spin when turned manually.

The drum motor used in the JVC HR3300/Ferguson 3292 and its derivatives tends to suffer from this fault, so we'll describe how to tackle the repair. Obviously the only way of providing a guaranteed lasting repair is to fit a new motor, but there must be instances where you want to get a little more life from the old one. Precise constructional details tend to vary a bit, but Fig. 6 shows the most common arrangement.

Remove the cover from the machine and take off the pulley. Make sure that the bench is clean, as any ferrous particles will end up stuck to the magnet when the motor is opened up. The end plate is attached by staking over the metal of the body and can be removed by filing the metal away. Clean off the filings and lever the end plate off with a small screwdriver, taking care not to sever the supply wires. Once the end is off the brushgear will be seen. Pull the plastic carrier off with the brushes attached. The commutator can then be cleaned by running a thin, sharp blade along each gap, followed by washing in solvent (isopropanol or similar). Also wash the brushgear. Unless the motor requires lubrication, that's it. To lubricate, the armature must be removed. It's held in by the circlip at the drive end, where there are also some shims and a fibre washer – take care not to lose these. The armature cannot be removed yet as it's trapped by the polepiece which must be pushed out. Lubricate the drive end of the spindle with light oil and reassemble, being very careful with the brushes. Stake the end plate on again. Test the motor before fitting it in the machine.

Table 1: Common VCR motor faults.

VCR	*Fault*	*Cause*
Philips N1700	Capstan or drum wow	Severe brushgear wear. Usually past repair.
Toshiba V5470	Capstan wow	Shorted segments – see text.
Sanyo VTC5300	Failure to load	Reel/loading motor worn out – see text.
Sharp VC8300	Blown fuse	Loading motor burnt out.
JVC HR7350 etc.	Capstan motor noisy	Axial displacement of armature on spindle – repairable.
JVC HR3300 etc.	Drum wow Dead spot on capstan motor	Shorted segments. Worn brushgear – may be beyond repair.

The capstan motor used in the Toshiba V5470 is similar but has a tacho attached. Note the position of the tacho as there's very little clearance and incorrect assembly will result in rubbing.

The loading/reel motor used in the Sanyo VTC5300 gives problems though these are not of its own making. The cause of the trouble is the loading ring which, as in all Betamax machines, carries the pinch roller and several guides and is located at the two extremes of its travel by a spring-loaded roller which engages with a notch in the periphery of the ring. The VTC5300 relies on the motor to overcome the spring loading, a situation that leads to excessive current being passed by the brushes with much arcing. In severe cases the motor can stall completely. In time the commutator segments wear through to the underlying insulation, with the result that if the motor stops in this position it refuses to start until disturbed.

When you have a VTC5300 that occasionally refuses to load until the loading ring is moved, the cause could be either a defective motor or a stalled motor. If the former is the case it's the result of stalling. The notch in the ring can be made less steep – gently – but the motor will almost certainly need renewing if it's the original one. You see it can be the chicken, the egg, or both! A somewhat puzzling symptom before the motor's final demise is that interference from the brushes is picked up by the head preamplifiers, giving rise to white dots on the screen – as if the static earthing is amiss.

So a defective motor is not necessarily a scrap one. It's often worth attempting to repair this rather expensive item – if you can do so with confidence. In the final article of the present series next month we'll be dealing with the brushless d.c. motor.

C-MAC and its Variants

Harold Peters

In the world of satellite TV new terminology is bandied about as if it had been with us for years. It's seldom explained: the assumption is that you *know*. Despite the IBA's efforts to enlighten us, the European agreed satellite TV transmission standard "C-MAC packet" and its variants still confuse many. So let's go over the basics.

Over two decades have passed since colour TV broadcasting started to spread across the globe, using three different systems – NTSC, SECAM and PAL. Brilliant though these were at the time each has its deficiencies and we can now do lots of things we couldn't do then. DBS (direct broadcasting from satellites) gives us a chance to start from scratch and introduce technology to see us through the next couple of decades. It would be foolish not to seize this opportunity and adopt a new colour system that improves upon but can be converted to the existing three. Conversion is important: it gives us compatibility with existing systems – we don't want to make our investment in current technology obsolete overnight. We don't, anyway, but others might: Japan and the USA have been pressing for the adoption of a non-compatible 1,125-line, 60Hz system for satellite transmissions, but Europe has settled on MAC, a system developed by the IBA.

Deficiencies of Current Systems

The worst deficiency of existing systems is caused by interleaving the colour subcarrier amongst the higher definition frequencies of the luminance signal. This gives rise to moiré patterning when something like check suiting is present in the picture. The situation would be worse with satellite TV transmissions where, for optimum efficiency from a weak station so far away, frequency as opposed to amplitude vision modulation is used. Remember how with f.m. v.h.f. radio we use pre-emphasis and de-emphasis circuits to compensate for interference due to noise, which with f.m. is "triangular" – that is it affects the higher frequencies more than those close to the carrier? This is fine for the luminance signal with TV, but not for the colour subcarrier which, by virtue of its high modulation frequency, finds itself at the noisiest part of the signal (see Fig. 1). Transmit any of the three current TV systems via satellite and the colour-to-noise ratio becomes well below that of the luminance signal on which it rides. MAC overcomes this problem – and others – but before going into detail let's define "C-MAC packet".

What is C-MAC?

The C indicates the type of digital sound and data system used. There are also systems A, B, D, D2 and E which we'll look at later. MAC stands for Multiplexed Analogue Components and refers to the way in which the picture is modulated on to the carrier as three separate components – Y (luminance), U (blue colour-difference) and V (red colour-difference). "Packet" denotes that the digital part of the signal comes in packets of 751 bits each. The packets have their own address – like the teletext clock run-in or the PAL colour burst – which makes it easy to vary the combination of sound and data signals transmitted. But back to MAC itself.

With MAC the active 52µsec of every line is divided into two sections. The first third carries the whole of one colour-difference signal for the line, compressed in the ratio 3:1. The second two-thirds of the line carry the luminance signal, compressed in the ratio 3:2. The two U

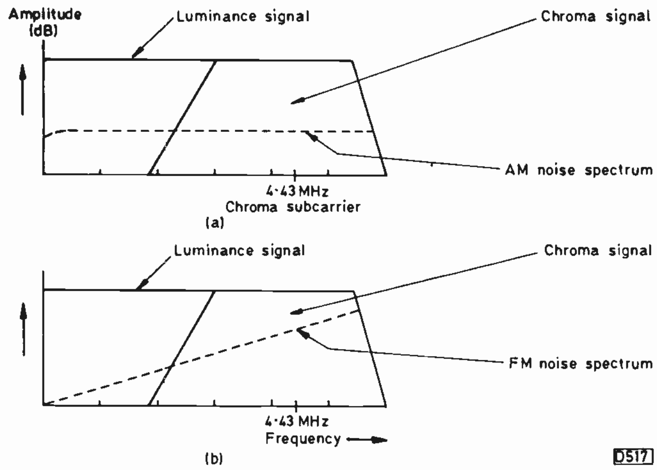

Fig. 1: (a) With terrestrial TV transmissions the "white" noise affects the luminance and chroma signals equally. (b) With an f.m. transmission the "pink" noise increases with frequency, discriminating against the colour signal.

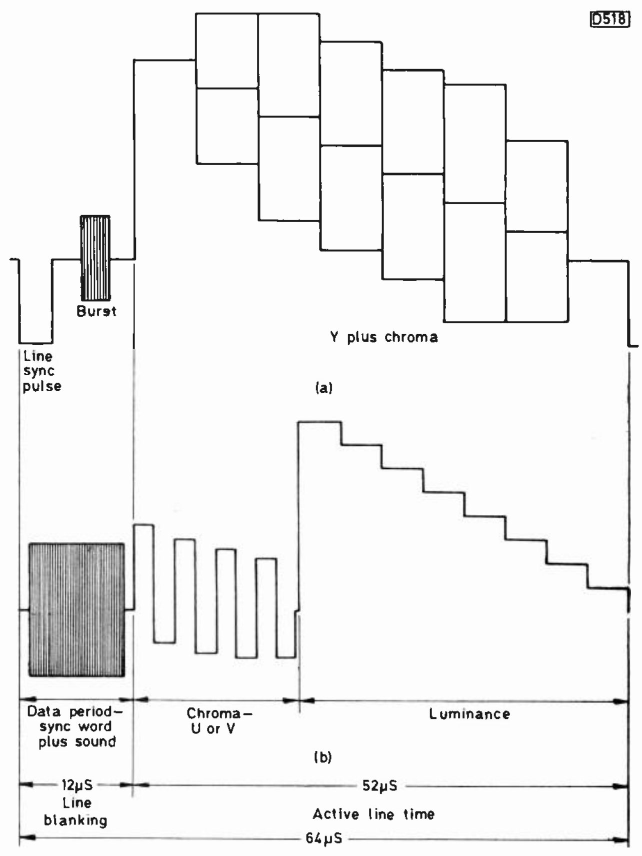

Fig. 2: (a) A single line of PAL carrying a colour-bar signal. (b) A single line of MAC, again with a colour-bar signal. The seven-bit sync word plus digital sound and data occupy the line blanking period.

(B − Y) and V (R − Y) signals are transmitted on alternate lines. See Fig. 2. Both signal components for each line are frequency modulated on to an r.f. carrier, and to receive them and produce a normal display each component has to be stored and stretched after detection, with the three YUV signal components correctly superimposed upon each other. This involves storing the colour-difference signals for a whole line and adding alternate lines together, as we do today with PAL but with the important difference that we are now handling baseband (i.e. video) signals and not a 4·43MHz carrier – so glass delay lines are out. Matrixing to produce the original R, G and B signals is done in the normal way.

Because there's no subcarrier there will be no subcarrier patterning, while the luminance signal will have its full 5·6MHz (spot size) bandwidth instead of being restricted to about 3MHz by subcarrier traps as at present. It also means that the colour bandwidth can be increased from the present 1MHz to 2·8MHz.

The compression of the two signal components transmitted on each line means that the actual bandwidth required is 8·4MHz (2·8 × 3 and 5·6 × 3/2). In the ordinary way this would clobber the sound carrier, but as we shall see the sound is digital and is included in the line blanking interval.

Thus at a stroke C-MAC gives us the following advantages: better vision definition; better colour resolution (no more smearing); no more cross-colour or subcarrier patterns; no more sound-on-vision; and it travels better through space! Mind you, if it's then converted back to PAL, SECAM or NTSC you've gained nothing.

The Variants

The European Broadcasting Union (EBU) has approved C-MAC for satellite TV transmissions. C relates to the type of modulation found in the 12µsec of non-active (i.e. non-picture) line time – the line blanking interval. Two earlier systems were proposed:

A-MAC conveys the digital sound, teletext etc. on an f.m. subcarrier at 7MHz. To date there are no takers for this one – it overlaps the vision signal.

B-MAC uses teletext type NRZ (non-return to zero) digital information for the signals transmitted during the line blanking interval – in the same way that the BBC has used its sound-in-syncs system to carry the sound signals throughout the network since colour began. It has a 1·625Mbit per second capacity, locked to twice the subcarrier frequency, and is used down under by the Aussat satellite which provides TV transmissions for the outback. B-MAC reduces receiver complexity, but we can do better.

C-MAC has a 3Mbit/sec capacity during the non-picture line time. The bit rate is 20·25Mbit/sec, making it possible to transmit in addition to high-quality stereo TV sound four different language commentaries *and* two stereo radio programmes, or twelve different mono radio programmes, or two stereo radio programmes and a 15Mbit data or supertext channel – and so on.

The important difference between C-MAC and the others is the method of modulation used. With A, B and D2 the sound and data signals are added to the vision signal components at baseband and the whole lot then goes to the transmitter on one line and is all frequency modulated. C-MAC uses phase shift keying (PSK) however, or rather 2-4PSK, a quadrature phase shift keying variation in which the carrier can assume only one of two phasors, +90° representing a digital one and −90° a digital zero. This is done to improve efficiency and use the bandwidth to the full. The transmitted signal is thus f.m. for the picture and digital for the sound, killing off sound-on-vision for good but involving the transfer of two separate signals from the studio and two different kinds of modulation in the transmitter's i.f. driver stages.

The 3Mbit/sec (approximately) digital signal is, as we said, divided into packets of 751 bits, each with its own digital address. There are 164 packets per field, or 4,100 packets per second, and since a receiver will respond only to the addresses for which it is programmed the system becomes quite versatile and changeable at will.

Compatibility with Cable

There's bound to be a snag – and there is. C-MAC uses the full 27MHz bandwidth of a satellite channel. This is fine for DBS, but what about cable? You might think that the European cable operators have enough channels already, but in most countries their contracts include a "must carry" clause which obliges them to distribute all the national broadcasters' signals as well as their own. Now 27MHz won't go down a cable. Even if the signal is remodulated in a.m. form it still occupies 16MHz, all due to the sound/data signal. There are two ways of reducing the bandwidth – D-MAC and D2-MAC.

With D-MAC, instead of binary coding the data signal is duo-binary coded on to the PSK carrier (instead of going from +90° to −90° it stops at 0° as well). This permits the full 3Mbit/sec data to be passed, after detection, through 8·5MHz wide cable channels. It's now the same bandwidth as the vision signal. Problem solved? No! In France and W. Germany, which will be first up with DBS in Europe, there are already many kilometres of cable which have only 7MHz spacing. They don't mind degrading the top end of the vision signal a little but as far as the sound is concerned they've decided on D2-MAC.

This uses the duo-binary coding of D-MAC but halves the data burst rate from 20·25Mbit/sec to 10·125Mbit/sec. The whole signal can then be passed through a 5MHz channel satisfactorily. At the same time the picture is added to the signal at baseband, as with B-MAC. So at the expense of half the versatility and using a simple detector at the receiving end we have a signal that, as they say, is "transparent to cable", i.e. it goes down the pipe without any fuss. Mind you they could well miss out on the best bit, E-MAC or Extended-MAC.

Extended-MAC

It's possible, as an extension of the C-MAC principle, to produce wide-screen pictures with enhanced definition. This is done at the expense of the extra digital sound but is fully compatible with standard C-MAC receivers. The C-MAC sync system remains the same, i.e. a digital word preceding every line of information, with the field sync triggered by line 625, but the sound information is limited to the digits required for the stereo sound accompanying the picture (42 packets). This leaves about 7µsec of line blanking time into which extra luminance information can be fitted, using the same compressed f.m. as the rest of the luminance signal. The extra colour-difference information required fits into the field blanking interval, 16 colour-difference extensions filling one complete line. This extra picture information (see Fig. 3), when stored, stretched and added to the standard vision signal compo-

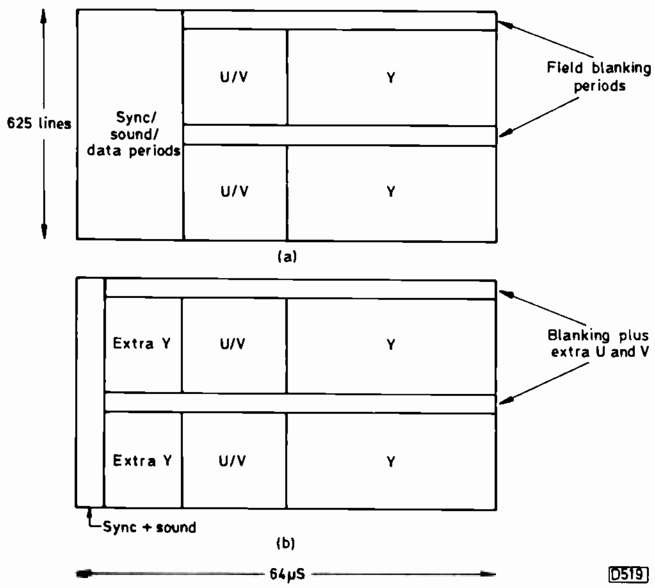

Fig. 3: (a) Layout of one field of MAC. (b) Layout of one field of Extended-MAC.

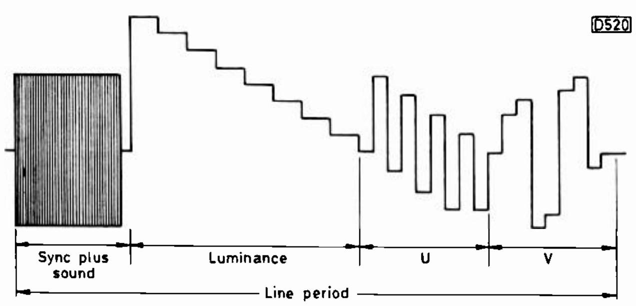

Fig. 4: S-MAC, a variation favoured in the USA for studio work. Having the entire signal on one line makes for simpler mixing and trick work.

nents, can be displayed at either side of the normal C-MAC picture with undetectable joins – and in a totally compatible way, leaving a standard C-MAC set displaying the same picture as though the side pieces had not been added.

The result is very much like the Cinemascope films on TV today, even to the extent of being able to "pan" the extra picture at either side of the standard one so that viewers with standard C-MAC receivers don't miss the action if it moves on to the "wide-screen" part. Panning instructions, along with the other control data required, are given on line 625.

Those who've seen demonstrations of Extended-MAC compare it favourably with the Japanese 1,125-line high-definition system. The techniques devised by the IBA to improve the resolution of the E-MAC pictures have not to date been divulged – but it is done!

TV and the Human Eye

Let's go back to basics and forget about MAC for the moment. The eye is fooled into seeing a picture on the screen produced by spots of light that move faster than the persistence of vision of the human eye allows you to see. The eye sees luminance detail better than colour detail, and the central parts of your field of view focus on the eye's "rods", which are good for detail, while the peripheral scene is focused on the "cones" which sense movement better than detail.

The aspect ratio of current TV displays is 4:3, about the same as the scene scanned by the rods. The recommended viewing distance (6H) is six times the picture height away from the screen. At this point the eye doesn't have to move in its socket to follow movement across the screen, so it's considered to be the nearest point at which viewing can be enjoyed comfortably without undue eyestrain. It also means that there is little point in adding stereo sound since if the ear detects movement but the eye doesn't an element of artificiality is introduced.

The intention with wide-screen viewing is that you sit close enough to the screen (about 3H to 4H) for the picture edges to go outside your field of view. This means that you have to move your head/eyes to follow the action and that stereo sound is essential to enhance the effect of "presence".

It also means that the scene will fall on the eye's cones, which because they detect movement will be annoyed by the flicker. Close viewing also makes the line structure of the 312·5-line interlaced field very prominent. Wide-screen E-MAC receivers are intended to incorporate a field store to make it possible to up-convert the signal to either 625-line sequential scanning or a 1,250-line interlaced field, both of which will raise the line scan rate to 31,250Hz and eliminate flicker and lineyness.

The elegance of E-MAC is that it is totally compatible with C-MAC. Down-conversions to PAL etc. would therefore still be possible. All the extra signal processing electronics would be in the wide-screen set, where there ought to be plenty of room. The IBA engineers have allowed for four teletext lines in the system and a VITS (vertical interval test signal) line. Thus far nothing seems to have been overlooked – except maybe fault-finding, the topic most likely to be in the minds of those of us who've braved the horrors of PCF80s, flywheel line sync and dual-standard switching to get this far. Maybe the youngsters will devise a diagnostic programme which, fed into a micro, will reveal all. But if you think you have problems, consider the studio end.

S-MAC

Studio MAC (S-MAC) is the name given in the USA to similar time-compression methods agreed for studio work (see Fig. 4). Digital standards have already been drawn up, and in an ideal world it would be nice to switch your broadcasting network overnight from analogue to digital. That day is some way ahead and meanwhile analogue component techniques will continue.

This approach provides many advantages in the broadcasting world: component TV converts readily to any existing system, the entire signal goes through a single cable, and so on. Trick work and studio mixing preclude the use of MAC as we know it since the U and V colour-difference signals are carried on alternate lines. Instead, the luminance signal is compressed 2:1 and the U and V signals are compressed 4:1. All are present on the same line. Such a signal needs 11MHz bandwidth lines to carry it and can be reprocessed to C-MAC anywhere along the way. Its main use today is in America, where use of component television within a broadcaster's network overcomes many of the shortcomings of NTSC.

Acknowledgement

The writer is indebted to the IBA's Engineering Information Department for assistance in compiling this article.

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FERGUSON 3V31

This machine will sometimes record normally. At other times sound recording will stop and the sound from the previous recording will come through loud and clear, although the picture has been recorded all right.

The most common cause of this problem (we've had it on several occasions) is one or more dry-joints on the PCB at the audio head or at the full-erase head. Also check the jointing at the other end of the leads – at the audio board. A second possibility is a contact problem in RY1 or RY2 on the audio board. Tapping and probing, with a scope at the head terminations, should prove this. If all these points are in order the oscillator block T1 is suspect.

PANASONIC TC2201 (PIU-S1C CHASSIS)

The problem with this set is intermittent line collapse. If the brightness or contrast is increased when the set is working normally a line whistle will develop, the width will decrease and the picture will break up. Decreasing the brightness/contrast will restore a correct display. The fault sometimes occurs without adjusting these controls. The e.h.t. is correct.

A very common cause of this type of problem is failure of C816 (220μF) and/or C813 (1μF) in the power supply. If necessary check C527 and C528 (both 10μF) on board C (line generator panel).

SONY SLC5

The reported fault was failure to record. Playback of its own recordings is muted (both video and audio), the recording being discernible in the trick modes. Removing the mute signal gives playback with cyclical noise bars. We suspect a fault in the capstan servo phase control loop.

The problem is that the control track signal is missing. This could be due to failure of the control head replay amplifier or to an open-circuit, worn or dirty control track head. A useful clue can be obtained by recording on the faulty machine then trying the tape on a known good one. Without control track pulses the replay servo will not lock up (hence the noise bars) and the replay electronics will be muted.

PANASONIC U1 CHASSIS

For the first three-five minutes everything is o.k. Then the field starts to jitter and this sometimes becomes a momentary field collapse. After this the set may work all right for half an hour or so but the fault will return. When the fault is present there's an oscillation on the waveform at the collector of the lower field output transistor Q408.

A very common cause of this fault is that D403 in the field output stage is defective, increasing the output stage bias current. The correct replacement diode from Panasonic should be used. The fault can damage the field driver and output transistors Q406/7/8. It's worth replacing the h.t. smoothing capacitor C812 (220μF) in these sets, also the 20V supply reservoir capacitor C814 (2,200μF) and the field scan coupling capacitor C415 (2,200μF). Check for dry-joints in the yoke circuit, especially at L705 and the NS phase coil L706.

ITT CVC45/1 CHASSIS

The problem is no results. The 300V d.c. supply is present and the chopper and line output transistors are o.k. A new TBA920 line oscillator chip has been tried and the line oscillator board seems to work all right when tested with a separate supply.

In our experience this trouble is almost invariably caused by failure of resistors on the CMP40 chopper control panel. Remove this panel then disconnect and check with a high-range ohmmeter all resistors of value 100kΩ and above. Replace all that read high or open-circuit.

GRUNDIG 2 × 4 SUPER

When a two-three hour recording is played back the first part is all right but in the later part the sound is slow – on picture search the top half of the picture curls over diagonally. Tapes recorded on other machines play back perfectly.

The tape is running too fast in the record mode. The cause is probably slight misadjustment of control APB on the servo panel. Adjust on record for a sampling pulse on every fourth ramp at test point SM2. In the absence of a scope, trial and error adjustment after noting the control's initial setting may work – don't turn it more than 10° in either direction. Failing this, check the components in stages T1546, T1548, T1551 and T1563 with freezer and a hairdryer – an extension board will have to be used to gain access.

PHILIPS G11 CHASSIS

If the set is switched on using its own on/off switch the overvoltage glow-switch fires momentarily after which the set runs all right: if it's switched on at the mains the glow switch fires continuously. The h.t. is correct but varies slightly (2-3V) with changes of picture content.

First check the two mains rectifier thyristors for leakage – preferrably by substitution. If they are all right, use a scope to check the peak voltage at their common cathode connection at switch on. If the peak voltage does not exceed 175V the glow switch is faulty: if it does, concentrate on the slow-start components in Tr4045's emitter circuit.

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TELEVISION NOVEMBER 1986

GRUNDIG MODEL 4200

The problem concerns the tuning memory batteries. The original four 1·5V batteries lasted for several years with the set in daily use, but with only occasional use loss of memory led me to check them. I found only 3V across them with evidence of sulphating at the last negative terminal and one battery showing a reverse voltage! A new set of alkaline batteries suffered a similar fate after a month or so.

We've had similar problems to this and have found it necessary to replace the corroded battery holder as well as fitting new batteries. Some of these cells are notorious for their poor reliability. It seems to affect some manufacturing batches. Try another make. It may be worth replacing diode Dil282 in case it leaks power into the batteries when warm.

TEST CASE

287

Each month we provide an interesting case of TV/video servicing to exercise your ingenuity. These are not trick questions but are based on actual practical faults.

We much regret the passing of Rediffusion/Doric as a setmaker. Their products were good, their back-up service excellent and their staff friendly and helpful. The Rediffusion Mk. 3 chassis was one of the more successful thyristor line timebase designs and though it's now somewhat dated many sets of this type are still going strong.

The particular Mk. 3 on the bench this month was fitted up for both cable (h.f.) and u.h.f. aerial operation. Its trouble was complete failure to produce either sound or a raster, a problem we've had before with this chassis. At switch-on there was, as expected, a momentary burst of energy. This was followed by a great big nothing. Failure of the regulating thyristor to switch on is the usual cause of this sort of thing. Briefly, the stabilisation system works by using a triggered thyristor to return excess energy from the line output stage to the h.t. reservoir capacitor (the reverse current regulator system described in Colin Boggis's article last month). Regulation is effected by adjusting the timing of the thyristor's gate trigger pulse. If anything prevents the thyristor (6THY2) from switching on there will be a rapid build up of energy in the line output stage followed by operation of the over-voltage protection circuit, which shuts down the line generator chip. Hence the initial burst of energy at switch on.

The simplest way to deal with this situation is to power the set from the mains supply via a variac. At about 60 per cent of full mains voltage the energy from the power supply section of the receiver about matches the basic requirement of the line timebase: under these conditions a good though unregulated picture should be – and indeed was – produced. The regulation adjustment potentiometer 6RV2 is inoperative under these conditions, which are ideal for fault finding. Diagnosis is quite easy: you check the d.c. voltage developed across 6C42 (1μF electrolytic) in the control circuit, the operation of the switching transistors 6TR1/2 which produce the trigger pulse, and the effect on the switching duty cycle of adjusting 6RV2 to vary the d.c. voltage at the base of 6TR2. Normally the trouble is due to failure of the 22V zener diode 6D7 in 6TR2's emitter circuit or the trigger pulse coupling components 6R17 or 6C20. Not this time though! The trigger-pulse waveform (37) at the collector of 6TR1 was present and correct, and moved backwards and forwards as 6RV2 was adjusted (the waveform was checked with the scope triggered by the line sync pulses). The trigger pulses were also reaching the gate of 6THY2. A dud thyristor perhaps?

Another thyristor (the type fitted, TD3F/600, incorporates the parallel diode) was tried but this didn't clear the fault. Attention was then turned to the gate bias network. 6R13/4/5 were all unhooked from the circuit and tested in turn with an ohmmeter. All were within tolerance. What do you do when a known good thyristor fails to fire with perfectly adequate triggering pulses applied to its gate? You look for further clues! Here are the two that led us to the correct diagnosis. First the line-rate pulse waveform at the gate of 6THY1 was excessively thick in the horizontal plane. Secondly the picture, despite being unregulated and produced with a mains input level of only about 145V, had rather too much hum modulation of the line scan. Got it? We'll confirm next month!

ANSWER TO TEST CASE 286
– page 811 last month –

The situation described last month was a puzzler indeed: the playback picture produced by a Panasonic NV2000 was juddering and rolling due to an unstable and misshapen f.m. carrier signal from the video heads. The strange thing was that the spurious effects occurred at the start *and* at the finish of both heads' sweeps. This period of instability lasted for about eleven TV lines, which equates with about 6° of the tape wrap. Now in practice the nominally 180° wrap of the tape around the head drum is made about 186°, to give some overlap between the scanning periods of the two heads and ensure a clean switch between them.

As it came to us this machine would have needed a playback head switch to work correctly! The man who had fitted the new heads had contrived to wire all four rotating devices – the two heads and the two transformer windings – in series. The red- and brown-coded wires were connected correctly, but the two yellows had been crossed . . . So each head's output was applied to its opposite number and the strange waveform was due to random reinforcement and cancellation of the signals from the two heads when both were providing signals during the 6° overlap period. This apart, the strangely-wired head assembly worked amazingly well in both the playback and record modes. No wonder none of us could make sense of it!

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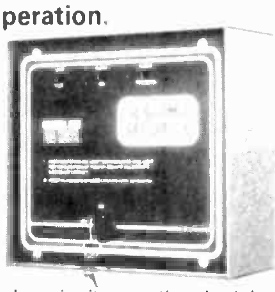

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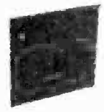

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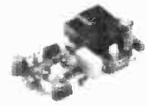

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AY106	180p
BA145	10p
BA148	10p
BA154	6p
BA157	12p
BB101	13p
BB103	16p
BB105B	18p
BB205B	24p
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BC115	10p
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BC301	18p
BC302	18p
BC303	18p
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BD115	26p
BD124P	50p
BD124	110p
BD128	35p
BD131	25p
BD132	25p
BD135	20p
BD136	20p
BD137	20p
BD138	20p
BD139	20p
BD140	20p
BD144	90p
BD150	30p
BD157	38p
BD158	38p
BD166	30p
BD175	30p
BD177	30p
BD179	32p
BD181	45p
BD182	60p
BD183	60p
BD187	30p
BD201	33p
BD202	38p
BD203	42p
BD204	42p
BD222	31p
BD225	31p
BD232	31p
BD234	32p
BD235	28p
BD236	30p
BD237	21p
BD238	24p
BD244	50p
BD245	50p
BD433	28p
BD434	30p
BD435	31p
BD437	28p
BD438	36p
BD439	40p
BD440	40p
BD441	40p
BD442	40p
BD533	50p
BD534	38p
BD535	38p
BD536	38p
BD537	40p
BD538	40p
BD675	40p
BD676	40p
BD677	38p
BD678	40p
BD679	40p
BD680	40p
BD681	45p
BD682	45p
BDX32	100p
BDX65	80p
BDY92	100p
BF180	16p
BF181	18p
BF183	20p

BF184	20p
BF185	20p
BF194	5p
BF195	5p
BF196	6p
BF197	7p
BF198	7p
BF199	6p
BF200	16p
BF240	16p
BF241	10p
BF255	12p
BF256	18p
BF257	18p
BF258	18p
BF259	18p
BF262	25p
BF263	25p
BF270	18p
BF273	15p
BF311	21p
BF324	25p
BF336	20p
BF337	20p
BF338	20p
BF355	28p
BF362	30p
BF367	13p
BF371	17p
BF414	18p
BF420	16p
BF421	18p
BF422	21p
BF423	15p
BF440	16p
BF451	17p
BF455	14p
BF458	19p
BF459	19p
BF461	60p
BF462	62p
BF469	30p
BF470	28p
BF471	28p
BF479	30p
BF493	18p
BF494	16p
BF595	16p
BF596	16p
BF597	10p
BF615	30p
BF758	41p
BF869	22p
BF870	22p
BF872	23p
BF960	38p
BF963	40p
BF964	38p
BF966	40p
BFR40	25p
BFR51	21p
BFR62	21p
BFR79	25p
BFR90	52p
BFR91	99p
BFX29	20p
BFX84	20p
BFX85	20p
BFX87	15p
BFX88	15p
BFX89	60p
BFY17	30p
BFY18	40p
BFY41	28p
BFY50	14p
BFY51	14p
BFY52	14p
BFY56	25p

BFY57	25p
BFY64	25p
BFY90	45p
BLY48	85p
BLY49	85p
BR100	14p
BR101	43p
BR103	37p
BSX20	15p
BSX26	18p
BSX29	19p
BT106	90p
BT109	90p
BT116	80p
BT119	100p
BT120	100p
BU100A	110p
BU104	100p
BU105	80p
BU108	100p
BU110	110p
BU111	140p
BU124	60p
BU126	70p
BU204	75p
BU205	70p
BU208	75p
BU208A	80p
BU208D	100p
BU325	55p
BU326	85p
BU406	85p
BU406D	95p
BU407	75p
BU407D	95p
BU408	85p
BU408D	95p
BU409	95p
BU426	120p
BU500	110p
BU526	80p
BU801	95p
BU806	120p
BU807	95p
C106D	23p
MJ2500	100p
MJ2501	110p
MJ2955	55p
MJ3000	115p
MJ3001	115p
MJE29A	30p
MJE30A	30p
MJE340	25p
MJE350	80p
MJE520	30p
MJE2955K	90p
OC28	100p
OC29	80p
OC35	100p
OC36	120p
OC45	50p
OC71	30p
OC72	50p
OC200	180p
R2008B	100p
R2010B	100p
TAG4443	76p
TAG4444	78p
TIP29	15p
TIP29A	22p
TIP29C	25p
TIP30	25p
TIP30C	30p
TIP31A	24p
TIP31C	30p
TIP32	24p

TIP32A	24p
TIP32C	28p
TIP33	50p
TIP34	50p
TIP41A	22p
TIP41C	25p
TIP42A	22p
TIP42C	25p
TIP47	40p
TIP48	40p
TIP50	60p
TIP51	120p
TIP52	120p
TIP53	120p
TIP54	140p
TIP105	65p
TIP106	65p
TIP107	65p
TIP110	47p
TIP111	50p
TIP112	40p
TIP115	45p
TIP116	45p
TIP117	50p
TIP120	43p
TIP121	46p
TIP122	47p
TIP125	47p
TIP126	56p
TIP127	56p
TIP141	90p
TIP142	90p
TIP145	65p
TIP146	90p
TIP147	100p
TIP2955	42p
TIP3054	45p
TIP3055	42p
TIS43	46p
TIS44	40p
TIS61	15p
TIS88A	45p
TIS90	15p
TIS91	18p
TIS93	20p
VK1010	88p
VN.10KM	60p
VN.46AF	88p
VN.66AF	100p
VN.88AF	115p
VN.89AF	110p
ZTX107	11p
ZTX108	11p
ZTX109	12p
ZTX212	27p
ZTX300	13p
ZTX301	16p
ZTX302	16p
ZTX303	24p
ZTX304	17p
ZTX320	29p
ZTX326	29p
ZTX500	13p
ZTX501	13p
ZTX502	18p
ZTX503	18p
ZTX504	25p
ZTX550	24p
2N.696	26p
2N.697	22p
2N.698	40p
2N.699	46p
2N.706A	22p
2N.708	22p
2N.914	28p
2N.918	36p
2N.930	18p

2N.1131	28p
2N.1132	28p
2N.1613	24p
2N.1711	24p
2N.2102	50p
2N.2160	300p
2N.2218A	24p
2N.2219	24p
2N.2221	23p
2N.2222	23p
2N.2369	15p
2N.2484	20p
2N.2646	40p
2N.2904	20p
2N.2905	20p
2N.2906	18p
2N.2907	18p
2N.2926	8p
2N.3019	28p
2N.3053	18p
2N.3054	35p
2N.3055	35p
2N.3055H	50p
2N.3440	58p
2N.3442	85p
2N.3702	9p
2N.3703	9p
2N.3704	9p
2N.3705	9p
2N.3706	9p
2N.3707	9p
2N.3708	9p
2N.3771	85p
2N.3772	90p
2N.3773	100p
2N.3819	29p
2N.3866	68p
2N.3903	11p
2N.3904	11p
2N.3905	11p
2N.3906	11p
2N.4031	25p
2N.4036	25p
2N.4037	25p
2N.4058	13p
2N.4443	76p
2N.4444	76p
2N.5061	20p
2N.5294	30p
2N.5296	30p
2N.6106	40p
2N.6107	40p
2N.6109	40p
3N.128	55p
3N.143	65p
DIODES	
AA119	9p
BY100	40p
BY103	32p
BY126	6p
BY127	8p
BY133	8p
BY164	40p
BY176	85p
BY179	35p
BY182	32p
BY184	32p
BY187	32p
BY196	20p
BY206	11p
BY207	11p
BY208	18p
BY210	22p
BY223	72p
BY225	120p
BY226	18p
BY227	19p
BY228	32p

BY296	20p
BY298	26p
BY299	28p
BY476	90p
BYX10	15p
BYX55/350	30p
BYX55/600	30p
BYX55/800	32p
BYX70/300	29p
BYX70/500	32p
BYX70/800	36p
BYX71/600	80p
OA47	6p
OA90	4p
OA91	4p
OA200	7p
OA202	7p
IN.914	2p
IN.4001	4p
IN.4002	4p
IN.4003	4p
IN.4004	4p
IN.4005	4p
IN.4006	4p
IN.4007	5p
IN.4148	2p
IN.5400	9p
IN.5401	10p
IN.5402	10p
IN.5403	11p
IN.5404	11p
IN.5405	12p
IN.5406	13p
IN.5407	13p
IN.5408	13p
ZENERS	
400MV BYZ88 Range 2V7 to 39V	6p
1.3W Zeners BZX61 Range 2V7 to 39V	12p
JAPANESE TRANSISTORS	
2SB324	55p
2SB507	68p
2SB754	80p
2SC495	60p
2SC1060	99p
2SC1061	200p
2SC1096	78p
2SC1161	110p
2SC1172	150p
2SC1306	90p
2SC1307	100p
2SC1678	120p
2SC1969	130p
2SC2028	75p
2SC2029	120p
2SC2078	120p
LOW PROFILE SOCKETS	
8pin	6p
14pin	8p
16pin	9p
18pin	12p
20pin	14p
22pin	16p
24pin	18p
28pin	20p
40pin	25p
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	
DAF96	60p
DF96	50p
DL92	47p
DY86	50p
DY87	50p
DY802	45p
EABC80	50p
E891	44p
EBF80	45p
EBF89	50p
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
EL36	60p
EL84	50p
EL95	50p
EL500	80p
EL504	100p
EY86	31p
EY87	31p
EY88	42p
EZ35	45p
EZ80	50p
EZ81	55p
GZ34	180p
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
PL82	45p
PL83	32p
PL84	50p
PL95	140p
PL500	110p
PL504	95p
PL508	170p
PL519	450p
PY81	70p
PY88	48p
PY500A	160p
LINEAR IC'S	
AN-214P	200p
AN-240P	150p
AN-360	120p
AN-7110	140p
AN-7114	160p
AN-7115	160p
AN-7120	140p
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	55p
CA3089E	150p
CA3090AQ	300p
CA3130E	80p
CA3130S	100p
CA3140E	38p
CA3189E	250p
CA3240E	90p
HA-1156W	110p
HA-1197	150p
HA-1306W	170p
HA-1319	250p
HA-1339	170p
HA-1342	170p
HA-1366WR	160p
HA-1368	160p
HA-1377	220p
HA-1389	140p
HA-1392	230p
HA-1397	250p
HA-1398	240p
LA-1201	85p
LA-1352	120p
LA-1365	140p
LA-3301	120p
LA-3350	120p
LA-3361	115p
LA-4030	200p
LA-4031	140p
LA-4032	140p
LA-4050	130p
LA-4051	160p
LA-4100	120p
LA-4101	100p
LA-4102SK	140p
LA-4112	250p
LA-4125	210p
LA-4140	70p
LA-4201	120p
LA-4220	120p
LA-4400	190p
LA-4420	140p
LA-4422	130p
LA-4430	130p
LA-4460	170p

LA-4461	180p
LA-5112	120p
LM301	26p
LM311	35p
LM324	35p
LM325	45p
LM339	40p
LM348	60p
LM380	100p
LM381	150p
LM382	130p
LM387	100p
LM709DIL	30p
LM723	40p
LM741DIL	18p
LM741 MET	45p
LM747	58p
LM748	35p
LM1458	33p
LM3900	30p
M-51513L	180p
M-51515BL	270p
M-51516	260p
M-51517L	280p
MB3712	150p
MB3730	260p
MB3756	260p
MC1327	70p
NE555	20p
NE556	40p
SAS560	110p
SAS570	110p
SN76003N	140p
SN76013N	140p
SN76023N	140p
SN76033N	150p
SN76110N	70p
SN76115	70p
T2800D	52p
TA-7120	65p
TA-7137P	83p
TA-7146P	400p
TA-7193P	400p
TA-7200	200p
TA-7201	200p
TA-7203	180p
TA-7204	110p
TA-7205	80p
TA-7210	200p
TA-72222AP	120p
TA-7310P	100p
TA-7609	270p
TAA550	16p
TBA120S	45p
TBA395	60p
TBA396	60p
TBA520	100p
TBA530	100p
TBA540	100p

TBA560	100p
TBA750	100p
TBA800	35p
TBA810S	60p
TBA820	75p
TBA920	100p
TBA950	100p
TBA990	100p
TCA270	40p
TCA800	200p
TCA940	100p
TDA1170	100p
TDA1412	60p
TDA2002	80p
TDA2003	150p
TDA2020	140p
TDA2030	140p
TDA2522	90p
TDA2530	100p
TDA2532	100p
TDA2540	100p
TDA2560	100p
TDA2593	100p
TDA2690	100p
UPC-555H	60p
UPC-556H	80p
UPC-575C2	100p
UPC-577H	64p
UPC-592H2	95p
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UPC-1025H	230p
UPC-1026C	105p
UPC-1028H	90p
UPC-1031H2	180p
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UPC-1155	200p
UPC-1156H	140p
UPC-1181H	115p
UPC-1182H	150p
UPC-1185H2	250p
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74LS SERIES	
74LS00	17p
74LS01	17p
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74LS05	17p
74LS08	17p
74LS09	17p
74LS10	17p
74S11	17p
74S12	17p
74S13	26p
74S14	30p
74S15	17p
74LS20	17p
74LS21	17p

74LS22	17p
74LS24	38p
74LS26	17p
74LS27	17p
74LS28	17p
74LS30	17p
74LS32	17p
74LS33	17p
74LS37	17p
74LS38	17p
74LS40	17p
74LS42	39p
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74LS145	83p
74LS147	120p
74LS148	110p
74LS151	38p
74LS153	42p
74LS154	100p
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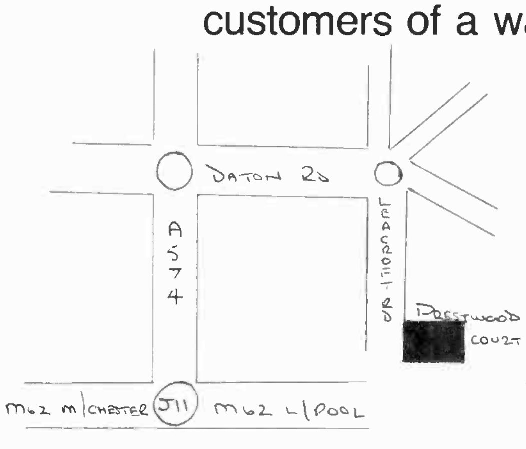

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GH 3F	KV Gen	1.35
IS 1555		0.23
VIIN	KV 1810UB	0.91
CV 12E	GEN.=CSM-2A 4A 101	2.20
U05G	KV 1810UB	0.91
BR 303	KV 2704=SHDR 3042	1.54

THYRISTORS

SG-264A	KV Gen.	3.82
SG-629	KV 1810UB	6.05
SG-6533	KV Gen =SG613	8.60

IC's

BX-342	SLC7UB	3.82
CX-104A	KV 1810UB	4.90
CX-108		8.35
CX-109		3.95
CX-136A	VTR Gen	7.25
CX-143A	SLC5/7UB	6.90
CX-177		4.90
CX-186	SLC5UB	4.90
CX761A		8.35
M51231P	KV 2200UB	2.20
STK 1225		12.90
STK 2129		12.90
STK 4026		8.35
STK 5314		6.95
TBA 120U		2.98
TCP 4621 AF6		12.65
TDA 2578A	KV 2752UB	3.85
TDA 3652	KV 2752UB	3.95
TDA 4600-2	KV 2052/6UB	4.90
UPC 1365C	KV Gen	8.35
UPC 1394C	KV 2060/62UB	2.20
UPO 546C107	SLC7UB	16.65
UPD 547C049	SLC7UB	8.45

TRANSISTORS

P S U TRANS	KIT 2SC 2335 SLC7	7.60
TRANS ASSY	TAF 40	6.30
2SA 771	TAF 5A=2SA 1206	2.20
2SA 835	Gen.	1.35
2SA 1027R	ICF-C820L=2SA 1115P	0.91
2SA 1175	SLC7UB	0.23
2SB 733	KV 2204UB	0.91
2SB 740C	TCK 88B	0.91
2SB 856	Gen	1.35
2SC 403C		0.23
2SC 867A	Gen	2.20

TRANSISTORS CONTINUED

2SC 945=2SC	634 SP=2SC 1364	0.23
2SC 1034		4.90
2SC 1061	Gen	2.25
2SC 1114	Gen.	4.90
2SC 1124		0.91
2SC 1316	Gen. Trs. Assy.	6.10
2SC 1362-7	Gen =2SC 634 SP-47	0.23
2SC 1413A	KV Gen.	6.95
2SC 1454-6		3.95
2SC 1475	KV 1810UB=2SA 1174	0.91
2SC 1962	Gen	1.35
2SC 2009	Gen	0.23
2SC 2278	Gen	0.91
2SC 2369	SLC5/7UB	2.98
2SC 2551	KV Gen.	0.91
2SC 2785	AG-7UB	0.23
2SC 2958		0.91
2SC 3153	KV 2060UB	3.82
2SD 257	ST 5150	2.20
2SD 725	KV 2204/2704	8.40
2SD 773	Gen.	0.23
2SD 774	SL/HMK	0.91
2SD 870	KV 2704	5.35
2SD 1164	SLC6UB	0.91
2SD 1497-02	KV 2252/2752	3.82
2SD 1497-06	KV 2252/2752	3.82

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SL-F1	DSR-35A	38.75
SLC6	ACE	28.75
SLC7	ACE	23.55

PILOT LAMPS

STR6060F	1-518-070-00	0.95
Gen.	1-518-115-XX	0.95
360mA 11V Gen.	1-518-116-00	0.95
40mA 4.5V Gen.	1-518-169-XX	0.95
130mA 23V	1-518-263-00	1.15
13V HMK11	1-518-323-00	0.95
40mA 8V TAF-45	1-518-409-21	0.95

MANUALS (0 VAT RATED)

ALL SONY TV & VIDEO SERVICE MANUALS	7.75

VIDEO SPARES

SLC5/7	SONY PART NUMBER	
BOOSTER ANTENNA	1-463-296-00	30.50
MODULATOR	1-464-116-00	50.50
TAPE UP SENSOR (C7)	1-543-145-00	1.35
CONTROL KNOB (C7)	3-659-547-00	0.94
LID TIMER (C7)	3-703-075-00	0.94
CAP 2 SHAFT (C7)	3-703-075-00	0.25
CAPSTAN MOTOR	8-838-008-10	32.60
IDLER KIT	A-670-634-8B	4.45
LIMITER ASSEMBLY	X-365-331-00	2.30
IDLER ASSEMBLY	X-365-932-40	0.94
BRAKE ASSEMBLY	X-365-932-82	1.35
PINCH ROLLER	X-365-933-70	0.95
SLC6		
SOLENOID	1-454-293-11	8.75
MODULATOR	1-464-188-00	58.80
THREADING GEAR	3-671-126-00	0.94
DC MOTOR	8-835-070-11	13.50
IDLER KIT	A-670-639-1B	3.30
REEL MOTOR (MK1)	A-673-710-1A	13.50
REEL MOTOR (MK2)	A-673-710-6A	21.50
FORWARD ASSEMBLY	A-674-007-1A	3.10
CAPSTAN MOTOR	A-675-113-1A	6.50
PULLEY ASSY LOAD	X-367-101-50	0.94
SL-F1/C9		
OC/DC CONVERTOR	1-464-217-00	18.75
CARRIAGE MOD KIT (C9)	A-675-121-2B	7.55
CASS. LOAD MECH. (C9)	A-675-123-6A	58.60
GUIDE PIN KIT	A-675-910-7C	5.11
UPPER CYLINDER	A-676-013-8A	22.30
5 RING ASSEMBLY (C9)	X-366-943-10	15.05
PINCH ROLLER (SLC20)	X-366-930-76	7.35

BELTS

INDIVIDUAL BELTS AVAILABLE IF REQUIRED

SL8000 KIT 5 PIECES		6.55
SLC5/7 KIT 6 PIECES		4.45
SLC6 KIT 6 PIECES		6.20
TC Gen.	3-434-110-00	0.94
TAKE UP BELT TC Gen	3-472-332-00	0.94
BELT DRIVE TC Gen	3-498-114-00	0.94
BELT MIDWAY TC 161SD	3-531-646-00	0.94
BELT CAPSTAN TC 92	3-536-447-01	0.94
CAPSTAN TC 135/136SD	3-542-458-00	0.94
BELT FLAT TC 186SD	3-543-978-00	0.94
BELT CAPSTAN TC Gen.	3-558-706-00	0.94
BELT CAPS. HST-300	3-564-319-00	0.94
T/UP BELT HMK-3000	3-573-122-00	0.94
BELT HMK3000	3-573-153-01	0.94
HMK 70 & UNIV T/TABLE	4-827-489-XX	2.76

SWITCHES & RELAYS

RELAY SLC7	1-515-416-00	3.75
RELAY	1-515-418-00	3.75
RELAY TC-K55	1-515-547-11	3.75
CHANNEL KV1340/1820	1-516-847-00	15.75
TIMER SW SLC5/7	1-552-438-00	1.40
POWER SWITCH	1-554-965-11	3.95
SLIDE SW REC SL8000	1-552-834-00	0.94
SLIDE SW R/P SL8000	1-552-836-00	1.40
SW POWER KV Gen	1-554-820-11	3.95
SW PUSH KV 1612	1-554-966-11	3.95
SW PB POWER KV 2060	1-554-967-11	3.20

REMOTE CONTROLS

RM 604B KV 1612	A-100-902-8A	35.20
RM 606 KV 2704	A-100-904-1A	42.60
RM 603B KV 2206	A-100-904-2A	50.50
RM 609 KV 1612 (MK2)	A-100-905-7A	35.20
RM 615	A-100-909-4A	42.60
RM 620 KV 2200	A-147-026-1A	30.50
RM 632 KV 2252	A-147-064-0A	30.50
RMT 200 SLC7	A-670-107-1A	42.60
RM 75T SLC5/T7	A-670-110-2A	19.40
RM 616	A-670-123-2A	42.60
RM 72 SLC6	1-463-424-00	17.40

GENERAL COMPONENTS

CAP 33mF 160v KV	1-123-024-11	0.94
CAP 22mF 400v KV	1-123-032-11	0.94
CAP 0.018mF 1 5v KV	1 129-952-11	1.38
TRAP 6MHz	1-409-333-00	0.94
TELE. AERIAL KV1400	1-501-178-00	6.30
FILTER 6Mhz	1-527-262-11	0.94
TERMINAL ANTENNA	1-536-683-11	7.30
STYLUS ND 143G	1-549-114-00	9.75
REC/PLAY HEAD	8-825-710-00	17.60
R/P HEAD PP128-3602C	8-829-236-XX	13.50
R/P HEAD 181-3602D	8-829-373-40	4.10
MOTOR DNF-1001B	8-835-006-00	17.40
MOTOR DNE-4100A	8-835-049-01	13.65
VID TEST TAPE KR52H	8-969-995-52	32.20
CARTRIDGE XL 150	A-450-506-9A	17.40
STYLUS ND 150G	A-458-706-2A	7.90
PINCH ROLLER TC Gen	X-348-930-60	0.94
P. ROLLER TC 204SD	X-354-241-30	1.40
MOTOR KIT MT-Gen.	X-354-931-41	13.50
PINCH ROLLER	X-355-862-00	0.94
PINCH ROLLER TCK 55	X-356-400-60	0.94
CAS HOLD. ASSY. TCK44	X-357-350-91	1.40
BEARING ASSY. HMP70	X-482-740-81	3.10

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Large Quantities of Late Model Thorn TVs. All with first class cabinets.

TELE-TEXT/ULTRASONIC/INFRARED/REMOTES

All at UNBEATABLE PRICES for QUANTITY & QUALITY

Also Philips G11/Pye G11/Basic/Remote/TELE-TEXT

Some examples of QUALITY working TVs

THORN 8800 ★★★★★★★★★★★★★★★★★★★★★★★★ £25
THORN 8800 **(remote)** ★★★★★★★★★★★★★★★★★★★★ £30
THORN 9000 ★★★★★★★★★★★★★★★★★★★★★★★★ £30
THORN 9000 **(remote)** ★★★★★★★★★★★★★★★★★★★★ £35
THORN 9600 ★★★★★★★★★★★★★★★★★★★★★★★★ £40
THORN 9600 **(full feature remote)** ★★★★★★★★★★★ £45

THORN 9600 TELETEXT ★★★★★★★★★★★★ **from £75**
(VARIOUS MODELS)
THORN 9900 ★★★★★★★★★★★★★★★★★★★★★★★★ £50
THORN 9900 **f/f remote** ★★★★★★★★★★★★★★★★★ £60
PHILIPS G11 ★★★★★★★★★★★★★★★★★★★★★★★★ £55

(prices quoted are based on quantity)

NO DEALER TOO LARGE OR SMALL. SINGLES SOLD

Brand New Remote Control Hand Sets Available for the majority of British & European TV sets.

1000s of UNTESTED Colour TVs

I.E. DECCA 30s, GEC 2110, GRUNDIG, TANBERGS, G8s 520s-550s, Thorn 3500/8000/8500, TT, PYE, ETC.

(Many of these untested TVs just switch on)

ALL AT LOW LOW PRICES

VAN LOADS DELIVERED DIRECT FROM SOURCE RING FOR QUOTE

New TV Trolly Stands **£4.95** Also Video Stands **POA**

Colour TV panels & tubes available

All prices subject to V.A.T. *CALLERS WELCOME*

Export Orders Welcome for those Countries using the P.A.L. System

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CHORLTON, MANCHESTER M21 2ER.

TEL: 061-861 8501

MAIL ORDER ADVERTISING

British Code of Advertising Practice

Advertisements in this publication are required to conform to the British Code of Advertising Practice. In respect of mail order advertisements where money is paid in advance, the code requires advertisers to fulfil orders within 28 days, unless a longer delivery period is stated. Where goods are returned undamaged within seven days, the purchaser's money must be refunded. Please retain proof of postage/despatch as this may be needed.

Mail Order Protection Scheme

If you order goods from Mail Order advertisements in this magazine and pay by post in advance of delivery, Television will consider you for compensation if the Advertiser should become insolvent or bankrupt provided:

(1) You have not received the goods or had your money returned; and
(2) You write to the Publisher of Television summarising the situation not earlier than 28 days from the day you sent your order and not later than two months from that day.

Please do not wait until the last moment to inform us. When you write, we will tell you how to make your claim and what evidence of payment is required.

We guarantee to meet claims from readers made in accordance with the above procedure as soon as possible after the Advertiser has been declared bankrupt or insolvent.

This guarantee covers only advance payment sent in direct response to an advertisement in this magazine not for example, payment made in response to catalogues etc., received as a result of answering such advertisements. Classified advertisements are excluded.

SETS & COMPONENTS

CASH PAID Now for your surplus TV spares, Transistors, I.C.'s etc. Tel. MR. FORSHAW 0902 29022.

HITACHI, MITSUBISHI, Panasonic, Sony, Toshiba, JVC, Sharp, fully refurbished. PEARSON TELEVISION 0484 863489. Delivery arranged.

NEW AND SECONDHAND COLOUR TV SPARES. Panels & Tubes most makes also panel repair service. Tel. Southport (0704) 74411 anytime (24hr).

PHILIPS G11 AND BUSH T20 regular supplies. For prices phone 01-845 2036.

SUPERVIEW TUBES CHRIS KELLEHER'S TV, Kanturk Cork 029 50046. New plant using high beam RCA longlife electron guns new tube results Munster delivery weekly.

GENUINE GRUNDIG SPARES. Fast helpful service, sensible prices. TELEQUIPMENT, PHILIPS, OSCILLOSCOPES, TEST EQUIPMENT, MANUALS. **Ochre Mill Technical. Stone 0785 814643.**

HALTON TV
TRADE DISPOSAL

The Wholesaler you won't find competing with you on the High St.

TV and Videos

GEC, Philips, Decca, Doric, Thorn

★ Remember, we have NO retail outlet ★

St Michaels Industrial Estate, Widnes
Tel. 051 423 1577

COLOUR BAR GENERATOR

Pal Colour Generator with 11 patterns plus sound. Grey scale, Colour Bars, Red, Green & Blue Raster, Cross-hatch, Dots, Chequer Board, Black Raster, White Raster, Half Black & White, Mains Powered. £77.75

OUTPUTS PROVIDED
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SOUND OUTPUT
LINE PULSE
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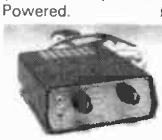

Same as above plus RGB output £83.50
Black and White Pattern Generator.
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CRT TESTER/REJUVENATOR £160.25

PRICES INCLUDE VAT AND POSTAGE

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WV11 3BE.

ARE YOU OR YOUR COMPANY INVOLVED IN VIDEO & TV SERVICING?

Then why not join our many satisfied customers

VCR PROTECTIVE COVERS
PERSONALISED WITH YOUR TRADE NAME

- Fits all modern VCRs – excluding portables
- Made from sturdy quilted anorak type material
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- Allows discreet removal to and fro – your customer will greatly appreciate this
- Creates good caring company image

Price (including P & P)
£6.50 each
Pack of 5 – £30
Pack of 10 – £55

AND NOW BY POPULAR REQUEST

PERSONALISED T.V. TRANSIT COVERS!
(tea cosy style)
★ No more scratched screens!

Price (including P&P)
Standard size £7.50 each (Pack of 5 – £35) (Pack of 10 – £65)
Extra Large (for the 'monsters') £8 each (Pack of 5 – £37.50) (Pack of 10 – £70)

DON'T DELAY – ORDER TODAY!
You'll wonder what you did without them!

Just print out your trading name and enclose with your order and cheque/P.O. to:
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Tel: 091-272 4646
Please allow 21 days for delivery

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The prepaid rate for semi display setting £6.78 per single column centimetre (minimum 2.5 cms). Classified advertisements 40p per word (minimum 12

PRICE BUSTERS IN BIRMINGHAM FOR

TESTED AND UNTESTED
TV's AND VIDEO's
ALSO AVAILABLE DIRECT LORRY LOAD

RING – 021-772 2733

WILTSGROVE LIMITED

(Next Door to UNCLE'S DISCOUNT STORE)

128-130 Ladypool Road,
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CASH ONLY

"STOP PRESS"

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THE TRADING POST

CLEARANCE SALE OF EX-RENTAL COLOUR TELEVISION SETS AND VIDEO's

Colour TV's working *from* **£20.00 + VAT**
Off the pile **£12.00 + VAT** (batches of 10)
T.V. Stands *from* **£3.00**

GOOD DISCOUNTS FOR DIRECT LOADS

Open 9am to 5pm Monday to Friday
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THE TRADING POST, UNIT 13, SAVILLE ROAD, WESTWOOD, PETERBOROUGH
TEL. 0733 261500

NOTICE TO READERS

Whilst prices of goods shown in classified advertisements are correct at the time of closing for press, readers are advised to check with the advertiser both prices and availability of goods before ordering from non-current issues of the magazine.

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Thorn 9000
UNIVERSAL
1 year guarantee

TRIPLERS
£4.95 inc. p&p

The UNIVERSAL TRIPLER can be used in most G.E.C., I.T.T., Pye, Rank, Decca & Continental sets.

WING ELECTRONICS
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T.V. **SPARES, PANELS AND MANUALS**
PHILIPS · GRUNDIG

TELEVIEW **01-994 5537**
194, Acton Lane, London W.4.

SERVICE PAGES

words), box number 70p extra. All prices plus 15% VAT. All cheques, postal orders etc., to be made payable to Television, and crossed "Lloyds Bank PLC". Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Dept., Television Room 204B (H.H.), IPC Magazines Limited, Kings Reach Tower, Stamford Street, London SE1 9LS. (Telephone 01-261 5942).

FYLDE T.V. AND VIDEO DISTRIBUTORS

Unit 7, Arkwright Court.
Blackpool/Fylde Industrial Estate
Very End of M55 left at roundabout.

UNLIMITED SELECTION OF

THORN	8800	**PHILIPS**	G11
	8800 R/C		G11 R/C
	9000		G11 TTX
	9000 R/C	**GEC**	S/S
	9600 R/C	**JVC**	20"
	9600 TTX	**MONO's**	20" + 24"

AND MANY MORE

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BEST SOURCE IN THE SOUTH FOR CLEAN WORKING TV & VIDEOS

TVs Bush/Decca/GEC/ITT/Japs/Philips
Thorn REMOTE & TEXT
Videos 2000, Beta & VHS

PLEASE PHONE FOR LIST
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FROM £12 EACH

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SMITHS ELECTRONICS
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HARLESDEN, LONDON NW10

WIZARD DISTRIBUTORS MANCHESTER

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FIDELITY SPARES MAIN DISTRIBUTOR.

Did you know we also stock

FUSES	I.Cs
TUBES	TOOLS
AERIALS	VIDEO LEADS
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Tel: 061-872 5438; 061-848 0060.

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WORKING TVs £20.00
RE-GUNNING TUBES

2 year guarantee
Most types available
including Sony

Access — BARCLAYCARD VISA

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ONE YEAR GUARANTEE

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Broken Tube We Can Help.

16" 420 EDB – EFB – CZB, 42 – 001, 42 – 556.

20" 51 – 161, 51 – 500 – 554 – 570 – 575 – 580 – 590 – 51 – 001 AXT – 510 JKB – VB – UFB – RJB – UDB – HWB – 510 ABUB from £45.

22" 56 – 500, 56 – 540 – 610 – 611 – 615 – 700 – 712 – 560 EGB – DAB – DMB – BYB – EGB – TB – GAB – AXB – ETB – HB – DYB – ATB – BMB – HW 56 – 001 AXT.

26" 66 – 500 – 510 – 540 – 611 – 615 £55.

HITACHI 510 HWB – VLB – VSB – 560 DZB – HWB – 490 DKB22 FROM £34.

SONY £65 Cash & Carry only.

DELTAS £29.00 Reguns.
£14.50 Slightly used. 6 month guarantee.
A56-120 A56-140 A51-110 A49-191 A47-342 or 343
A44-270-1 A66-120 A66-140 (410) A67-120
All prices are inclusive

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Callers ring first, open every day including Sunday
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I/Cs – Tuners – Transistors – Valves – Diodes etc. any quantity considered – immediate payment.

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Start off on the right course... be **fully** informed! One week intensive instructional courses, run by an ex-broadcasting engineer. Residential, marvellous accommodation with **excellent food**. Theoretical and practical "Hands on" instruction. Training covers all aspects of television and radio reception. Become an aerial erector who can provide the best, because he's learnt the best way!

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Dundonnell, by Garve,
Ross-Shire IV23 2QY.
Tel: 085-483-213.

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The Theory and Practice of PAL Colour Television in three important Video Cassette Programmes

Part 1. **The Colour Signal**
Part 2. **The Receiver Decoder**
Part 3. **Receiver Installation**

VHS★★★V2000★★★
BETAMAX★★★UMATIC

For full details telephone
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(enclosing this advert)

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Versatile and reliable. Although many things have become cheaper, picture tubes are still expensive. So utilize tubes fully by using our new generation machine.

· **Regenerates picture tubes even better · Also IN-LINE · Removes short-circuits, even between cathode and filament · Measures beam current, emission current, life expectancy, etc.**

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Trade Prices subject to official order

CABINETS ★ KNOBS ★ TUNERS ★ CONTROLS ★ CRT'S ★ TRANSFORMERS
SEMI'S ★ I.C.'S ★ CAPACITORS ★ REMOTES ★ TRIMS ★ END USER PARTS

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Audio-TV-Video ★ Microwave ★ Photo-copier ★ Typewriter

All U.K. model spares available. Same day despatch of orders received before 1pm.
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FROM WVE

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CABINETS ★ KNOBS ★ TUNERS ★ CONTROLS ★ CRT'S ★ TRANSFORMERS
SEMI'S ★ I.C.'S ★ CAPACITORS ★ REMOTES ★ TRIMS ★ END USER PARTS

Tel: 0734 876444 — ***Willow Vale Electronics Ltd*** — Tel: 0734 876444

11 Arkwright Road, Reading, Berkshire RG2 0LU

GENUINE FIDELITY PARTS AT STANDARD FIDELITY TRADE PRICES

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AVON METERS

We buy and sell and repair TV coinmeter. Reasonable prices, one year guarantee.

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0272 559761

COINMECHS DOUBLE POLE 50p Slotmeters required, working or faulty. Must be complete, state quantity and price. Box No. 224.

22 SMITHS 2000 50 pence coin meters. Most unused. £150 to clear. 0322 29581.

METERS. Reconditioned 10p/50p available from stock. Contact THE METER CO. (Poole) LTD. (0202) 683498.

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B45H/G UHF AMPLIFIER 20dbs gain, next to the set fitting, battery PP3 or 8V to 14V working. **SPECIAL PRICE £7.70.**

SEND OR TELEPHONE FOR OUR COMPLETE LIST OF RADIO AND TV BOOSTER INCLUDING **VIDEO** (VCR) **BEAMER-BOOSTER £10.50.**

P&P £1 NO VAT. ACCESS/VISA CARDS WELCOME

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Parabolic Dish Antennas
(Parent company est. in TV communications since 1969)
SATELLITE TVRO ANTENNAS
TOP QUALITY SOLID
GLASSFIBRE DISH ANTENNAS
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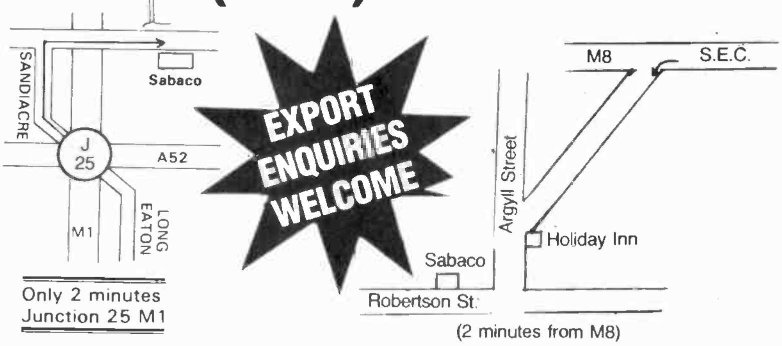

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0.0015/2KV	10p
5n2/2KV	10p
6n2/2KV	15p
2n0/2KV	15p
2n2/2KV	15p
470pf 4KV	10p
7500pf/2KV	10p
3000PF/3000V	10p
4n7/2KV	15p
8n2/2KV	15p
0.0082/2500	15p
150/3500	10p
1800/4KV	5p
4.7nf/5KV	10p
170/8KV	10p
180/8KV	10p
210/8KV	10p
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.47/100V	80p

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BF181	20p
BF182	20p
BF184	20p
BF194	10p
BF195	10p
BF196	10p
BF197	12p
BF198	10p
BF199	10p
BF200	20p
BF222	10p
BF224	15p
BF238	20p
BF240	16p
BF244	40p
BF245b	20p
BF255	20p
BF256	20p
BF257	20p
BF258	25p
BF262	15p
BF263p	25p
BF264	15p
BF271	10p
BF273	10p
BF274	10p
BF324	25p
BF337	50p
BF355	30p
BF362	20p
BF363	15p
BF367	15p
BF391	15p
BF394	10p
BF419	30p
BF422	15p
BF423	15p
BF448	30p
BF450	20p
BF458	30p
BF459	30p
BF460	30p
BF468	30p
BF469	30p
BF470	20p
BF480	50p
BF494	30p
BF594	10p
BF597	10p
BF760	30p
BF819A	20p
BF858	30p
BF869	30p

BF694	10p
BF758	30p
BF760	30p
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BC113	10p
BC114	10p
BC115	10p
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BC125	10p
BC126	10p
BC139	10p
BC140	30p
BC141	25p
BC143	25p
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BC148	10p
BC149	10p
BC153	10p
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BC157a	10p
BC158	10p
BC159	10p
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BC171	10p
BC172	10p
BC173	10p
BC174	10p
BC183	10p
BC184	10p
BC204	10p
BC207	10p
BC212	10p
BC213	10p
BC214	10p
BC237	10p
BC238	8p
BC239	10p
BC250	8p
BC251	10p
BC252	10p
BC262	10p
BC263b	20p
BC294	30p
BC298	10p
BC300	30p
BC301	30p
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BC307	7p
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BC309	10p
BC327	10p
BC328	10p
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BC338	10p
BC347	10p
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BD238	30p
BD239	15p
BD240	50p
BD243c	30p
BD244	50p
BD250a	30p
BD252	20p
BD253B	50p
BD331	20p
BD373b	20p
BD416	25p
BD433	25p
BD437	25p
BD438	30p
BD439	50p
BD544	40p
BD678	30p
BD681	30p
BD682	30p
BD507	50p
BD509	30p
BD510	30p
BD517	30p
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Degausing Thermistor (fits most sets)	20p
GEC Double Thermistor	25p

Filters

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6MHz	30p

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CVC 9 power supply board	£1.50
CVC 20/2 mains panel	£2.00
ITT Mains Filter .1/250v/ CVC 5 to CVC 45 3 pin type	20p
Pots 10 k with Switch	25p
Mullard Surface Wave Filter RW 153P Colour TV Filter	40p
Mullard Surface Wave Filter RW 154 Colour TV Filter	40p

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4.433-619	
6MHz	
8.867238	
11.059.000	30p
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Antistatic Isolators Disc Type Black	10p
RCA 1693	£1.00

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42 Pin × 5	£1.00	18 Pin × 10	£1.00
28 Pin × 5	80p	28 Pin × 4	£1.00
16 Pin × 10	70p	AB Mains Switch u/v	30p
24 Pin × 5	75p		
14 Pin × 10	70p		
18 Pin × 10	80p		

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