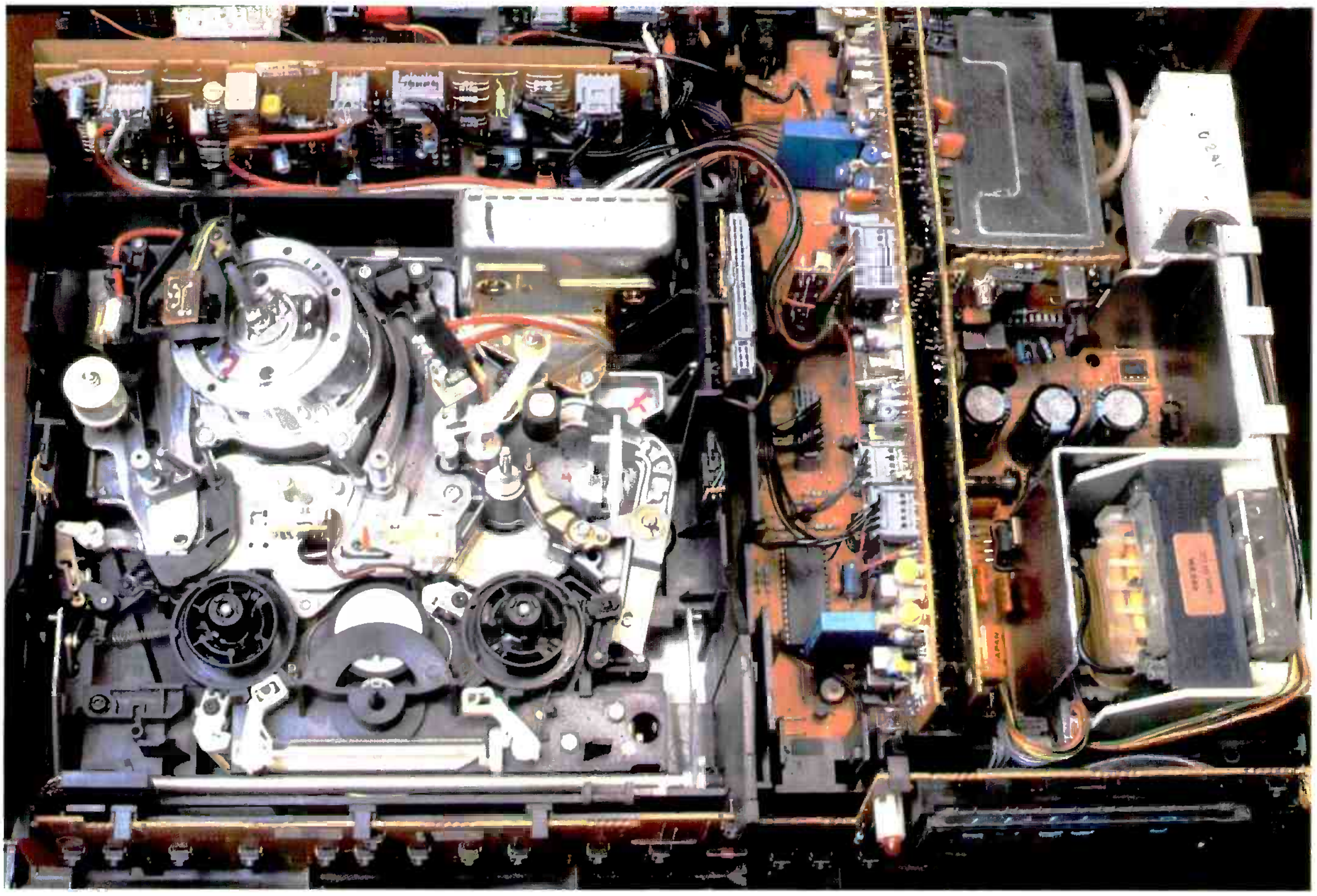
JULY 1993 £2.20

TELEVISION

SERVICING·VIDEO·SATELLITE·DEVELOPMENTS



Servicing the Philips VR6462 VCR

Digital Television Broadcasting

Modern Colour Signal Processing

Panasonic's Digital CTV Chassis

Bush 2114 Fault Notes · DX-TV

VCR Clinic · TV Fault Finding

07

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A REED BUSINESS PUBLICATION

TELEVISION

JULY 1993

Vol. 43, No. 9
Issue 513

On sale June 16th

CORRESPONDENCE
All correspondence regarding advertisements should be addressed to the Advertisement Manager, "Television", Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS. Editorial correspondence should be addressed to "Television" Editorial Department, Reed Business Publishing, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.

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OUR NEXT ISSUE DATED AUGUST WILL BE PUBLISHED ON JULY 21

BC107	8p
BC108	8p
BC109	8p
BC109C	10p
BC140	20p
BC141	20p
BC142	20p
BC143	20p
BC147	8p
BC148	8p
BC149	8p
BC157	8p
BC159	8p
BC160	30p
BC171	10p
BC172	10p
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BC183	7p
BC183L	7p
BC184	7p
BC184L	7p
BC212	7p
BC212L	7p
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BC213L	7p
BC214	7p
BC214L	7p
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BC303	20p
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BC549	8p
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BC556	8p
BC557	7p
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BC559	8p
BC560	8p
BC637	20p
BC638	20p
BC639	20p
BC640	20p
BCY70	16p
BCY71	16p
BCY72	16p
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BD124P	50p
BD131	25p
BD132	25p
BD133	50p
BD135	20p
BD136	20p
BD137	20p
BD138	20p
BD139	20p
BD140	20p
BD144	90p
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BD899	50p
BD901	50p
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BDX65	80p
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BDW24	55p
BDW93	50p
BDW94	50p
BDY92	100p
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BF167	30p
BF180	16p
BF181	18p
BF183	20p
BF195	7p
BF199	8p
BF200	16p
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BF240	16p
BF245	25p
BF254	15p
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BF257	18p
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BF259	18p
BF262	25p
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BF270	18p
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BFX89	60p
BFY17	30p
BFY18	40p
BFY50	14p
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BR103	37p
BR303	85p
BRY49	38p
BSS74	33p
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BSX26	18p
BT100A	70p
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BT151	58p
BTY79	140p
BU100A	110p
BU104	80p
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BU108	100p
BU109	80p
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BU806	75p
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BU903	130p
BU920	130p
BU922	130p
BU930	130p
BUT11AF	60p
BUT12	80p
BUT56A	150p
BUX80	180p
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BUX85	50p
BU69A	200p
BUY71	300p
BUZ71	75p
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MJ15003	325p
MJ15004	370p
MJ2501	110p
MJ2955	55p
MJ3000	115p
MJ3001	115p
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MJE350	80p
MJE520	30p
OC28	350p
OC29	250p
OC35	350p
OC36	250p
OC45	50p
OC72	50p
OC200	180p
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R2010B	100p
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TIP3054	45p
TIP3055	42p
TIS44	40p
TIS61	15p
TIS90	15p
TIS91	18p
TIS93	20p
VK1010	88p
VN10KM	60p
VN66AF	100p
VN88AF	115p
ZTX107	11p
ZTX108	11p
ZTX109	12p
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ZTX303	24p
ZTX304	17p
ZTX320	29p
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ZTX501	13p
ZTX502	18p
ZTX503	18p
ZTX504	25p
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2N930	18p
2N1131	28p
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2N1711	24p
2N1893	30p
2N2102	50p
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2N2219	24p
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2N2222	23p
2N2369	15p
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2N2646	40p
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2N3019	28p
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2N4036	25p
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2N5192	50p
2N5241	500p
2N5245	45p
2N5294	30p
2N5296	30p
2N5366	25p
2N5401	12p
2N5448	12p
2N5496	80p
2N6107	40p
2N6292	40p
2N6385	120p
2N6403	160p
3N143	65p
DIODES	
Rectifier Diodes	
BY127	8p
BY133	8p
BY164	40p
BY179	35p
BY184	32p
BY196	20p
BY206	11p
BY207	11p
BY210	22p
BY225	120p
BY227	19p
BY228	28p
BY296	20p
BY298	23p
BY299	22p
BYX10	15p
BYX55/350	30p
BYX55/600	25p
BYX70/500	32p
OA47	10p
OA90	10p
OA91	10p
OA200	10p
OA202	10p
IN.914	2p
IN.4001	3p
IN.4002	3p
IN.4003	3p
IN.4004	3p
IN.4005	3p
IN.4006	3p
IN.4007	4p
IN.4148	2p
IN.5400	9p
IN.5401	8p
IN.5402	8p
IN.5403	8p
IN.5404	8p
IN.5405	11p
IN.5406	12p
IN.5407	12p
IN.5408	12p
RGP15	15p
RGP30	16p
SKE4F2/06	60p
SKE4F2/08	80p
SKE4F2/10	100p
SR2M	60p
I.C. SOCKETS	
8PIN	5p
14PIN	6p
16PIN	7p
18PIN	10p
20PIN	12p
22PIN	13p
24PIN	14p
28PIN	16p
40PIN	18p
ZENERS	
400 MW	
BZY88 RANGE	
2V7 to 39V	5p
1.3W	
BZX61 RANGE	
2V7 to 39V	9p
CRYSTALS	
Freq in MHz	
1.0	260p
2.4576	180p
3.276	115p
4.0	110p
4.194	130p
4.43	95p
5.0	130p
6.0	115p
10.0	140p
11.0	250p
12.0	120p
14.756	200p
15.0	160p
18.0	130p
18.432	130p
24.0	250p
48.0	160p
VOLTAGE REGULATORS	
7805	25p
7806	25p
7808	25p
7812	25p
7815	25p
7818	25p
7824	25p
7905	25p
7906	30p
7908	30p
7912	30p
7915	30p
7918	30p
7924	30p
78L05	24p
78L08	24p
78L12	24p
78L15	24p
78L18	24p
78L24	24p
79L05	35p
79L08	35p
79L12	35p
79L15	35p
7818KC	100p
7824KC	100p
LM309K	100p
LM317K	200p
LM317T	100p
LM323K	350p
LM723	35p
78H08KC	800p
78H12KC	700p
79HGKC	800p
VALVES	
DAF96	100p
DY87	80p
EB91	50p
EBF80	60p
EBF89	60p
ECC84	80p
ECH83	100p
ECH84	90p
ECL80	65p
ECL82	80p
ECL84	100p
ECL85	80p
EF85	80p
EF183	75p
EF184	85p
EL34	300p
EL95	85p
EL500	100p
EY86	70p
EY87	70p
EY88	80p
PC97	100p
PCC85	60p
PCF80	100p
PCF801	110p
PCF802	80p
PCF806	115p
PCH200	100p
PCL81	65p
PCL82	80p
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PCL85	80p
PCL805	80p
PFL200	110p
PL36	120p
PL83	60p
PL84	80p
PL95	180p
PL504	120p
PL508	200p
PL519	430p
PY81	100p
PY88	100p
PY500A	190p
LED's	
3mm	
RED	5p
YELLOW	8p
GREEN	8p
5mm	
RED	5p
YELLOW	8p
GREEN	8p
RECTANG. LED's	
5mm × 2.5mm	
RED	5p
YELLOW	8p
GREEN	8p
LINEAR IC's	
AN203	210p
AN210	165p
AN214Q	170p
AN228	280p
AN240P	130p
AN252	150p
AN259	250p
AN262	140p
AN271	230p
AN274	250p
AN301	330p
AN303	250p
AN304	360p
AN315	210p
AN316	350p
AN360	100p
AN362	140p
AN366	150p
AN610	160p
AN612	160p
AN3312	350p
AN3320K	800p
AN3331K	900p
AN3792	400p
AN3794	450p
AN3795	500p
AN3821	800p
AN3821K	600p
AN3822K	700p
AN3830K	800p
AN3990K	300p
AN3991K	400p
AN5010	450p
AN5011	400p
AN5015	350p
AN5020	200p
AN5025	250p
AN5030	550p
AN5033	400p
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AN5260	350p
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AN6247	200p
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AN6307	250p
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AN6362	480p
AN6371	470p
AN6387	560p
AN6811	130p
AN6884	240p
AN7105	210p
AN7110	130p
AN7114	150p
AN7115	150p
AN7116	90p
AN7120	130p
AN7130	110p
AN7140	450p
AN7145	195p
AN7146	210p
AN7154	180p
AN7156	240p
AN7168	260p
AN7178	270p
AN7222	180p
AN7254	150p
AN7256	250p
AN7310	90p
AN7311	90p
AN7410	250p
AY3-1015	290p
AY3-1270	800p
AY3-1350	450p
AY3-8910	360p
AY3-8912	400p
BA301	65p
BA311	80p
BA313	60p
BA333	100p
BA340	150p
BA401	60p
BA402	60p
BA511	160p
BA514	160p
BA516	150p
BA521	160p
BA524	240p
BA526	180p
BA527	95p
BA532	140p
BA534	290p
BA536	180p
BA546	180p
BA612	160p
BA656	150p
BA658	380p
BA684	400p
BA685	400p
BA1310	160p
BA1320	110p
BA1330	160p
BA1360	160p
BA4403	220p
BA5101	400p
BA5102	220p
BA5204	200p
BA5402	180p
BA5406	180p
BA5408	180p
BA6104	250p
BA6208	250p
BA6209	260p
BA6304	120p
BA6305	140p
BA6410	220p
BA6411	250p
BA6993	150p
BA7001	150p
BA7004	200p
BA7007	200p
BA7021	180p
BA7022	350p
BA7751LS	150p
BA7752	250p
BA7755	150p
BA7767AS	200p
CX108	950p
CX134A	950p
CX136	600p
CX139	1450p
CX139A	750p
CX141	750p
CX143	800p
CX143A	1250p
CX145	725p
CX150B	325p
CX158	825p
CX175	325p
CX186	750p
CX187	825p
CX804A	775p
CX832	825p
CX867	575p
CX868	525p
CX877	300p
HA1125	150p
HA1137W	135p
HA1197	150p
HA1199	145p
HA1319	240p
HA1338	300p
HA1339A	350p
HA1377	160p
HA1388	120p
HA1389	210p
HA1392	200p
HA1394	280p
HA1397	250p
HA1398	240p
HA11219	280p
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KA2206	150p
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KA2912	125p
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LA1185	150p
LA1201	75p
LA1210	140p
LA1222	80p
LA1230	130p
LA1231	210p
LA1364	200p
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LA1460	220p
LA2000	150p
LA2101	270p
LA2200	190p
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LA3201	80p
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LA4460	130p
LA4461	130p
LA4500	200p
LA4505	220p
LA4507	360p
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LINEAR ICs - Cont.

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JAPANESE TRANSISTORS

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2SC3870	200p
2SC3883	280p
2SC3890	150p
2SC3895	400p
2SC3897	650p
2SC3907	420p
2SC3909	450p
2SC3927	550p
2SC3946	120p
2SC3950	120p
2SC3953	120p
2SC3954	150p
2SC3973	275p
2SC3975	275p
2SC3987	220p
2SC3996	1200p
2SC4006	100p
2SC4020	280p
2SC4023	325p
2SC4056	350p
2SC4106	200p
2SC4123	450p
2SC4124	250p
2SC4169	80p
2SC4236	550p
2SC4237	750p
2SC4242	200p
2SC4262	50p
2SC4301	550p
2SD198	140p
2SD199	280p
2SD200	210p
2SD201	280p
2SD257	195p
2SD313	40p
2SD315	75p
2SD325	30p
2SD330	110p
2SD348	480p
2SD357	60p
2SD358	40p
2SD371	240p
2SD380	660p
2SD381	80p
2SD388	170p
2SD389	90p
2SD400	14p
2SD401	50p
2SD402	120p
2SD415	120p
2SD424	400p
2SD426	150p
2SD427	360p
2SD438	45p
2SD467	15p
2SD468	25p
2SD471	75p
2SD525	50p
2SD526	70p
2SD545	60p
2SD549	120p
2SD551	400p
2SD555	500p
2SD560	150p
2SD571	80p
2SD575	530p
2SD600	30p
2SD601	40p
2SD602	60p
2SD612	50p
2SD613	70p
2SD636	10p
2SD637	40p
2SD638	60p
2SD639	60p
2SD640	350p
2SD642	50p
2SD655	60p
2SD661	60p
2SD666	70p
2SD667	70p
2SD668	120p
2SD669	40p
2SD673	350p
2SD676	250p
2SD716	80p
2SD717	180p
2SD718	100p
2SD722	240p
2SD725	270p
2SD734	60p
2SD-741	120p
2SD-743	130p
2SD-756	100p
2SD-757	120p
2SD-758	140p
2SD-762	140p
2SD-763	140p
2SD-768	180p
2SD-772	200p
2SD-773	40p
2SD-774	60p
2SD-777	400p
2SD-784	650p

2SD-786	100p
2SD-787	80p
2SD-788	100p
2SD-789	80p
2SD-792	400p
2SD-794	100p
2SD-795A	140p
2SD-811	450p
2SD-819	400p
2SD-820	450p
2SD-821	550p
2SD-822	400p
2SD-826	100p
2SD-836	60p
2SD-836A	60p
2SD-837	80p
2SD-838	400p
2SD-841	160p
2SD-844	200p
2SD-845	250p
2SD-850	260p
2SD-856	48p
2SD-858	250p
2SD-863	60p
2SD-864	200p
2SD-866	120p
2SD-866A	140p
2SD-868	450p
2SD-870	400p
2SD-871	450p
2SD-879	60p
2SD-880	40p
2SD-882	80p
2SD-892A	140p
2SD-894	120p
2SD-895	200p
2SD-896	200p
2SD-900	400p
2SD-905	450p
2SD-916	130p
2SD-917	300p
2SD-921	320p
2SD-923	380p
2SD-946	120p
2SD-947	100p
2SD-950	300p
2SD-951	350p
2SD-957A	520p
2SD-958	60p
2SD-966	100p
2SD-970	170p
2SD-973	60p
2SD-973A	70p
2SD-985	120p
2SD-986	120p
2SD-1012	60p
2SD-1020	40p
2SD-1021	120p
2SD-1022	400p
2SD-1024	130p
2SD-1030	75p
2SD-1031	130p
2SD-1037	750p
2SD-1046	200p
2SD-1047	225p
2SD-1061	130p
2SD-1060	130p
2SD-1062	150p
2SD-1063	200p
2SD-1064	250p
2SD-1065	200p
2SD-1069	150p
2SD-1071	460p
2SD-1073	350p
2SD-1088	150p
2SD-1094	520p
2SD-1110	225p
2SD-1111	60p
2SD-1113	225p
2SD-1128	200p
2SD-1133	100p
2SD-1135	150p
2SD-1138	80p
2SD-1140	40p
2SD-1142	350p
2SD-1148	175p
2SD-1151	50p
2SD-1159	90p
2SD-1160	150p
2SD-1163A	220p
2SD-1164	120p
2SD-1168	425p
2SD-1169	280p
2SD-1173	350p
2SD-1185	400p
2SD-1186	400p
2SD-1187	250p
2SD-1189	125p
2SD-1190	150p
2SD-1191	120p
2SD-1192	90p
2SD-1196	150p
2SD-1197	150p
2SD-1207	50p
2SD-1210	280p
2SD-1211	120p
2SD-1218	75p
2SD-1223	75p
2SD-1225	120p
2SD-1227	40p
2SD-1229	250p
2SD-1237	300p
2SD-1246	30p
2SD-1247	40p
2SD-1248	270p
2SD-1251	180p
2SD-1263	90p
2SD-1264	120p
2SD-1265	75p
2SD-1266	180p
2SD-1267	100p
2SD-1267A	125p
2SD-1271	40p
2SD-1271A	225p
2SD-1272	200p
2SD-1273	50p
2SD-1275	50p
2SD-1276	200p
2SD-1277	190p
2SD-1279	600p
2SD-1288	175p
2SD-1289	300p
2SD-1291	400p
2SD-1292	60p
2SD-1297	425p
2SD-1302	40p
2SD-1308	140p
2SD-1309	140p
2SD-1310	140p
2SD-1313	1000p
2SD-1326	200p
2SD-1328	60p
2SD-1347	70p
2SD-1348	85p
2SD-1350	150p
2SD-1376	125p
2SD-1379	100p
2SD-1380	100p
2SD-1383	100p
2SD-1384	50p
2SD-1389	200p
2SD-1390	350p
2SD-1391	450p
2SD-1392	150p
2SD-1395	150p
2SD-1396	240p
2SD-1397	175p
2SD-1398	130p
2SD-1399	300p

2SD-1400	280p
2SD-1402	280p
2SD-1404	125p
2SD-1406	80p
2SD-1407	160p
2SD-1408	125p
2SD-1409	170p
2SD-1412	100p
2SD-1413	175p
2SD-1414	700p
2SD-1415	190p
2SD-1417	125p
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2SD-1426	160p
2SD-1427	380p
2SD-1428	360p
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2SD-1451	260p
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2SD-1453	140p
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2SD-1556	700p
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2SD-1565	75p
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2SD-1590	100p
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2SD-1877	250p
2SD-1878	300p
2SD-1879	275p
2SD-1884	300p
2SD-1886	460p
2SD-1887	460p
2SD-1896	300p
2SD-1910	280p
2SD-1911	400p
2SD-1913	50p
2SD-1929	60p
2SD-1939	75p
2SD-1941	500p
2SD-1959	280p
2SD-1961	50p
2SD-1978	50p
2SD-1984	150p
2SD-2012	50p
2SD-2046	50p
2SJ-48	425p
2SJ-49	425p
2SJ-50	425p
2SJ-56	700p
2SJ-74	60p
2SJ-75	280p
2SJ-76	220p
2SJ-77	350p
2SJ-79	225p
2SJ-103	75p
2SJ-106	40p
2SJ-108	60p
2SJ-115	525p
2SJ-116	1000p
2SJ-117	550p
2SJ-118	600p
2SJ-119	700p
2SJ-122	800p
2SJ-161	650p
2SJ-162	680p
2SK-19	45p
2SK-40	50p
2SK-49	50p
2SK-56	100p
2SK-68	100p
2SK-73	75p
2SK-106	40p
2SK-107	40p
2SK-109	120p
2SK-118	50p
2SK-125	100p
2SK-133	650p
2SK-134	415p
2SK-135	415p
2SK-147	160p
2SK-150	150p
2SK-162	115p
2SK-163	40p
2SK-168	40p
2SK-176	800p
2SK-192	45p
2SK-195	150p
2SK-197	140p

2SK-214	170p
2SK-216	120p
2SK-217	35p
2SK-218	400p
2SK-240	140p
2SK-270	50p
2SK-294	350p
2SK-310	200p
2SK-312	750p
2SK-315	70p
2SK-320	120p
2SK-322	140p
2SK-323	130p
2SK-358	300p
2SK-370	40p
2SK-371	40p
2SK-386	600p
2SK-388	850p
2SK-405	450p
2SK-413	500p
2SK-414	500p
2SK-415	500p
2SK-429	180p
2SK-511	450p
2SK-513	325p
2SK-517	200p
2SK-531	350p
2SK-534	700p
2SK-537	900p
2SK-538	400p
2SK-539	1100p
2SK-555	400p
2SK-556	500p
2SK-566	475p
2SK-567	400p
2SK-695	550p
2SK-719	300p
2SK-724	600p
2SK-725	600p
2SK-727	1200p
2SK-735	600p
2SK-758	300p
2SK-787	1100p
2SK-794	500p
2SK-872	950p
2SK-903	500p
2SK-1057	800p
2SK-1058	800p
2SK-45	100p
2SK-51	100p
2SK-59	100p
2SK-73	60p
2SK-74	50p
2SK-77	50p
2SK-81	50p
2SK-85	160p
2SK-87	45p
2SK-88	70p
2SK-121	150p
2SK-129	175p
2SK-165	225p
2SK-166	300p

COMPUTER ICs

2114	150p
2532	200p
2716	100p
2732	200p
2732A	220p
2764	150p
27C64	200p
27128	150p
27256-25	150p
27512	300p
4116	40p
4164-15	80p
4164-12	90p
4164-10	100p
41256-15	80p
41256-12	100p
41256-10	110p
41464-12	150p
41464-10	200p
6116	80p
6264-15	160p
6264-12	180p
6264-10	210p
62256-12	300p
6502	300p
6502A	380p
65C02	330p
6522	280p
6551	380p
6800	210p
6802	220p
6803	500p
6808	500p
6809	500p
6810	150p
6818	380p
6840	290p
6845	200p
6850	90p
8080A	380p
8085A	380p
8086	500p
8088	480p
8156	300p
81LS96	130p
81LS97	130p
81LS98	130p
8224	240p
8226	240p
8243	250p
8250	750p
8251	200p
8253	160p
8255	160p
8256	700p
8257	220p
8271	3400p
8279	270p
8283	400p
8284	440p
8287	260p
8288	650p
8748	700p
8755	800p
Z80ACPU	100p
Z80BCPU	160p
Z80ADMA	200p
Z80APIO	150p
Z80BPIO	150p
Z80ACTC	140p
Z80BCTC	200p
Z80ASIO	210p
Z80ASIO-1	210p
Z80ASIO-2	210p
Z80ADART	260p
74S289	180p
74S387	200p
75107	65p
75110	75p
75113	100p
75122	110p
75150	95p
75154	100p
75162	700p
75182	95p
75183	95p
75188	55p
75189	55p
75195	185p
75451	40p
75454	65p
75492	55p
8T26	95p
8T28	110p

SIMMS

256K×9-80	1000p
256K×9-70	1100p
1MB×9-80	3000p
1MB×9-70	3200p

SIPS

256K×9-80	1100p
256K×9-70	1200p
1MB×9-80	3100p
1MB×9-70	3200p

OPTO COUPLERS

4N25	50p
4N26	60p
4N27	50p
4N28	50p
4N29	90p
4N30	90p
4N31	90p
4N32	100p
4N33	100p
4N36	58p
4N37	58p
4N38	68p

BRIDGE RECTIFIERS

W005 1A/50V	16p
W01 1A/100V	18p
W02 1A/200V	19p
W04 1A/400V	21p
W06 1A/600V	23p
W08 1A/800V	28p
BR81D 2A/100V	33p
BR82D 2A/200V	33p
BR84D 2A/400V	37p
BR86D 2A/600V	43p
BR88D 2A/800V	43p
BR32 3A/200V	43p
BR34 3A/400V	43p
BR36 3A/600V	44p
BR62 6A/200V	80p
BR64 6A/400V	72p
BR251 25A/100V	150p
BR252 25A/200V	165p
BR254 25A/400V	185p
BR256 25A/600V	200p
BR258 25A/800V	240p
BR351 35A/100V	185p
BR352 35A/200V	200p
BR354 35A/400V	220p
BR356 35A/600V	230p
BR358 35A/800V	260p
BY164 1.5A/100V	40p
BY179 1.5A/800V	40p

TRIACS

TIC206D 4A/400V	60p
TIC225D 6A/400V	69p
TIC226D 8A/400V	68p
TIC236D 12A/400V	85p
TIC246D 16A/400V	105p
TIC253D 20A/400V	190p
TIC263D 25A/400V	205p
T2800D 8A/400V	62p

THYRISTORS

2N5061 0.8A 60V	20p
C106D 4A/400V	28p
TIC116C 8A 300V	59p
TIC116D 8A/400V	70p
TIC116M 8A/600V	79p
TIC126D 12A/400V	75p
TIC126M 12A/600V	90p
BR103	37p
BR303	85p
BT106	180p
BT116	80p
BT119	100p
TIC44	22p
17088	200p
17089	200p
17127	200p
15/80H	230p
15/85R	230p
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SG613	800p

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SWITCH CLEANER	150p
SILICONE GREASE	170p
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PLASTIC SEAL	160p
GLASS CLEANER	160p
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VT7 VT17 VT18 VT19 £23.50
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VT100 110 111 112 113 115 118 120 125 128 220 225/VT400 405 410 413 414 415 418 510 518 520 525 526 VTM625 626 £18.00
VT3000 £10.00
VT4000 4200 5000 5500 £15.00
VT77 680 3000 6500 7000 8000 8030 8040 8100 8300 VT8500 8700 9000 9300 9500 9700 9900 £12.00
VT8 VT9 VT56 VT57 £34.00
VT65 £35.00
VT130 VT135 VT138 VT145 VT250 VT255 VT258 VT420 425 426 428 430 431 435 438 535 536 VTL301 VTM630 635 636 £29.50
VT52 61E VT62E VT63 VT64 VT640 £20.00
VT150 (4 HEAD) £27.00
VT530 £25.00

ITT
VR3605 3905 3935 3943 3954 3985 3993 £6.50
VR3833 VR3913 VR3914 VR3963 VR3975 VR3912 £6.50
VR3986 £20.00
VP3826 VR3906 3916 3926 3946 VR3948 6948 £15.75
VR3927 £17.00
VR3976 £24.50
VR3977 £31.00
VR3994 £23.00
VR3995 3997 £31.50
VR3917 £16.00

JVC 3HSS
HR2200 HR3300 HR3320 HR3330 HR3350 HR3360 HR3660 HR3750 HR3860 HR4100 £6.50
3292 8903 8900 8901 8902 8903 8906 8922 8928 3VD1 3V06 3V22 £6.50
HR3660 HR7600 HR7610 HR7650 HR7700 HRD110 HRD111 HRD120 HRD121 HRD220 HRD225 HRS100 £6.50

FERGUSON 3HSSL PIN
8904 8924 8941 8943 8944 3V16 3V23 3V24 3V31 3V35 3V36 3V38 3V39 3V49 £6.50
HRD140 HRD141 HRD143 HRD150 HRD157 HRD158 HRD160 HRD5101 HRS10 £15.50

FERGUSON
3947 8948 3V42 3V44 3V45 3V46 3V47 3V52 3V54 3V55 3V56 3V57 £15.50
8950 8951 3V64 FV10 FV11 3V65 FV20 FV21 FV22 FV26 £17.00
3V48 £24.50
3V43 3V53 £31.50
8930 8940 3V29 3V30 £7.50
8945 £24.00
3V00 £10.00
FV31 £22.00
FV37 £38.00

JVC
HRD170 171 210 211 £17.00
HRD565 566 £24.50
HRD725 HRD755 £31.50
BR7000E BR7000S £30.00
HR7200 7300 7350 2650 £7.20
HRD455 £20.00
HRD520 £22.00
HRD300 HRD400 HRD600 £19.00
HR4100 £10.00
HRD750 £33.00
HRD250 257 £27.00

JVC & FERGUSON
3V32 8942 HR7655 £23.00
HRD180 230 3V59 FV12L FV20B FV22 26 30 32 33 £30.50
HRD370 3V58 FV13H HRD430 HRD470 £27.00
HRD530 700 FV14T £33.50
GRC1 GRG2 3V41 £30.00

LOGIK
VR960 £16.00
VR950 £16.00

LOEWE
OC410 420 440 £24.00
OC50 OC55 OC60 OC65 £15.00

LUXOR
9225 £21.50

MATSUI
VX500E VX600A VX800A VX810A VX880A VX770R VX773B £13.60
VCRL3 VX730 £15.00
VX735 VX755 £16.00
VX735A VX755A VX765 VX850 £17.60

MITSUBISHI
HS303 HS304 HS320 HS700 £19.50
HS306 HS318 HS710 £20.00
HS307 £37.00
HS319 £37.00
HS330 £32.00
HS400 £29.00
HS349 £28.00
HS411 £32.00
HSE30 £28.00
HS338 £28.00
HSE11 £37.00
HS300 HS301 HS302 HS310 £18.50
HS200 £6.50
HS337 HS347 £22.00

NATIONAL PANASONIC 4HSS-3HSSN
NV3000 NV300 NV7200 NV333 NV7500 NV7800 NV7850 NV322 NV332 NV340 NV390 NV2000 NV2010 NV7000 NV8170 NV8200 NV8400 NV8600 NV8610 NV8620 £6.26

NATIONAL
NV777 NV330 £17.00
NV430 AG1000 £11.00
NV280 NV460 470 480 £16.50
NV730 NV770 (4 HEAD) £18.50
NV366 £18.50
NV180 NVG48 £23.00
NV370 NV380 NV100 NV630 £8.50
NV788 £23.00
NV810 NV830 £30.00

NATIONAL Cont.
NV850 NV950 £35.00
NV870 NV890 NV970 £39.00
NVG33 NVG46 NVL23 NVL25 NVL28 £38.00
NVG30 NVG31 NVG40 NVG130 NVJ30 NVL20 £20.00
NVG10 NVG11 NVG12 NVG14 NVG16 NVG120 NV250 NV280 NV450 NV465 £16.50
NVG18 £25.00
NVG20 NVG21 NVG22 NVG25 NVG28 NVG200 NVD48 £25.00
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NVG45 NVG46 £30.00
NVH70 £50.00
NV688 £25.50
NV600 £23.00
AG 6800 6810 £39.00
AG-6100 6200 6300 £32.00
NVH65 £50.00
NVG7 NVG9 NV230 £18.00
NV780 £36.00
NVG15 NVG400 £48.00
NVM7 NVMC20 NVF70 £62.00

N.E.C.
N9011 N9012 N9013E N9014E N9014G N9015 N9016 N901A N902A N9033 N9034 N9054 N9063 N9065 N9066 N906A £20.00
N911A N915A N916A N917 £27.00
PCV754 PV2300 PV2400 PV760 PV794 PV770 PV774 PVC763E £18.00
N380 N381 N830 N831 N832 N833 N834 N835 N836 £7.00
8261 AH1 (for model DX3000) £45.00
N895 £31.50

NORDMENDE
360 9 460 V100 V140 V200 V250 V304 V341 V450 V550 £7.00
V1001 V1005 V1015 V1025 V1035 V1041 V1055 V1065 V1105 V2005 £18.00
V110 V333 £20.00
V101 V102 V103 V112 V141 V142 V200 V300 V3005 V300 V301 V302 V350 V500 £7.00
V1205 V1215 V1235 V1245 £20.00
V1305 £33.50
V380 £27.00
V502 V503 V5005 £37.00

ORION
VH3 VH555 VH600 VH700 VH844 VH900 VH1000 (ALL MODELS) £13.00
VH1 VH2A £7.00

PHILIPS
VR6460 VR6520 64VR60 VR6420 £8.50
VR6711 4 HEAD £41.00
6920 VR6440 £58.00
VR6441 VR6540 VR6541 VR6640 VR6642 £14.00

RANK
BV6900AS £18.00
N830EA RV300 RV310 RV320 RV330 RV340 RV350 RV380 £7.00

SAISHO
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VR3300X VR3600X VR3650 VR3800 £14.00
VR3200 VRJ500 £15.00
VR2000 VR3300 VR3600 £15.00

SALORA
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SV7300 8200 8300 9200 £19.50
SV7400 8400 £23.00
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SAMSUNG
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SANYO
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VHR1110 VHR1150 VHR1300 VHR1700 VHR2300 £16.00
VHR3200 VHR3270 VHR3100 VHR3150 VHR3300 VHR3400 VHR3310 VHRD500 £18.00
VHR1100 VHR1200 £18.00
VHR1500 VHR2500 £28.00
VHR2700 £24.50

SHARP
VC390 VC393 VC496 £30.00
VC488 £48.00
VC779 £20.00
VC789 VC790 £32.00
VC300 VC381 VC383 VC386 VC387 VC388 VC482 VC483 VC486 VC3300 VC8381 VC9100 VC9300 VC9500 VC9700 VC9400 VC9600 VC200 220 384 385 471 477 481 £13.00
VC582 VC583 VC651 VC681 VC750 VC780 VC781 VC683 VC684 402 500 571 573 581 584 585 600 682 685 693 VC700 772 7810 782 7822 783 8481 £13.00
VC6000 VC6200 VC6300 VC7300 VC7700 VC7750 VC8000 VC8300 £20.00
VC793 £36.00
VC473 785 786 £25.00
VC699 VCA501 VCA602 £29.00

SONY
DSR 19R (FOR SL-T 9ME) £39.00
DSR 21R (FOR SLC 8-C9) £30.00
DSR 35R (FOR C20 C30 C40 SLF1UB SLF1E 2 PIN SLC24PS SLC33E SLC44PS SLF30PF SLF60PS SLK85 SLT20ME SLT30ME £15.00
DSR 43R (FOR SLC7 RANGE SL5000 SL5100 SL3000 1 PIN SLC6E SL36ES SL37E £13.00
SL3000 8000 8080 SLC5E SLT7ME £16.00
SLV201 202 £29.50
SLK75 SLT50ME £29.00

TOSHIBA
V63 £18.00
V9680 £42.00
V8600 V8700 £38.00
V21 V31 V33 V50 V51 V53 V9600 £14.50
V55 V57 £7.00
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V93 V80 £20.00
V5470 V5480 £18.00

TRIUMPH
VR9500 VR9501 VR9525 £13.00

THOMSON
TX8000 V309 316/320 321 323 326 4100 4200 4300 VK305T 306T 309BL 3301 312T 410T 411T £6.50
TX8500 V318 342 343 351 352 353 4210 4230 4260 £15.75

VCR PINCHROLLERS

AKAI
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VS1 VS2 VS3, VS4 VS5, VS6, VS9, VS10, VS8 VS15 £2.50
VS105, VS112, VS115, VS116, VS126 VS244, VS245 VS247 VS248, VS515, VS516, VS205 £2.50
VS201, VS301 VS303, VS304, VS603, VS606, VS607, VP58-P82 £2.50
VS125, VS155 VS165, VS220, VS240, VS250, VS512, VSX9 £2.50

AMSTRAD
VCR4500 VCR4600, VCR4600, VCR6000 VCR6100, VCR9000 £2.50
VCR5200 £2.50
VCR7000 £2.50
TVR1 £2.50

AIWA
AV66, AV77 £2.50
G700 G900 £2.60

ALBA
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VCR5000, VCR6000 £2.50

AUTHENTIC
N850 £2/50

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RTV100, 200, 202, 222 224, 301 306 307 RTV309, 311 312, 315, 316, 317 319, 320 328 RTV404, 414 434 444, 478 707 RTX100 £2.50
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RTV324, 325 £2.50
RTV330, 454, 520 530, 535, 560, 660, 670 RTV720 730, 740, 800 810, 900 910, 920 £2.50

DECCA
VR8300 £2.50
VRH8495DK (Pressure Roller Assembly) £6.25

FERGUSON
3V00, 3V16, 3V22 3V23 3V24, 3292, 8900 8901 8902, 8903 8904 8906 8909 8912 8922 8923, 8924 8925 8929 £2.50
3V29, 3V30, 3V31 3V32 8930 8931, 8940, 8941 8942 £2.50
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FISHER
FVHP420, FVHP520 FVHP530 £2.60
FVHP615, FVHP710 FVHP715, FVHP716, FVHP722 FVHP725 FVHP830, FVH618, FVH620 FVH622, FVH622 FVH711 FVH720 FVH721, FVH722 FVH725 FVH730, FVH840 £2.50
FVHP905 FVHP970 FVHP980, FVHP990 FVHP5000 FVHP5005, FVHP5050, FVHP5075 FVHP5100 FVHP905 FVHP906 FVHP908 FVHP910, FVHP911 FVHP915, FVHP916, FVHP918, FVHP975 £2.50
VBR330, VBS3500, VBS7000, VBS7500 VBS7600, VBS9000, VBS9900 £2.50

FIDELITY
HQS200 VCR100 VCR600, VCR6100 £2.50
VTR1000 £2.50

FIJITSU
HS760, VX715 VX720D £2.50

FUNAI
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VIP1000, VIP1400, VIP3000 £2.50

GEC
V4004 £2.50

GRANADA
VHSAH1, VHSAH3, VHSVH4, VHSWH1 VHSXH1, VHSYH2 £2.50
VHSAN3, VHSBP1 £2.50
VHSAY3 £2.50
VHSBH1, VHSCH1 VHSFS1, VHSFS2 VHSEH2 VHSEH3 £2.50
VHSBY3 VHSCC1 £2.50
VHSDS2 £2.50
VHSDP1 VHSFP2 (Pressure Roller Assembly £6.25
VHSEY1 £2.50
VHSFG2 VHSFG4 £2.50
VHSFJ4 VHSYJ2 £2.50
VHSF63 £2.50
VHSTJ1, VHSTJ2, VHSTJ3 £2.50
VHSWJ1 VHSWJ3 VHSXJ3 £2.50

GRUNDIG
BARCELONA, MADRID MVS500 MVS550 MVS600 MVS620, 660, SE5110, SE5140 SE6100 SE6160, TVR4500 VS500 VS505 VS510, VS520, VS521 VS530 VS540 VS550 VS600, VS610 VS620 VS630, VS640 VS660 VS680 VS5180 VS5480 £2.50
MVS400 MVS440, VS400 VS410, VS440 VS460 £2.50
VS120 £2.60
VS150 £2.50

GOLDSTAR
GHV1221 GHV1232 GHV1240, GHV1241, GHV1242 GHV1243 GHV1244 GHV1245, GHV1246 GHV51 GHV8210, GHV8215, GHVP1240 GHVP1241 GHVP1247 GHVP1248, GHVP1290 GHVP1291, GHVP1295 GHVP1296 VCP4100, GHV51 GHV8000 GHV8200 VCP4000, VCP4130 VCP4200 VCP4300 VCP4301, VCP4305, VCP4306 VCP4310, VCP4311, VCP4315, VCP4316, VCP4320 VCP4321, VCP4325, VCP4326 £2.50

HINARI
V20H VXL10, VXL11, VXL19, VXL5, VXL6 VXL7 VXL8, VXL9, VXL90 £2.50
VXL2 VXL3 £2.50
VXL4, VXL20, VXL35 £2.50

HITACHI
VT11, VT14, VT16, VT17, VT19 VT33, VT330, VT34, VT35, VT38, VT39, VT52, VT6500 VT680, VT6800, VT7 VT7000, VT8000, VT8500 VT9700, VT9900 £2.50
VT61, VT62 VT63 VT64, VT65, VT86, VT88, VT110 VT122 VT120 VT128, VT130 VT135 VT138 VT150 VT168 VT220, VM200 VM500, VM600 VT100 VT111 VT113 VT115 VT118 VT125 VT145, VT175 VT225 VT250 VT255 VT258, VT260 VT400 VT405 VT410, VT413, VT414 VT415 VT418 VT420 VT425, VT426 VT428 VT430 VT431, VT435 VT438, VT450 VT498, CT510, VT518 VT520 VT525, VT526 VT530 VT535 VT536, VT540 VT545 VT546 VT548 VT570 VT575 VT576, VT580 VT588 VT640 VT8 VT85 VT86, VT88, VTL30, VTM625 VTM626 VTM630, VTM636, VTM640 VTM645 VTM646 VTS80, VTS85 £2.50
VT3 000 5000 VT8000 VT9300 VT9500 £2.50

ITT
VR3605, VR3905 VR3935 VR3985, VR3986 VR3993, VR3994 VP3826, VR3906 VR3916, VR3926 VR3946, VR3948 VR3976 VR3995 VR3997 VR6948 £2.50
VR3913 VR3914 VR3943 VR3954, VR3963 VR3984 £2.50
VR3907 £2.50
VR3912 £2.50
VR3917 VR3833 £2.50
VR3929, VR3968 (PRESSURE ROLLER ASSEMBLY) £6.25

JVC
HR2000, HR3300, HR3330 HR3360 HR3660, HR4100 HR7700 HR7200 HR7300, HR7350, HR7600, HR7610 HR7650, HR7655 £2.50
HRD110 HRD111 HRD120 HRD121, HRD140, HRD150 HRD160 HRD225 HRD455, HRD565 HRD725 HRD157 HRD158 HRD170 HRD180 HRD210, HRD230 HRD250 HRD257 HRD300, HRD320 HRD370 HRD400 HRD430 HRD470 HRD530 HRD566, HRD700 HRD750 HRD755 HRD950 HRP50 HRS5000 HRS5500 £2.50

MATSUI
VX850 £2.50

MITSUBISHI
HS200 HS300 HS301 HS302 HS303 HS304 HS310 HS320 HS700 HS330 £2.50
HS306 HS307 HS337 HS338 HS349 HS400 HS411 HS412, HS421 HS710, HSB10 HSB20, HSB30, HSE10, HSE20 HSE30 HSE70 £2.50

NATIONAL
NV100 NV180 NV300 NV333 NV340 NV366, NV600, NV688 NV777 NV788, AG6010, AG6015 AG6100 AG6200, AG6400 AG6810 NV3321 £2.50
NV230 NV370 NV430 NV460 NV730 NV810 NV830 NV850 NV870 NV890 NV2000 NV2010, NV3000 NV7000 NV7200, NV7800 NV8600 NV8610, NV8620, NVG14 AG1000 AG1200, AG1500, AG2100 AG2100 AG2200, NV260 NV280 NV380 NV450, NV465 NV470 NV480, NV630, NV650 NV770 NV780 NV8050, NV8150 NV8200, NV8300, NV8400, NVG15 NVG30, NVG400, NVH70 NVG130 £2.50
NVG7 NVG19, NVG12, NVG18 NVG9 NVG10 NVG11, NVG120 NVG16 £2.50
NVG21, NVG25, NVH65 NVG33, NVG46, NVG50 NVG300 NVF65 NVF70, NVFS1, NVFS100, NVH75 NVJ30 NVL20, NVL23 NVL25 NVL28 £2.50
NVD48, NVD80, NVG21, NVG45 £2.50

NEC
N830, N831 N832 N833 N895 £2.50
PVC2300 PVC2400 PVC740 PVC744 PVC746, PVC760 PVC764 PVC766 £2.50

ORION
VH1 VH2 £2.50
VC150 VC180, VH1000, VH200, VH201 VH205, VH212, VH250 VH254 VH288 VH3, VH300, VH303, VH3030 VH312 VH33, VH3312 VH404 VH704, VH708 VH712 VH770, VH780, VR2948 £2.50
VH300 VH3050 VH2308, VH2400 VH2600 VH2700, VH4300 VXL20 VXL25 VXL30 Etc £2.50

PHILIPS
VR6460 VR6920 £2.50
VR2020, VR2021 VR2022, VR2023, VR2024 £3.20
VR6711 £2.50
VR6540 £2.50
DV856 VR6485 VR6585 VR6589 VR6880 VR6948 £2.50
VR445 VR6442, VR6542, VR6843, VR6943 £2.50
DV464 VR2324, VR2300, VR2334 VR2340 VR2350 VR2414 VR2480 VR2486, VR2489 VR2490 VR2498 VR6462, VR6463 VR64664 VR6560, VR6560 VR6860 VR6861 VR6862 VR6863 £2.50

Pressure Roller Assembly
DV186, DV190 DV286 DV486, DV471 DV582, DV571 DV761 VR6180, VR6182, VR6185 VR6285, VR6290, VR6291, VR6293 VR6362 VR6367, VR6390, VR6391 VR6393, VR6467 VR6468, VR6470, VR6561 VR6570 VR6581 VR6670, VR6676 VR6760 VR6761 VR6762 VR6870, VR6970, VR6975 VR86B1, 63SB7 68SB4, 71SB4 72SB8 92SB31 £6.25

SANYO
VHR1100 VHR1300, VHR1500 VHR2300, VHR1150 VHR1200 VHR2100 VHR2500, VHR2700 £2.50
VTC5000 VTC5150, VTC5500 VTC9300, VTCM10 VTCM20 VTC5150 VTC5350 VTC5400 VTC6000, VTC6500, VTC9100, VPR5800 VTCM11, VTCM21 VTCM31, VTCM50 £2.50
VHR3100, VHR3300, VHR3310 VHR3700, VHRD500, VHRD700 £2.50
VTC3000 £2.50

SHARP
VC381 VC386 VC2300, VC3300, VC7300, VC7700, VC8300 VC9100, VC9300, VC9500 VC9700 VC200 VC2300, VC3300, VC384, VC385, VC388, VC390, VC393, VC6000, VC6200, VC7750 VC800 £2.50

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Part No.	Models	Price
1-439-216-00	KV-2002E, 2010E, 2200E, 2015, 1820E, 2010SE, KV-2012ME, 2016ME, 2015ME, 2010ME	£14.00
1-439-256-11	KV-2704EC, 2704UB, 2704ET, 2704E(A), 2704E	£35.00
1-439-286-21	KV-2215UB, 2217UB, 2215EI, 2215FE, 2212EX, 2215ET	£30.50
1-439-289-21	KV-2706F, 2706FE, 2705UB, 2706E, 2706UB, 2720EC	£40.00
1-439-303-00	KV-2064EC, 20PS1, 2062ME7, 2056EC, 2060SA, KV-2062E(ESP)	£27.00
1-439-311-00	KV-1440AEC, 1440AS MK2, CPS-14CD3, CPV-14CD2, KTX-1350NF, KTX-1430UB	£20.00
1-439-332-21	KV-2756, 2730EC, 2730FE, 2764EC, 2752UB, 2752F	£36.00
1-439-333-00	KV-1882EC, 1882UB, 1882F, 1882CH, 1882AEB, 1882AM, KV-1882ME3, 1882HK, 1882AS, 16TR1, 882EC(PS), 1770R	£20.00
1-439-363-21	KV-19HT1A, 19FX1MT, 18G2, 1802M7, 1802GE, ADM-16B, KV-2092UB, 2096UB	£22.00

FLYBACK TRANSFORMERS

FERGUSON

00D-4208-001	TX9	£14.00
00D-4-208-002	TX9	£14.00
00D-4-235-002-01G	TX90	£14.00
00D-4-247-001	TX90	£14.00
00D-4-247-001 HT1	TX90	£14.00
06D-3-093-001	TX100	£14.00
(110) 06D-3-087-001	TX100	£14.00
(110) 06D-3-084-001	TX100	£14.00
06D-3-088-001	TX100	£14.00

GRUNDIG

29201-019-05	£8.00
29201-024-11	£14.00
29201-024-04	£14.00

PHILIPS

PS 140-17112	G11	£14.00
PS 140-10306	G90AE	£11.50
PS 140-10353	G90B	£15.50
PS 140-10151	K12	£15.00
PS 140-10283	K30 K30111	£15.00
PS 140-10246	K40	£13.00
PS 140-10247	KT4	£14.00
PS 140-10149	KT2	£9.00
PS 140-10161	KT3	£9.00
PS 140-17033	G8	£10.00
PS 140-17089	G9	£10.00
PS 140-10328	NC3	£14.00

ITT

CVC20	£11.50
CVC25	£11.50
CVC30	£11.50

HITACHI

2432981	CPT 1444	£15.00
2434274	CPT 2174 CPT2176 CPT 2178	£18.00
OUTPUT TV MODULE	HM6251 (REF 2370551)	£5.50
	HM6232	£5.50

IDLERS & PULLEYS REPLACEMENTS

AKAI

VS1-2 VS4-5 VS15 VS3 6 12 56 58 59	FF-REW IDLER	M1327773	£4.50
VS1-2 VS4-5 VS15 VS3 6 12 58 59	T-UP IDLER	BV327815	£6.00
V9700	IDLER	BV321979	£6.00
VS125 126 155 VS165 240 244 245 247 248 250 512 515 516 VS22 38 105 112 115 116 205 220	IDLER ASSY	MZ366960J2	£11.00
VP7100 VS9300 VS9500 VS9800	T-UP IDLER	PU47752	£4.50
VP7100 VS9300 VS9500 VS9800	UNLOADING IDLER	PU46381	£4.00
VP7100 VS9300 VS9500 VS9800	REW IDLER	PU46380	£6.00
VP77 VS10	REEL IDLER	BV327815	£3.00
VP88	IDLER	BV336067	£5.00
VS1 3 4 9 12 VS15 58	REEL TABLE	BR347731	£5.50
VS23 35 37 53 55 VS66 75 VSA77	CLUTCH	ML373043	£13.00
VS9700	FF IDLER	BV321761	£3.20
VS9700	REW IDLER	W321762	£4.25

AMSTRAD

VCR7000	IDLER	150280	£1.50
TVR1 VCR4500 VCR4600 VC5200 VCR9000	CLUTCH	150873	£3.75
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TVR1 VCR4600 VCR5200	REF CLUTCH		£3.50
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3V16 3V22 8902 8903 8909 8912 8922	T-UP IDLER	PU49280	£5.50
3V23 3V29 3V30 3V31 3V32 3V35 8923 8924 8929 8930 8931 8940 8941 8942	REEL IDLER	PU48967	£2.50
3V23 3V31	ROLLER ASSY	PU49042A	£4.00
3V29 3V30 3V31 3V32 3V35 3V36 3V38 3V39 3V49 8930 8931 8940 8941 8942	T-UP IDLER	51402	£1.25
3V29 3V30 3V31 3V32 8930 8931 8940 8941 8942	T-UP CLUTCH	PU51380	£2.25
3V35 3V36 3V38 3V39 3V49 8943 8944	REEL IDLER	PU55374	£2.85
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TC358	1050P
TC360	1000P
TC365	1000P
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86173	1000P
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JXGE	1000P
JXDE	1000P
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BLAUPUNKT 210	1600P	LOT08
GRUNDIG 2922010	1600P	LOT09
ITT CVC800/1/3	1500P	LOT10
ITTD218/37 EQ	1600P	LOT11
NORMENDE 5255	1600P	LOT12
SABA 81000 200	1600P	LOT13
SALORA T236 EQ	1650P	LOT14
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SABA 770223500	1600P	LOT16
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TELEFUNKEN EQ	1400P	LOT18
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NORMENDE 5255	1600P	LOT20
ITT CVC 1150/1	1500P	LOT21
ITT COMPACT 80	1500P	LOT22
FE TX100 GREEN	1450P	LOT23
HINARI CT4/5 5113	1500P	LOT24
SELECO 6320410	1600P	LOT25
BLAUPUNKT 8667	1600P	LOT26
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ITT CT3326 MUL	1500P	LOT28
ITT D066/37 EQ	1600P	LOT29
ITT 3546 EQ	1500P	LOT30
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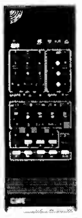

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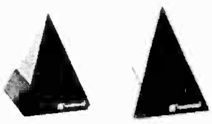

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HITACHI VT8000 ....17.50
HITACHI VT9300 ....17.50
HITACHI VT17 ....15.95
HITACHI VT63/64 ....13.25
HITACHI VT120E 13.95
ITT FS9/10 DIGIVISION 13.95
ITT RG305 ....13.95
ITT RG306 ....13.95
ITT TX3126 ....20.95
ITT VS4 ....13.95
ITT VS5 TEXT 15.95
MASPRO SE-E-90/S 15.95
MATSUI 1440 ....13.95
MATSUI 1465 ....18.50
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NEC N-831/33G 11.50
NEC RB83EG/EP 11.50
NIKKAI NT14/20/21 ....23.50
ORION VH1204 ....21.95
ORION VH3050/60RC 21.95
ORION VR2949/2957 ....21.95
ORION VSP20 ....19.95
ORION VXL20 ....21.95
PANASONIC EUR51200 ....14.95
PANASONIC EUR51142 ....36.50
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PANASONIC C71/C74 ....21.50
PANASONIC TNQ1411/2 ....14.95
PANASONIC TNQ1419 ....13.95
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PANASONIC TX2112
GENUINE 34.95
PANASONIC TX2200 ....21.95
PANASONIC TX2234 ....21.95
PANASONIC TX2244 ....21.95
PANASONIC TX2464
GENUINE 34.95
PANASONIC TX2470/72 ....21.50
PANASONIC TX2482/92 ....21.50
PANASONIC TX3300 ....21.95
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GENUINE 12.50
PANASONIC NV730 ....15.25
PANASONIC NV870
GENUINE 28.95
PANASONIC NVG10
GENUINE 28.95
PANASONIC NVG12
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GENUINE 23.45
PANASONIC NVG40
GENUINE 29.95
PANASONIC NVG45
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PANASONIC NVL28
GENUINE 44.50
PACE 6000 ....15.95
PHILIPS G11 I/R TEXT 13.95
PHILIPS KT3/30 NON TEXT ..12.95
PHILIPS KT3/30 TEXT 12.50
PHILIPS RC5991 ....12.95
PHILIPS RC5903 GENUINE ..12.95
PHILIPS 3A 17.50
PHILIPS SIMPLE 10.95
PHILIPS MINIATURE 9.95
PHILIPS VR6362/7 ....13.25
PHILIPS VR6462 ....14.50
PHILIPS VR6467 ....13.25
PIONEER 505/525 ....17.50
PROGRAMMABLE 22.50
PYE DV464/05 ....13.25
PYE DV662/05 ....14.50
RANK T26A 13.95
RANK T524A 13.95
RANK T528A 19.95
REDIFFUSION MKIV 12.95
REDIFFUSION MKIVA 12.95
SABA FS602 ....11.95
SABA FS603/4 ....11.95
SAISHO CT142R 14.50
SAISHO CT149TX 14.95
SAISHO VR1000/1100 ....15.25
SALORA 16J10/20 ....15.90
SALORA 20J/20/30/40 ....15.90
SALORA 86173 ....16.50
SALORA C20XZ1 ....17.95
SALORA SATELLITE 19.95
SAMSUNG SV716 ....15.50
SAMSUNG SV717 ....15.50
SAMSUNG VX616/617 ....15.50
SAMSUNG VX619/626 ....15.50
SAMSUNG VX627/629 ....15.50
SANYO CPT3144 ....17.95
SANYO E2 SERIES 17.95
SANYO VHR 1100/1200 ....15.95
SANYO VHR 1300/2300 ....15.95
SANYO VHR 2700/3100 ....15.95
SENTRA VCR8000/8100 ....17.50
SENTRA VX8400 ....14.50
SOLAVOX 16R19 ....13.95
SOLAVOX 20T19 ....14.95
SOLAVOX 26R09 ....15.95
SOLAVOX CML14 ....15.95
SONY RM604/606 ....14.95
SONY RM613 ....29.50
SONY RM615/632 ....14.50
SONY RM650/651/652 ....17.95
SONY RM654/657 ....17.95
SONY RM662/663 ....21.95
SONY RM664/665 ....21.95
SONY RM670 ....14.95
TASHIKO 14D962 ....16.95
TASHIKO 14D966 ....16.95
TATUNG RC40/45 ....14.95
TATUNG RC60 ....14.95
TATUNG RC70 ....12.50
TATUNG RC90 ....14.95
TELEFUNKEN FB170 ....27.50
TOP TEL 24.95
TOSHIBA CT995/6 ....16.95
TOSHIBA CT9128 ....17.95
TOSHIBA V55 ....11.95
TOSHIBA T534A/B 15.95

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AKAI VS1/5 ....17.95
AKAI VS4 ....34.50
ALBA 4000X 16.95
ALBA 6000X 17.95
AMSTRAD 4500/9000 ....14.95
AMSTRAD 4600/4700 ....14.50
AMSTRAD 6000 ....17.95
AMSTRAD 7000 ....15.25
FERGUSON 3V00/39 ....8.75
FERGUSON 3V32 ....23.50
FERGUSON 3V42/55 ....17.50
FERGUSON 3V59/FV12 ....26.95
FERGUSON 3V65/FV11 ....17.95
FERGUSON FV12 ....34.50
FERGUSON FV13 ....41.50
FERGUSON FV26 ....28.50
FERGUSON FV31 ....26.50
FERGUSON FV31R 27.95
FERGUSON FV32 ....27.95
FISHER FVH5000 ....24.50
FISHER FVH615/910 ....15.95
FISHER FVH725 ....34.50
FISHER FVH906/916 ....24.50
GOLDSTAR V1221/1290 ....15.95
GRUNDIG VS400/500 ....17.30
HINARI VTR200 ....17.95
HINARI VXL2/4/20/35 ....17.95
HINARI VXL6 ....19.50
HINARI VXL8/9/90 ....17.95
HINARI VXL10/11/19 ....17.95
HITACHI 8000/9700 ....15.70
HITACHI VT11/33 ....15.70
HITACHI VT17/19 ....24.70
HITACHI VT63/64 ....20.30
HITACHI VT65 ....28.50
HITACHI VT120E 21.95
HITACHI VT130E 24.95
HITACHI VT150E 33.95
HITACHI VT220E 21.95
JVC HRD170 ....17.95
JVC HRD250 ....23.50
JVC HRD470 ....27.50
JVC HRD540 ....17.95
JVC HRD725 ....34.50
JVC HRD755 ....34.50
LOGIK VR950/955 ....22.50
LOGIK VR960 ....17.95
MATSUI VX600 ....17.95
MATSUI VX730 ....17.50
MATSUI VX735A 17.50
MATSUI VX820 ....15.25
MITSUBISHI HS301/302 ....22.70
MITSUBISHI HS303/305 ....21.50
MITSUBISHI HS306 ....23.95
MITSUBISHI HS318 ....24.50
NEC 9034/9053 ....19.95
ORION VH1 ....19.50
ORION VH3 ....19.95
PANASONIC NV230 ....17.50
PANASONIC NV333 ....8.95
PANASONIC NV366 ....19.95
PANASONIC NV370 ....9.95
PANASONIC NV430 ....14.25
PANASONIC NV688 ....27.70
PANASONIC NV730 ....18.95
PANASONIC NV777 ....18.95
PANASONIC NV788 ....25.95
PANASONIC NV870 ....37.30
PANASONIC NV2000/7000 .....8.95
PANASONIC NVG7/9 ....17.30
PANASONIC NVG10/12 ....17.30
PANASONIC NVG18 ....28.70
PANASONIC NVG20/21 ....24.95
PANASONIC NVG30/40 ....24.50
PANASONIC NVG45 ....34.50
PANASONIC NVL25 ....38.50
PHILIPS VR6185 ....42.50
PHILIPS VR6367 ....40.70
PHILIPS 6460/6520 ....9.95
PHILIPS 6462/6560
GENUINE 44.95
PHILIPS 6467 GENUINE 40.70
PHILIPS 6760 GENUINE 41.70
PYE DV464 ....44.95
PYE DV468 ....40.70
REDIFFUSION 620 ....14.75
SAISHO VR705/805 ....15.25
SAISHO VR3200 ....17.50
SAISHO VR3500 ....17.50
SAISHO VR3600 ....19.50
SAMSUNG VI730 ....23.50
SAMSUNG VX520/710 ....17.50
SANYO VHR 1100/1300 ....18.95
SANYO VHR1110/1200 ....21.50
SANYO VHR 2300/3200 ....23.50
SCHNEIDER SVC20 ....21.50
SCHNEIDER SVC246 ....21.95
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SENTRA 8400 ....16.95
SENTRA 8600 ....17.95
SHARP VC9300/381/481 ....14.75
SHARP VC581/681 ....14.75
SHARP VC787 ....32.50
SHARP VCA140 ....14.75
SOLAVOX 1000 ....16.95
SONY C5/6/7 ....14.95
SONY SLC30 ....21.50
SUSUMI XR5 ....18.95
TASHIKO VVE921/2 ....19.95
TASHIKO VVE932 ....18.95
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TOSHIBA V55/57 ....8.75
TOSHIBA V73/83B 14.95
TOSHIBA V93B 18.95

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DUE TO UNFORESEEN CHANGES IN MANUFACTURERS' COSTS, WE RESERVE THE RIGHT TO INCREASE PRICES WITHOUT PRIOR NOTICE.

***** NEW *****
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FERGUSON 3V65/FV11R ...22.50
FERGUSON FV31/FV31R ...36.45
FERGUSON FV37/FV37H ...17.50
HITACHI VT11E 16.50
HITACHI VT64E 21.50
PANASONIC NV333/366 .....18.20
PANASONIC NV230 ....32.85
PANASONIC NV730 ....34.50

SERVICE AIDS

ALLEN KEYS (8 METRIC) 4.95
ANTEX 17W IRON 8.50
ANTEX 25W IRON 8.75
ANTEX IRON STAND 4.95
CIRCLIP KIT 5.95
CLEAR TEST TAPE 7.95
COLCLENE WIPES 95
FIBRE CLEANING PEN 2.95
HEATSINK COMPOUND 1.55
ONYX SOLDER PUMP 9.95
ONYX TIPS 1.50
PERMABOND ADHESIVE 3.95
PORTASOL
PROFFESSIONAL 31.95
PORTASOL TIP 3.95
SELF AMALGAMATING
TAPE 3.45
SILICON GREASE 1.85
SOLDA MOP 80
SOLDER 0.5KG 18SWG 8.50
SOLDER 0.5KG 22SWG 8.75
SPRING KIT 6.95
SUPER GLUE 1.25
UTILITY KNIFE 1.45
WELLER GUN TIPS (2) 1.25
WATCHMAKERS
SCREWDRIVERS 2.95
X1 PROBE KIT 14.50
X10 PROBE KIT 14.95

SUNDRIES

CTX EHT LEAD GENUINE 8.25
MATSUI LEVER ASSY 1.85
TX10 FOCUS UNIT 8.50
98003 POSITOR 1.35
98009 POSITOR 1.35
98012 POSITOR 3.35

TUNERS

PANASONIC TNV87510F2
TC208/TC225/TC2000/TC2024
TC2213/TC2284/TC85 ....31.95
PHILIPS ELC2003 ....24.45
U321 ....11.95
U411 (PHONO SKT) 18.50
U411 (COAX SKT) 19.75

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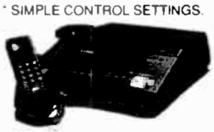
CAMCORDER COPYING KIT 7.95
SCART LEAD FULLY WIRED 4.95
SCART LEAD TO 6 PHONO ..4.95
SCART COPYING KIT 5.95
SCART TO 2 SCART SKT 5.95

SCART SWITCHING KIT 16.95
SCART TO 5 SCART SKT 6.95
VIDEO COPYING KIT 5.95
VIDEO FLY LEAD 75

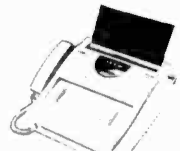
VIDEO REPAIR KIT

ALBA 4000 ....11.50
ALBA 6000 ....12.95
FERGUSON 3V23 ....15.95
FERGUSON 3V29/30 ....12.95
FERGUSON 3V31/32 ....15.95
FERGUSON 3V35/39 ....12.95
FERGUSON 3V44/45 ....14.95
FERGUSON 3V64/65 ....11.95
FISHER FVH615/715 ....12.75
FISHER FVH905 ....12.95
GOLDSTAR GVH1221 ....12.50
GOODMANS VCR1000 ....12.95
HITACHI VT8000 ....12.95
HITACHI VT9300 ....12.95
HITACHI VT11/33E 14.95
HITACHI VT120/130E 15.95
MITSUBISHI HS306 ....17.95
PANASONIC G DECK 7.75
PANASONIC NV230 ....12.95
PANASONIC NV333 ....12.95
PANASONIC NV370 ....12.95
PANASONIC NV430 ....12.95
PANASONIC NV730 ....12.50
PANASONIC NV777 ....11.95
PANASONIC NV2000/2010 ...22.50
PANASONIC NV7000 ....18.95
PANASONIC NVG10/12 ....11.45
PHILIPS VR6460 ....11.75
PHILIPS VR6462 ....12.50
PHILIPS VR6467 ....21.50
SENTRA 8000 ....11.50
SOLAVOX 1000 ....11.50
SONY C5/7 ....11.15
SONY C6 ....9.50

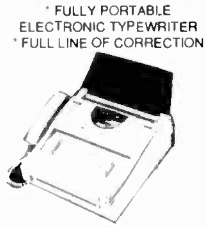
ADVANTAGE OF CHEAPER TELEPHONE COSTS.
* PHOTOCOPY FACILITY
SAMSUNG SF1700 ....£275.00
* 5 SHEET AUTOMATIC DOCUMENT FEEDER.
* AUTOMATIC FAX RECEPTION.
* SIMPLE CONTROL SETTINGS.



* 10 AUTODIALS FOR EASE OF USE
* PHOTOCOPY FACILITY.
CANON FAXPHONE £325.00
* 10 SHEET AUTOMATIC DOCUMENT FEEDER.
* HIGH VOLUME RECEPTION



WITH 100 METRE PAPER ROLL.
* 16 AUTODIALS FOR EASE OF USE.
* AUTOMATIC GUILLOTINE.
* PHOTOCOPY FACILITY.
* CANONS DE-CURL FEATURE FOR FLAT FAXES.
CANON FAX T50 ....£469.00
* FULLY PORTABLE ELECTRONIC TYPEWRITER
* FULL LINE OF CORRECTION



MEMORY' WORD DELETION & BOLD PRINT
* ABILITY TO CENTRE BETWEEN MARGINS
CANON ES3 ....£89.00

* 14 CHARACTER PER SECOND DAISYWHEEL PRINTING.
* SPELL CHECK FACILITY + 16K

* 5 SHEET AUTOMATIC DOCUMENT FEEDER.
* 10 AUTODIALS FOR EASE OF

USE
* 30 METRE PAPER ROLL
* MERCURY BUTTON TO TAKE

TEXT MEMORY
* PAPER FEED, BOLD PRINT & UNDERLINE FACILITY.
* 10, 12, 15, CHARACTER PITCH.
CANON ES23 ....£157.00
* 50K MEMORY
* 10, 12, 15, PS CHARACTER PITCH
* 80,000 WORD SPELL

VERIFIER
* LCD DISPLAY
* 15 CHARACTERS PER SECOND BI DIRECTIONAL PRINTING
* 3.5" MS DOS DISK DRIVE FOR UNLIMITED MEMORY.
SHARP PA-W1410 ....£329.00

ALL MACHINES ARE COVERED BY 12 MONTHS WARRANTY

THESE ARE A SMALL RANGE OF OUR BUSINESS MACHINES THAT WE SELL INC: CALCULATORS, COMPUTERS, FAX MACHINES, PHOTOCOPIERS & WORD PROCESSORS
PLEASE RING FOR DETAILS
CELLULAR TELEPHONES

***** SPECIAL OFFER *****
NOKIA 101 ....£149.00

WE OFFER A RANGE OF MOBILE PHONES INC.

MOTOROLA, PANASONIC, NEC,NOKIA, MITSUBISHI & TECHNOPHONE.
FROM NEW & USED HAND PORTABLES TO MOBILES AND TRANSPORTABLES
NO LONG TERM CONTRACTS & A RANGE OF BILLING PLANS TO SUITE EVERYBODY
PART EXCHANGE & RECONNECTIONS ARE WELCOME
WE ALSO PURCHASE SECOND HAND EQUIPMENT

CELLULAR SPARES
ANTENNAE

3DB BODY MOUNT 14.25
3DB GLASS MOUNT 15.95
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MOTOROLA 8800X 9.95
MOTOROLA 9800X 19.95
PANASONIC F1 ....9.95
PANASONIC H SERIES 14.95
PANASONIC I SERIES 23.50
NEC P3 ....9.95
NOKIA 101 ....14.95

BATTERIES

CLEARTONE CTN5000 ....19.50
CLEARTONE CTN9000 ....24.95
ERICSSON HOTLINE 23.50
KOKUSAI KE101 ....24.95
MITSUBISHI MT3 ....24.50
MITSUBISHI MT5 ....24.50
MITSUBISHI MT7 700MAH 23.95
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MOTOROLA 4800X SLIM 27.50
MOTOROLA 8000X 24.50
MOTOROLA 8500X 1000MAH 23.50
MOTOROLA 8500X 1500MAH 29.50
MOTOROLA 8800X 1000MAH 23.95
MOTOROLA 8800X 1500MAH 29.50
MOTOROLA PERSONAL 600MAH
....19.50
MOTOROLA PERSONAL 700MAH
....23.50
MOTOROLA PERSONAL SLIM 39.50
MOTOROLA 9800X 600MAH ...19.50
MOTOROLA 9800X 700MAH .23.50
MOTOROLA 9800X SLIM ...39.50
NEC 9A 700MAH 24.50
NEC 9A 1000MAH 29.50
NEC P3 700MA 23.50
NEC P4 700MAH 23.50
NOKIA 101 700MAH 24.50
NOKIA 190 ....23.50
NOKIA 620 TALKMAN 39.50
NOKIA 1320 CITYMAN 29.50
NOVATEL NVT4400 700MAH .24.50
OKI 700 1000MAH 24.95
OKI 900 1000MAH 24.95
OKI 1150 1000MAH 23.95
PANASONIC E/H SERIES ..32.50
PANASONIC F1 700MAH ...23.50
PANASONIC G SERIES 24.95
PANASONIC I SERIES 25.50
SONY CMH1 ....24.95
SONY CMH-333 ....24.50
TECHNOPHONE TP2 ....27.50
TECHNOPHONE TP3 ....24.50
TECHNOPHONE TP405 700MAH
....23.50

BATTERY CHARGERS

DESK TOP TRICKLE MOTOROLA
TRANSPORTABLE 38.95
MOTOROLA 8000/8800X ...23.95
MOTOROLA MICROTAC ...24.50
NEC P3 ....24.95
NOKIA 101 ....24.95
PANASONIC E/H SERIES ..39.95
PANASONIC F 24.95
SONY CMH-333 ....24.95
TECHNOPHONE TP2 ....24.95
TECHNOPHONE TP305 .....24.95
DESK TOP RAPID/COND
MITSUBISHI MT5 ....44.50
MOTOROLA 8000 SERIES 42.50
MOTOROLA 9800X 42.50
NEC P3 ....42.95
NEC P4 ....44.95
NOKIA 101 ....42.95
NOKIA 190 ....44.95
PANASONIC F SERIES 42.95
SONY CMH333 ....44.95

BATTERY ELIMINATORS

CLEARTONE CTN5000 ....14.50
ERICSSON HOTLINE 14.50
MITSUBISHI MT5 ....12.95
MITSUBISHI MT7 ....14.95
MOTOROLA 8000/8800X 12.95
MOTOROLA 9800X 12.95
NEC 9A 12.95
NEC P3 ....12.50
NEC P4 ....12.95
NOKIA 101 ....12.95
NOKIA 190 ....12.95
OKI 700 ....12.95
PANASONIC D SERIES 12.95
PANASONIC F SERIES 12.50
SONY CMH-1 ....14.95
SONY CMH-333 ....14.50
TECHNOPHONE TP2 ....12.95
TECHNOPHONE TP405 ......12.95

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COMPONENTS £1.00 PER ORDER UK
SERVICE MANUALS £1.25 EACH
CELLULAR TELEPHONES £5.00 PER ITEM
OFFICE MACHINES £5.00 PER ITEM
EXPORT ORDERS P/P CHARGES AT COST

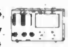
WHEN ORDERING: PLEASE ADD P/P VALUE TO ORDER TOTAL THEN ADD 17% VAT TO THIS TOTAL

DELIVERY BY RETURN ON ALL STOCK ITEMS
*** MINIMUM ORDER VALUE £5.00 ***

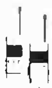
MICROWAVE CONTROL PANEL. Mains operated, with touch switches. Complete with 4 digit display, digital clock, and 2 relay outputs one for power and one for pulsed power (programmable). Ideal for all sorts of precision timer applications etc. **Now only £4.00 ref 4P151.** Good experimenters board.
FIBRE OPTIC CABLE. Stranded optical fibres sheathed in black PVC. Five metre length £7.00 ref 7P29R or £2 a metre.
12V SOLAR CELL. 200mA output Ideal for trickle charging etc. 300 mm square. Our price £15 00 ref 15P42R. Gives up to 15v.

PASSIVE INFRA-RED MOTION SENSOR. Complete with daylight sensor, adjustable lights on timer (8 secs -15 mins), 50' range with a 90 deg coverage. Manual override facility. Complete with wall brackets, bulb holders etc. Brand new and guaranteed. **Now only £19.00 ref 19P29**
Pack of two PAR38 bulbs for above unit £12.00 ref 12P43R
VIDEO SENDER UNIT. Transmit both audio and video signals from either a video camera, video recorder or computer to any standard TV set within a 100' range! (tune TV to a spare channel). 12v DC op. £15.00 ref 15P39R Suitable mains adaptor £5.00 ref 5P191R. Turn your camcorder into a cordless camera!
FM TRANSMITTER Housed in a standard working 13A adapter (bug is mains driven). £26.00 ref 26P2R. Good range.

MINATURE RADIO TRANSCEIVERS. A pair of walkie talkies with a range of up to 2 kilometres. Units measure 22x52x155mm. Complete with cases and earpieces. £30.00 ref 30P12R
FM CORDLESS MICROPHONE. Small hand held unit with a 500' range! 2 transmit power levels. Reqs PP3 battery. Tuneable to any FM receiver. Our price £15 ref 15P42AR.



12 BAND COMMUNICATIONS RECEIVER. 9 short bands, FM, AM and LW DX/local switch, tuning 'eye' mains or battery. Complete with shoulder strap and mains lead. £19 ref 19P14R. Ideal for listening all over the world.
CAR STEREO AND FM RADIO. Low cost stereo system giving 5 watts per channel. Signal to noise ratio better than 45db, wow and flutter less than .35%. Neg earth. **£19.00ref 19P30**



LOW COST WALIKIE TALKIES. Pair of battery operated units with a range of about 200'. Our price £8.00 a pair ref 8P50R. Ideal for garden use or as an educational toy.
7 CHANNEL GRAPHIC EQUALIZER plus a 60 watt power amp! 20-21KHZ 4-8R 12-14v DC negative earth. Cased. £25 ref 25P14R.
NICAD BATTERIES. Brand new top quality. 4 x AA's £4.00 ref 4P44R. 2 x C's £4.00 ref 4P73R, 4 x D's £9.00 ref 9P12R, 1 x PP3 £6.00 ref 6P35R Pack of 10 AAA,s £4.00 ref 4P92R.
TOWERS INTERNATIONAL TRANSISTOR SELECTOR GUIDE. The ultimate equivalents book. New ed. £20.00 ref 20P32R.
GEIGER COUNTER KIT. Complete with tube, PCB and all components to build a battery operated geiger counter. £39.00 ref 39P1R
FM BUG KIT. New design with PCB embedded coil. Transmits to any FM radio. 9v battery req'd. £5.00 ref 5P158R. 35mm square.
FM BUG Built and tested superior 9v operation £14.00 ref 14P3R
COMPOSITE VIDEO KITS. These convert composite video into separate H sync, V sync and video. 12v DC £8.00 ref 8P39R.
SINCLAIR C5 MOTORS 12v 29A (full load) 3300 rpm 6"x4" 1/4" O/P shaft. New. £22.00 ref 20P22R. Limited stocks.
As above but with fitted 4 to 1 inline reduction box (800rpm) and toothed nylon belt drive cog £45.00 ref 40P8R. 800 rpm.
ELECTRONIC SPEED CONTROL KIT for C5 motor. PCB and all components to build a speed controller (0-95% of speed). Uses pulse width modulation. £17.00 ref 17P3R. Potentiometer control.

SOLAR POWERED NICAD CHARGER. Charges 4 AA nicads in 8 hours. Brand new and cased £6.00 ref 6P3R 2xC cell model £6.00.
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COVER PHOTO
This month's cover photograph shows an internal view of the Tatung VRH8490, a Philips VR6462 clone. See servicing article on pages 622-3.

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Educashun

A letter in our correspondence pages this month casts doubt on the relevance of the National Vocational Qualifications (NVQs) being introduced and suggests that those involved are on to a good thing. The writer probably has a point. Some comments in a recent City and Guilds publication tend to confirm one's suspicions. We are told that schools and colleges which intend to offer C&G NVQs from September "will be working hard to ensure that everything is in place when the first students enrol. Once an NVQ co-ordinator and teaching team have been appointed they will need to consider a number of issues relating to the implementation of NVQs, such as the training and appointment of internal verifiers and vocational assessors. . . . and how NVQs will fit alongside other provision in the centre". In other words, no one at present has much of a clue about what they are supposed to be doing. This seems to be par for the course when it comes to anything to do with education.

It is obviously not an easy matter to set up new training arrangements, to decide what is to be taught and how to go about it. That said, the authorities do seem to flounder about and end up with questionable syllabuses. I recall seeing some of the efforts when colour television was first introduced. Educationalists who had no idea what a PAL decoder did or how a shadowmask tube worked and had to be set up scratched their heads and came up with reams of theory on the properties of light and so on. I wondered how anyone introduced to the subject in this way would ever be able to cope with a faulty colour TV set. What happened of course was that the trade had to take on the initial training.

There have long been complaints that education fails to keep abreast of what's going on in the real world. A correspondent put this brilliantly last month in asking "when was the last time you had to refer to atomic valency numbers in order to diagnose a faulty transistor?" Do you remember all that business about holes? And how one could think of the action of a transistor as being akin to empty bottles of milk going one way and full ones the other? Brilliant! But then the transistor was a classic case – like early electronic TV cameras – of experiment leading to the production of workable devices before the theory of operation was fully understood. Yet educationalists latched on to and kept on about all the irrelevant bits.

And so it goes on. I recall many years ago being involved in the production of a book that covered the PMG syllabus for marine radio officers. A good friend and well-known ham to whom I showed the proofs commented "all sound stuff maybe, but I'd rather I wasn't in a lifeboat depending on one of those officers". Educational courses tend to be classic examples of Parkinson's First Law – "work expands to fill the time available for its completion". If the educationalists can extend a course from a year to two or maybe three years they've got it made. The opposite of Churchill's famous belief that nothing should take more than one side of a sheet of paper to explain! It maybe wouldn't matter so much if the results were not so baleful.

We are all aware that far too many who leave school have difficulty with basic communicative skills. A recent article in *The Independent* by Michael Dummett, emeritus professor of logic at the University of Oxford, pointed out that many students arrive at universities with a poor grasp of English. "Since they are assumed to know these things" (grammar, punctuation, spelling) he wrote, "it is nobody's business to teach them; it is therefore only by unusual luck that students who have failed to master them before they come to university will be any better at them when they obtain their degrees." Does this perhaps throw a bit of light on the failures of the educational system? Many of these students become involved in education.

It seems to me that this matters particularly when it comes to electronics, since English is the international language of the subject. It has this status because of the pioneering work done in English-speaking countries and because, being a flexible language, English lends itself to the presentation of new knowledge. We benefit from this, but the situation could change. If our use of the language becomes so sloppy that it can no longer be used as a way of precisely recording knowledge, then some other language will take over the role. Japanese maybe? Who'll be laughing then about Janglese?

It's hard to know what can be done about the mental sloppiness that seems to pass from the outside world to education and back again, and the irrelevancies that seem to infect the world of education. Government intervention only seems to make matters worse, while teachers and educationalists cannot be trusted. Well perhaps a few of them, like the good professor, can. Let's hope they can make themselves heard.

Servicing the Philips VR6462 and Clones

Chris Watton

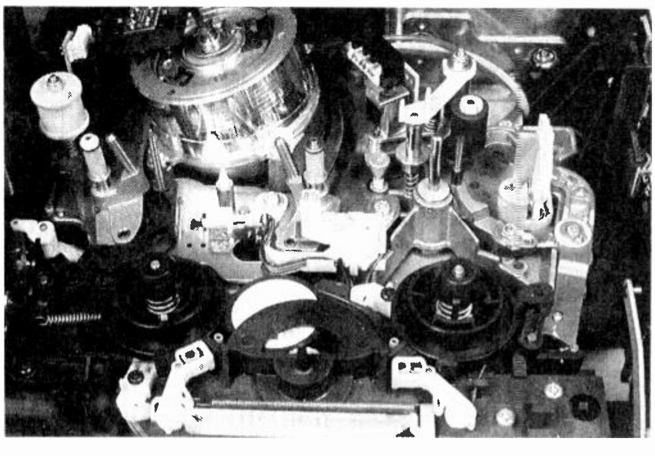
The Philips VR6462 was released during the mid-Eighties. Clones include the Finlux VR1010, Pye DV464, Tatung VRH8490 and GEC V4006. It was quite different from the mainstream, Japanese-based machines with which we'd become familiar, including for example auto-tracking and the ability to revert to a function if the mains supply is interrupted – this is unlike most machines which assume the standby condition when this happens. There are also some in-built test programmes that can be used to check the machine's condition in the event of a failure – various codes are displayed on the clock display. To call them up, press two buttons on the operating panel whilst connecting the power supply (this is known as power-on reset, or POR).

One of these functions reveals the number of hours' use the machine has had, which can be useful in assessing wear etc. since the last service. To call up this feature you disconnect the machine from the mains supply then press and hold in the forward search and ITR keys whilst reconnecting the mains supply. The clock then shows the machine's use in hours. To leave this function, disconnect the machine from the mains.

Another point to note is that the machine reverts to standby if not operated for eight minutes. This obviously rules out long-term E-E use. Thus customers with manual control TV sets cannot use the VCR's remote control as an upgrade.

The Mechanical Side

As with most VCRs, the problems that commonly occur arise in the mechanical section, where the lubrication applied to the moving parts dries out and the surfaces of rubber drive components wear down or become hard and misshapen. The cleanliness of the tape path and the condition of the pinch roller and back-tension band are very important.



View of the deck mechanism.

Servicing is reasonably straightforward once you know certain things about this type of machine. When the unit is first plugged in the deck goes through a cycle known as initialisation: the lift goes down, then the take-up and supply reels spin and finally the lift returns to the upper position. The machine is then ready to accept a cassette. You can test it in all modes with the top cover removed and no cassette inserted. For the record mode the protection switch must first be opened. This can be done by inserting a piece of paper between the contacts. The condition of the deck can thus be assessed without the possibility of tape damage. You can for example see if the reel drive is in order and whether the guide blocks move smoothly and reach their destinations.

Mechanical Service

The reel discs and idler parts can be serviced after removing the lift mechanism. To do this take off the front operating panel, which is secured by three plastic snap-fit clips, unclip the cassette flap then set the deck to the eject position. To remove the lift, bend slightly outwards the sides of the frame around the deck, at the same time raising the lift about half an inch. Then use a medium-sized screwdriver to press in gently the two operating levers which are engaged in the holes at the bottom of the lift. Once these levers have been freed the lift can be withdrawn. The deck is still operational, which can be helpful when dealing with such faults as noisy reel movement. A twin lead is connected to the lift's cassette-in switch: be careful not to damage it when removing the lift.

The reel discs can now be removed for cleaning and lubrication. They are held on their spindles by three locking tabs that drop into a groove at the top. There's a special tool for removing these, but with care you can do it using a small screwdriver, pulling the disc up as each tab is prized out of the groove. The important thing here is to be careful, as the tabs can easily be broken when removed in this manner. A soft brake fits under the reel disc on the take-up side: take care not to lose or damage it. Hold it in place with small pliers when refitting the disc. The back-tension band is beneath the supply disc.

It's common to find that both spindles are like glue, as the old lubricant has dried. I clean it all off using a cloth moistened with methylated spirit, then polish with chamois leather. Don't forget to clean out the bore in the discs as well. Apply new lubricant then refit the reels. Simply push them down on to the shafts, but ensure that the brakes are held clear when you do this.

The idler/swivelling wheel should next be replaced, along with the omega spring. A replacement comes with the new idler. It's secured by two small plastic sleeves which are also supplied. Take care when fitting these sleeves as it's possible to break off the pin that secures the spring. The spring locates in a groove beneath the idler wheel. Once this has been fitted, check for freedom of movement side-to-side. If the spring is located incorrectly this movement will be impaired.

The runners for the blocks that carry the guides and slant poles should be cleaned and lubricated. Finally the entire tape path must be cleaned and a new pinch roller fitted. This should have completed the upper deck service, and the lift can now be refitted.

Turn over the machine, remove three screws from the bottom and take off the metal cover. Be careful as the deck is now loose in the cabinet. A worm drive is connected to the end of the threading motor shaft. Its spindle becomes dry. As a result there's an awful noise when the lift is moving or a cassette is being loaded. A little light oil will cure this – just a spot on both ends. Except where there's a fault, most of the other items under this cover seldom require attention. Replace the cover and the machine is ready for testing. All should be well. If not, the following fault list may be of help.

Fault List

(1) Machine dead, no clock operation: Check the BZX79-C30 zener diode D6103. If necessary check transistor Tr7125 in the reset circuit and the microcontroller chip IC7091.

(2) Test signal present during play: Check the BC548 transistor Tr7508.

(3) No drum rotation: Check the L272 chip IC7001.

(4) Drum spins too fast: Check the optocoupler on the drum and the IR cassette LED.

(5) Cassette lift doesn't rise: Pin of lever 242 lost. Replace lever.

(6) Won't tune: Check transistors Tr7601 (BC556A) and Tr7420 (BC547).

(7) Function faults, e.g. no fast forward/rewind, intermittent play, tape tangling: The brake solenoid sticking can cause such troubles. It's best to fit a replacement. Sluggish brake solenoid operation can be caused by dry-joints in the power supply.

(8) Insufficient reel torque in fast forward/rewind, cue/review: There's an official modification – add a 22Ω resistor in parallel with R3101/R3103. Make sure there's no friction between the reel idler and the guide plate below and that the reel disc spindles are clean (see mechanical service).

(9) Unstable r.f. output or r.f. output only up to channel 23: Check the ZTK18 stabiliser D6601.

(10) Poor sound: Check the pinch roller and for dry-joints on the audio head.

(11) No reel drive in play: Check the BA317 diode D6147.

(12) Failure of IC7201 (L272M): The loading motor probably has shorted turns.

(13) Squeals during loading: Dry shaft on worm gear from motor.

(14) Knocking in fast wind: Idler is worn.

(15) Exit side of tape guide block doesn't reach the V block: Dry shaft on take-up reel disc.

(16) No functions or clock, drum spinning too fast: Check fuse F1109.

(17) No rewind: The photodiode on board P672 at the right-hand side of the deck could be leaky.

Modern TV Receiver Techniques

Part 7

Eugene Trundle

The colour decoder system we examined last month is representative of current analogue signal technology in the post-video demodulator section of a TV set. The main variations, found in high-performance and large-screen sets, relate to multi-standard decoding, video signal routeing and switching, and various refinements such as noise reduction and picture sharpening. In the present instalment we'll take a look at these then consider the tube-drive (RGB) amplifiers.

Video Noise Reduction

Poor signal-to-noise ratio results in a grainy picture. Fig. 1 shows a noise reduction system that's used in the luminance channel in some JVC receivers. After differentiation by C222 and R221 the luminance signal enters the M51494L chip at pin 1, where the coring circuit deletes all but the highest signal frequencies. Its output consists of mainly the noise component, plus signal transients that represent sharp edges and outlines in the picture. The next block in the chip (outline correct) amplitude limits the transients so that they are at the same peak-to-peak level as the noise. The 'pure noise' signal thus obtained is inverted and added to the main luminance input via pin 6. As a result, the noise is cancelled on an equal-and-opposite basis.

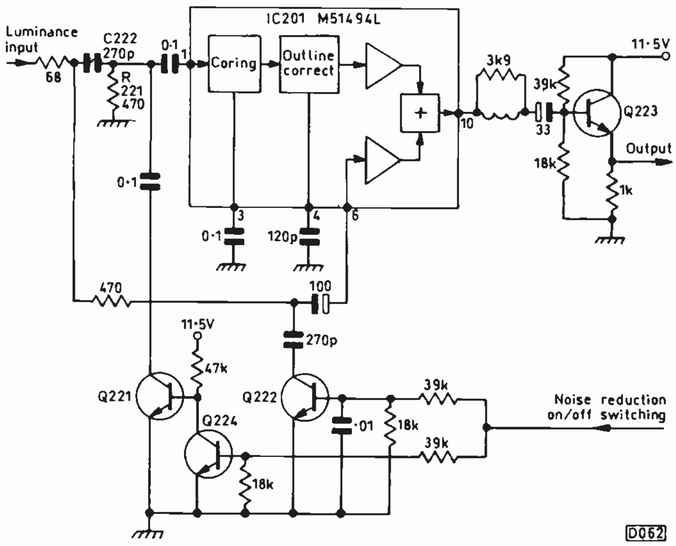


Fig. 1: An analogue video noise reduction system used by JVC.

It's difficult to avoid softening of the picture edges with this type of circuit: a trade-off between noise reduction and picture sharpness is involved. In this case the action of the circuit can be overridden by using a switching voltage to turn Q221 on and Q222 off.

Aperture Correction

A technique for sharpening the edges in pictures, born in the earliest days of TV cameras, is much used in TV and video equipment. Sometimes called contour enhancement, it involves giving luminance transients a negative-going preshoot and an overshoot. In a TV set it can be incorporated as part of the luminance delay circuit. One approach is shown in Fig. 2.

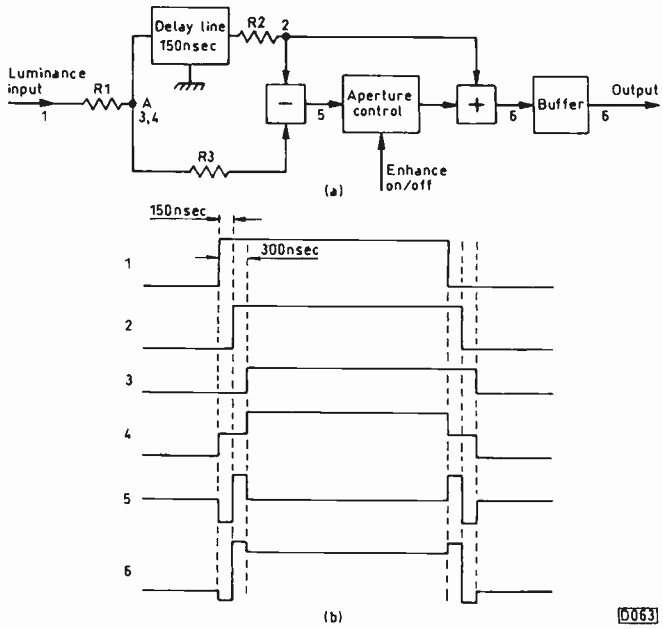


Fig. 2: An aperture-correction system: (a) block diagram, (b) waveforms that show the operation of the system, which is also widely used in VCR playback circuits.

The luminance signal (waveform 1) passes via R1 into a 150nsec delay line, emerging time-delayed as waveform 2 to the right of R2. It bounces back through the unterminated delay line, producing a 300nsec delayed signal (waveform 3) at the junction of R1 and R3, where real-time waveform 1 is also present, attenuated by 6dB by the action of the resistors. Thus at point A we get waveform 4. Waveforms 2 and 4 are subtracted to produce waveform 5, which is buffered and then added to waveform 2. The result is waveform 6, where you can see that preshoot and overshoot are present. These provide artificial sharpening of the edges of picture features. One 68cm screen set that uses this technique has a horizontal resolution of 630 lines.

Auto Grey-scale Correction

Fig. 4 last month showed a simplified block diagram of a colour decoder chip that incorporates automatic tube cut-off regulation to avoid tinting in the low-light parts of the picture and thus remove the need for manual black-level adjustment presets. Fig. 3 this month shows the output

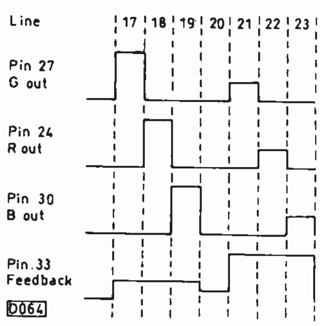


Fig. 3: Auto grey-scale correction pulse waveforms produced by the HA11498/U4646B chip. The test pulses are used to control both the black and peak white levels. Feedback is to pin 33 of the chip.

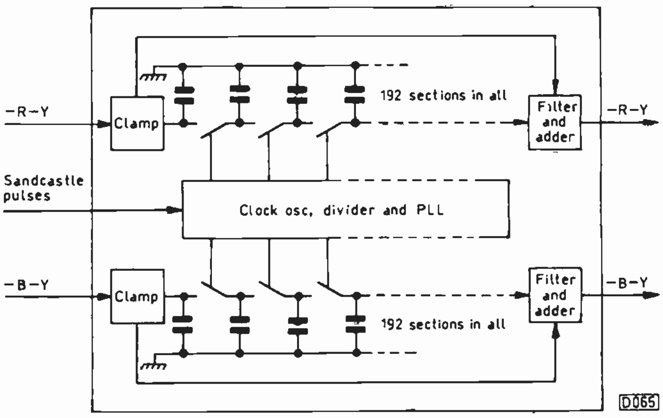


Fig. 4: Block diagram showing the operation of a BBD chrominance delay line.

waveforms of a later chip design in which the tube's cut-off and drive levels are both governed by a feedback loop that includes the tube itself, so that picture highlights and white areas don't vary in hue as the tube's electron guns age at different rates. Thus the need for drive adjustment is also eliminated throughout the life of the set.

A vertical sync pulse applied to pin 31 of this chip triggers an internal counter which produces a one TV line duration white-level pulse for the green gun on line 17, for the red gun on line 18 and for the blue gun on line 19. These outputs occur during the field blanking interval, and are thus invisible – they are above the viewed area of the screen. Beam current information is returned to the chip at pin 33, and is used to set the potential on separate reservoir capacitors in sequence, thus governing the drive level for each gun throughout the following field period. All three guns are blanked on line 20 to provide a reference level. Then lines 21, 22 and 23 are pulsed in sequence to measure the black-level currents, as described last month. The chip has seven capacitors to store auto-grey scale information: three for RGB white level, three for RGB black level and one for reference.

This chip, type HA11498/U4646B, is not a colour decoder like the previous example. It's a processor, containing the RGB matrixes, external RGB switching and the brightness, contrast and colour control circuits. These operations are controlled by an I2C data bus – we'll look a the way in which this works in a later instalment in the series. The use of separate chips for these groups of operations in up-market TV models gives greater versatility, as we'll soon see.

Electronic Delay Lines

Analogue chip delay lines, known as bucket-brigade devices (because their operation is akin to filling and emptying a series of buckets), are now being used in some colour decoders to replace the expensive, delicate and adjustment-fussy glass chroma delay line that has to date been the centre of the signal phase correction system in PAL receivers and the means of storing the chroma signal in Secam sets. These BBD delay lines are mainly used in multi-standard sets.

Fig. 4 shows the basic technique used in a dual-chroma BBD delay line – with this type of circuit the delay line is in the post-demodulation section of the colour signal decoding/processing department. The chip incorporates two sets of 192 capacitors in a 'switched ladder' arrangement. The incoming colour-difference signal is clamped and is then chopped into time segments by the first switch in the chain. Each segment in turn forms the charge on the first capacitor in the series. The charges are stepped along the chain by progressive switching, passing from one capacitor to the next one. Clearly the delay introduced by this action is determined by the clock rate, which in this case is 3MHz. This rate is equivalent to the line frequency multiplied by the number of capacitors in the chain, 192. A delay time of exactly one line is thus obtained – and different line rates can be catered for automatically.

At the output end the BBD device has adders to obtain the required comb filter and phase correction effects. It also has a clock oscillator that's controlled by the sandcastle pulse input, and built-in low-pass filters of the sample-and-hold type to remove the clock signal from the output. With a capacity of 192 samples per TV line the maximum bandwidth of this purpose-designed device is 1·5MHz, which is wide enough for the PAL colour-difference signals that, after filtering, demodulation and processing, extend to about 800kHz. It is because of this characteristic that the delay-line system works at baseband, downstream from the demodulators. In the previously described system (see Figs. 3 and 5 last month) the ultrasonic glass delay line operates at the chrominance subcarrier frequency, ahead of the demodulators. Fig. 5 shows a typical circuit/chip arrangement with an electronic chroma delay line.

Colour Transient Improvement

The limited chroma signal bandwidth is the price paid for economical use of transmission spectrum space and the need for compatibility, also the tape storage capacity of a VCR where the chroma bandwidth is even more limited, to about 450kHz. While the human eye is relatively insensitive to fine colour detail, the bandwidth limitation does mean that

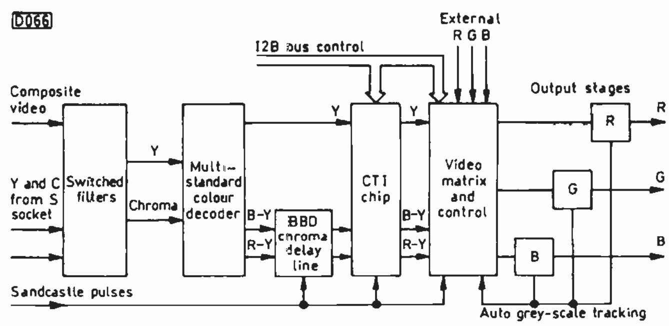


Fig. 5: Block diagram of a decoder using a baseband chroma delay line and a CTI chip.

signals corresponding to coloured edges in the picture have relatively slow rise and fall times. The idea of colour transient improvement (CTI) is to remove the resulting smear effect on the screen.

Fig. 6 shows in simplified block diagram form the arrangement within the Philips TDA4670 CTI chip. There are parallel processing paths for the R – Y, B – Y and Y signals. The actual CTI process is carried out in the lower part of the diagram. Negative-going colour-difference signals enter the chip at pins 3 and 7, where they are clamped and then monitored for transients by differentiator circuits. When a sudden (relatively sudden, see above!) change is detected the storage switches open, isolating the output buffer amplifiers from the colour-difference signals. The hold capacitors C1 and C2 then maintain the outputs at the level corresponding to the start of the transient. At the end of the transient the switches are closed again and the hold capacitors charge very

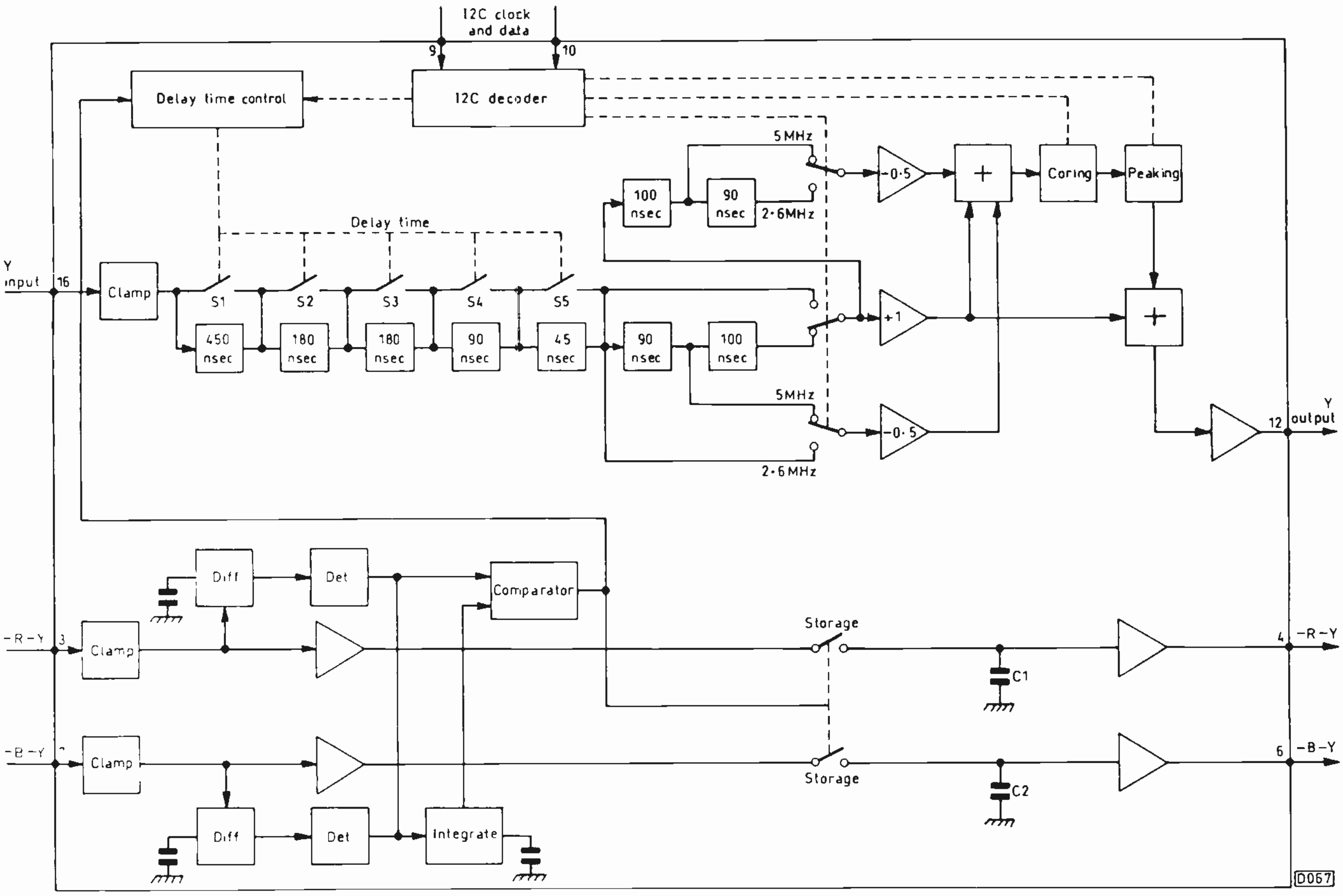


Fig. 6: Internal arrangements in a Philips CTI chip.

rapidly (150nsec) to the new signal level. This charge rate is equivalent to the rise time of a 6·5MHz sinewave signal, so the 'edge hardness' of a coloured image becomes equal to that of the luminance signal to which it is added – even though the chroma chain's resolution capability is no greater than before.

Inevitably this process delays the colour-difference signals: the new sharp transition occurs at the time when the original signal would have finally made it to the new level. Thus to avoid misregistration it's necessary to delay the luminance signal, and this delay must be governed by what's happening in the CTI section of the chip. Hence the electronic delay lines in the luminance path through the chip, arranged in 450, 180, 90, 45 and 100nsec blocks to give a fastly switchable luminance delay with a maximum duration of 1,135nsec. Switches S1 to S5 select the required delay time.

The delay time control block within the chip is governed by an output from the comparator in the CTI section and by the I2C bus decoder, which receives inputs at pins 9 and 10.

To improve the signal-to-noise ratio the luminance output signal is mixed with a peaking signal that's derived from a circuit with switchable peaking centres of 5MHz and 2·6MHz, under I2C bus control.

The Y output at pin 12 and the colour-difference signal outputs at pins 4 and 6 pass via an RGB matrixing, switching and control chip to the RGB output stages (see Fig. 5).

Fig. 7 shows the effect of CTI on the luminance and colour-difference signals. In the receiver a broadcast-standard luminance signal has a rise time of about 150nsec from black to peak white, see waveform A. Without improvement the corresponding colour-difference signal, waveform C, takes about 800nsec for the transition from zero to producing say bright red. The traditional compromise solution is to delay the luminance signal by a fixed time, about 325nsec, so that the centres of transients coincide in time and on the screen – see waveform B. The sharpened colour-difference transient shown at D is delayed by 475nsec with respect to the basic luminance signal delay, so the corresponding luminance transient has to be delayed by this additional amount so that both edges are brought back into registration on the screen.

Multi-standard Decoders

Last month we touched on how the TDA3562 decoder

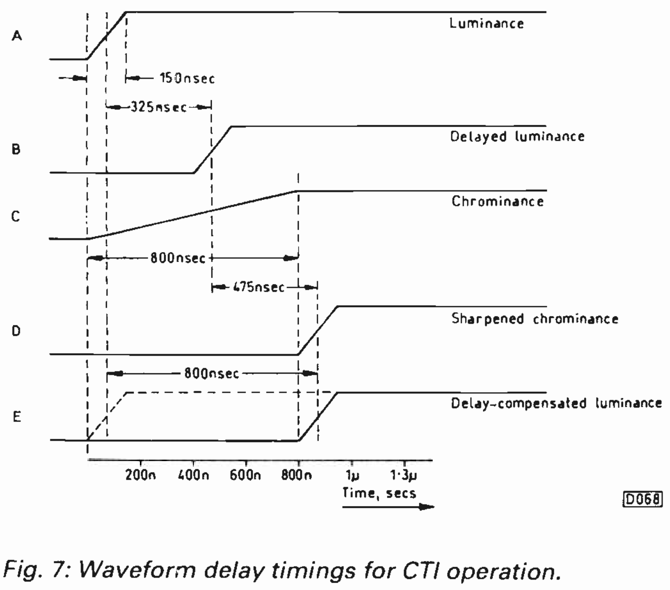


Fig. 7: Waveform delay timings for CTI operation.

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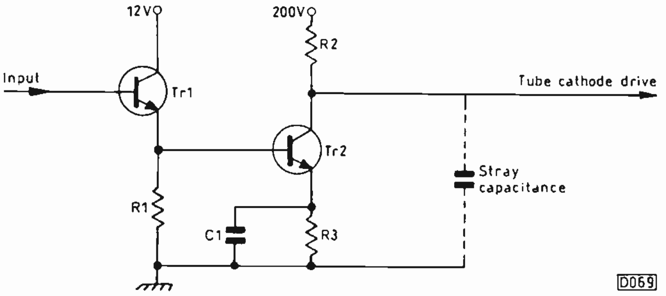

Fig. 8: Basic video output circuit for cathode drive.

chip caters for NTSC signals. Where this is required, Secam signals would be transcoded to PAL form in a chip such as the TDA3592A then decoded to RGB form in the normal way.

A more recent approach to multi-standard operation splits the various functions between chips in the way shown in Fig. 5. The TDA4650 decoder chip can handle PAL, Secam, NTSC/3·58 and NTSC/4·43 signals, recognising them by an initialisation process in which each decoding mode is entered in sequence. Once the system has been identified, the appropriate input filter is selected and the requisite (double-frequency) crystal is switched in. For NTSC reception a d.c. voltage to provide hue control can be applied to pin 17: it varies the phase of the reference signal fed to the chroma demodulators by ±30°. Earthing pin 17 puts the chip in the service mode, in which the colour killer is disabled and the burst signal is deleted. This enables the external subcarrier crystal oscillator circuits to be set for the correct free-running frequency.

Signal Routeing and Switching

Most modern TV receivers cater for many video signal sources apart from the set's own tuner/receiver section. RGB signals from a text decoder, a computer, a videodisc player or a satellite receiver can be applied to the post-demodulator section of the decoder chip or a separate processor chip, being switched in either by the status flag applied to pin 16 (fast blanking) of a scart socket or by a serial control bus like the I2C system shown in Fig. 5.

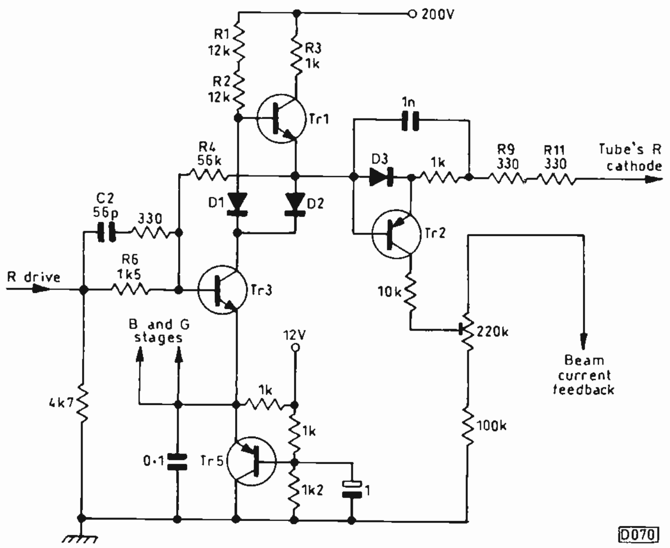

Fig. 9: High-performance, wideband video drive circuit used in some Finlux receivers. The basic arrangement is found in large numbers of models from various manufacturers.

For composite video and Y/C inputs a switching matrix must be provided upstream from the decoder. Audio switching is also involved, so the signal-routeing system is quite complex. It can involve three or four separate chips to cater for the various possibilities. A wide variety of switching circuits is in current use by different setmakers.

RGB Output Stages

Whatever form the decoder takes its RGB outputs consist of low-level drives from three separate i.c. pins. These must be raised to a high level to drive the tube's three cathodes. A typical tube requires peak-to-peak drive voltages of 70V. So three voltage amplifiers, each with a gain of about 35 and a bandwidth stretching from d.c. to about 6MHz, are required. They must be closely matched in terms of gain, frequency response and linearity if brightness-dependent tinting effects and coloration of luminance features like sharp vertical edges and areas of fine detail are to be avoided. For hard, sharply-defined captions and graphics with RGB signal sources like a computer or text decoder a bandwidth extending to 10 or 12MHz is desirable.

The basic video output circuit shown in Fig. 8 consists of two stages, an emitter-follower buffer (Tr1) and a voltage amplifier/inverter (Tr2) that operates with a collector supply of around 200V. Tr2 is a class A amplifier with R2 as its load. Because R3 is only partially decoupled by C1 it provides frequency-selective negative feedback, boosting the gain towards the top end of the stage's response.

One problem with this type of amplifier is the effect that stray capacitance has on its output. The tube's input characteristics plus wiring etc. contribute to this capacitance. When Tr2 is rapidly turned on to provide a black-to-white picture transition the stray capacitance is quickly discharged via the transistor. With a white-to-black transition however the transistor is driven towards cut-off, R2 then providing a charging path for the stray capacitance. This relatively long RC time-constant results in blurring of the right-hand edges of white objects in the picture and fudging of fine detail. To prevent this the video amplifier needs to have a low output impedance in both directions as it were, swamping the stray capacitance presented by the tube's gun, the connection system and amplifier wiring.

This brings us to Fig. 9, a type of circuit that's widely used in current TV sets. It's actually the R output stage – the G and B ones are identical. Tr3 is the output transistor, whose load consists of R1 and R2. With a negative-going output signal (picture becoming brighter) diode D1 is forward biased and the voltage across it, about 600mV, is insufficient to turn on both D2 and Tr1 (D2 is on to provide an output signal path). With a positive-going output signal (picture becoming darker) Tr3 moves towards cut-off, reverse biasing D1 and D2. Tr1 is now forward biased, providing a low-impedance charging path for the stray capacitance via R3 which is present simply to provide current limiting. R4 provides d.c. stabilisation by applying negative feedback to the base of Tr3. C2 provides enhancement of the stage's h.f. response.

Tr2 couples the signal to the tube's cathode by emitter-follower action, aided by D3 on positive-going transitions. The network in Tr2's collector circuit is used for black-level adjustment. In sets without automatic white-level regulation R6, or part of it, would be made variable to act as a drive control for setting up the highlight conditions as part of manual grey-scale adjustment.

The emitter of Tr3 and the other two (B and G) output transistors is returned to chassis via Tr5 which acts as a constant-current source. R9 and R11 are included to isolate the drive circuit in the event of a flashover in the tube.

In-tube Crispening

We have already looked at two techniques for artificially sharpening the luminance signal in order to crispen vertical edges in the picture. A third method, sometimes used in conjunction with those already described, involves manipulation of the electron beams within the tube. It's relevant mainly with larger sized tubes since poor transitions are more noticeable with these.

A small coil called the VM (velocity modulation) yoke is mounted on the tube's neck, with its magnetic field aligned with that of the line scan coils so that their fields oppose or reinforce one another depending on the direction of the current flowing through the VM yoke. If this yoke is fed with a waveform that's obtained by differentiating the luminance signal, the effect it has is to speed up the scanning velocity of the beams as a black-to-white transition is approached then slow it down as the transition is passed. The converse also applies of course. Since brightness is proportional to scan velocity, or beam dwell time, the effect is to 'darken' the black edge and brighten the adjacent white edge, emphasising the borderline. Another way of looking at it is to think of the cathode drive waveform as having a finite rise time, the progress of the scanning spot across the screen being delayed until the new waveform level has been achieved.

Because current has to flow in both directions through the VM yoke, it's driven by a push-pull pulse output circuit. Some CTI chips provide a specially-timed output pulse to feed to the VM processing circuit.

Next Month

Having reached the subject of picture displays, next month we'll take a detailed look at the subject, with coverage of direct-view tubes and, subsequently, LCD projection systems.

PUBLICATIONS

A completely updated third edition of *DX-TV for Beginners*, by Simon Hamer, has been published by HS Publications, 7 Epping Close, Derby DE3 4HR at £3·95 plus 85p UK postage. It's aimed at both newcomers to the hobby of long-distance TV reception and more experienced enthusiasts who want to get the most out of it. There are 32 A5-size pages.

An updated and thoroughly revised edition of John Breeds' *The Satellite TV Book – a Complete Guide to the Theory and Practice of Satellite Television* has been published by Swift Television Publications, 17 Pittsfield, Cricklade, Swindon, Wilts SN6 6AN. This 300-page reference work, which covers the entire field in considerable detail, is available from the publishers at £30 plus £2·50 UK postage.

We have been sent a sample copy of *The Eurosat Repair Manual* (see letters pages for Eurosat's address). It contains a good deal of fault-finding information on the products handled by Eurosat (all the main brands). What is particularly nice is the informal approach adopted throughout.

TV Fault Finding

Reports from Philip Blundell, AMIEIE, John Edwards, Michael Dranfield, Nick Beer, Brian Storm, Richard Newman, Chris Watton, Alfred Damp and Roger Burchett

Philips GR1-AX Chassis

This set was dead with just 5V on the 95V line. The standby LED was alight but attempts to bring the set on using the front controls or the remote control unit failed. I disconnected the scan coil plug (you can't use a dummy load with this chassis) and tried again – with the same result. Next I tried powering the set via a variac. With a 100V a.c. input the power supply produced an output of about 80V, but when the a.c. input was increased to 110V the power supply shut down and the standby line began to pulse. I left the a.c. input at this level and checked around the microcontroller chip where I found that the reset line was pulsing. Reset is generated by transistor Tr7673, whose base should be at 4·3V. The voltage here was higher. Replacing the BZX79-F4V3 zener diode D6671 solved the problem. **P.B.**

Tatung 145 Chassis

If you find that there's no picture, with just a loud humming noise on the sound, check whether C808 (100μF) in the power supply is open-circuit. **P.B.**

Sony KV2000 Mk 2

This set was dead. The mains fuse had blown and the chopper transistor Q607 was short-circuit. When these parts had been replaced the power supply worked with a dummy load, but there was a 50Ω resistance to chassis at pin 2 of plug F3 – the 135V feed to the line output stage. C901 (330pF, 2kV) was leaky. **P.B.**

Philips G110 Chassis

This set was dead. The mains fuse (1600) was shattered, the BUT18AF chopper transistor (7625) was short-circuit, the CNX83A optocoupler (7614) had failed and the four bridge rectifier diodes (6602-5) were short-circuit. It's the fourth time we've had this problem. Replacing the defective components has so far restored normal operation without any bouncers, but we can't help wondering whether there's something else lurking there! **J.E.**

Samsung CI541ZG

This set was dead with its relay clicking. We found that C411 (100pF, 2kV), one of the tuning capacitors in the line output stage, was short-circuit. Its body was badly cracked. **J.E.**

Sony KV2217

The sound and picture were normal but when text was called up the screen went blank. There was a normal picture and black text in the mix mode. The cause of the problem was the preset RV3 (100Ω) on the text panel: it read over 10kΩ. **J.E.**

Orion 14PS

After about three hours there was intermittent loss of height. We found that when warm the 500Ω vertical preset measured open-circuit between its slider and one leg. **J.E.**

Panasonic TC1785

The colour on this set couldn't be controlled: it was permanently at maximum, though the on-screen indicator moved. A voltage check at pin 31 of the microcontroller chip IC1101 produced a reading of 3·25V which didn't vary when adjustment was attempted. Disconnecting pin 31 proved that the chip was o.k. Control is carried out at pin 21 of IC101 on the i.f./decoder panel. When this pin was connected to chassis a monochrome picture was obtained. So this chip also worked correctly and the fault was between the two i.c.s. It was traced to D1149 in the pull-up and biasing circuit. This MA165 diode was leaky. **N.B.**

Tatung TYS9824 (180 Chassis)

This set intermittently developed a watery picture – weak with wobbly edges. More recently it had taken to loss of sound and vision, leaving a blank raster. Both faults were caused by a nastily cooked dry-joint at pin 15 of the AV/RGB PCB connector M152 on the daughter board. **N.B.**

Hitachi CPT2050

This set displayed only red chrominance – there was no G, B or Y picture content. Because the set was not set up correctly the symptom was not what you usually get (no picture) when the top-end resistor in the potential divider that supplies the tube's first anode goes open-circuit. A new 470kΩ resistor plus setting up restored a super picture.

A new volume control was also required: the original one was so noisy that the sound went up as you turned the control down past half way. **N.B.**

Panasonic TX3300 (U4 Chassis)

As these sets get older the most common cause of an overloaded line output stage is the output transformer (part no. TLF14567F). Often the short/leak cannot be read using an ohmmeter. Lift R551 and load the h.t. line with a bulb to ensure that the power supply is o.k., then check the line output transistor and the supplies derived from the line output transformer. If everything is o.k. here you can be reasonably sure that the transformer is the cause of the trouble. With this particular set the tube was excellent, but be careful when quoting – tube life is on average not brilliant with these sets. **N.B.**

ITT CVC20

A lesson learnt here on a chassis that shouldn't have any more tricks up its sleeve! There was partial field collapse: the lower half of the scan was completely missing and the upper half was severely reduced. The field output transistors were likely suspects but read o.k. Voltage checks suggested that there was a fault earlier in the circuit, but nothing could be found – D7/8 and the usual electrolytics were blameless.

The TIP31/TIP33 output transistors were in fact the cause of the fault though both read perfectly. Change them anyway next time – if there is one. **N.B.**

Samsung CI3312Z

A couple of dry-joints are becoming common in these sets. Check R823 in the feed to the 12V regulator and R411 which is connected across the primary winding of the line driver transformer. **N.B.**

Mitsubishi CT2230TX

There was no sound, not even a hiss from the two speakers. Checks showed that the 15V supply at pin 5 of the audio output chip was missing. R371 (2·2Ω), the safety resistor in the feed to the supply's bridge rectifier, had gone open-circuit of its own accord – current monitoring and soak testing proved that no other fault was present. **N.B.**

Philips KT4/K40 Chassis

You often find that a set which has the 1021 VST module, using an MSM5840H microcontroller chip in the 7101 position, has no tuning, channel number etc. with the standby indicator on all the time. This is usually due to a failure within the hybrid thick-film reset generator module U1101. **N.B.**

Fidelity ZX3000 Chassis

We have on several occasions traced the cause of field expansion at the top of the screen to loss of capacitance in C59. Its value depends on screen size: 1,000μF with 14 and 20in. sets, 2,200μF with 22in. sets. **N.B.**

Rediffusion Mk 3 Chassis

The tuning drift with this set was particularly bad at the low end of the band, which displeased the customer as it affected the video channel. The set also produced an excruciating whistle. We cured the whistle by sealing the line linearity coil. Resoldering the chassis and input connections inside the U321 tuner and cleaning its case earthing contacts cured the drift. **N.B.**

Fidelity ZX3000 Chassis

Excessive width with a number of dark bands down the left-hand side of the raster usually suggests a lack of damping across the line linearity coil. On several occasions I've found that the cause has been a dry-joint on the upper leg of the damping resistor (R103 – 220Ω, 1W) rather than the resistor being open-circuit. **N.B.**

Ferguson TX89 Chassis

This set was tripping. It didn't take us long to find that the main reservoir capacitor C69 (100μF, 400V) was open-circuit. **A.D.**

Hinari CT5

Intermittently distorted sound was the fault with this set. On investigation we found that one of the audio output transistors, Q602, was leaky. A replacement cured the fault but after a few minutes it was too hot to touch. As we had another of these sets in for a replacement line output transformer (a very common fault) we checked with this one and found that Q602 should run cool. While carrying out further checks I noticed that the legs of two resistors were shorting together. A look at the circuit diagram showed that this shorted out the 470μF audio output coupling capacitor C608. No wonder Q602 was so hot! **M.Dr.**

Panasonic TX21T1 (Alpha 2 Chassis)

There was no text although the channel flags were normal, indicating that part of the teletext circuitry was working. Approaching this fault with the knowledge that the many-legged devices (chips) are more reliable than the small, brown two-legged ones (ceramic capacitors), I soon discovered that the culprit was C3517 (10nF) at pin 15 of IC3501 – it feeds teletext data to IC3502. A replacement restored all those nice little characters on the screen. **B.S.**

Panasonic TX37A2 (Alpha 3 Chassis)

It took four of us to get this 37in. monster on to the work surface for repair. The complaint was of low brightness, getting steadily worse. After much checking around we decided that the RGB drives were all a bit on the high side. Checks on the c.r.t. base panel then revealed that transistor Q355 (2SC3311) was leaky. It supplies the black-level reference voltages to the RGB output transistors. A replacement restored the set to its former glory. **B.S.**

Panasonic TX28G1 (Alpha 2 Chassis)

If the problem with one of these sets is an intermittent or permanent EW fault, be sure to turf out C754 (180pF) in the EW parabola circuit. **B.S.**

Panasonic TX28W3 (Euro 1 Chassis)

The complaint with this set was of a yellow picture: sure enough the blue was missing. I gingerly checked to see if the RGB drives were emerging from the digital pack. Fears of chasing around many-legged flatpack chips receded when I found that the drives were present and correct. One of the blue drive biasing resistors, R3374 (100kΩ), turned out to be open-circuit, a replacement restoring the normal colour range. **B.S.**

Philips G110 Chassis

This set had come from another dealer who had given up. Basically it was dead. The power supply had been repaired, using the official service kit, but stubbornly refused to start. I ran the set with a reduced mains supply – about 90V a.c. from the variac – and connected a dummy load in place of the line output stage. I also shorted across pins 1 and 2 of the optocoupler to disable the control circuit. In this condition the power supply produced a normal 140V h.t. output.

This suggested that in normal operation the optocoupler was being turned hard on, shutting down the power supply. There's a protection circuit that consists of Tr7655 and Tr7656, with several feeds – from the line output, EW, beam current and audio circuits. When this circuit operates the optocoupler is turned hard on, shutting down the pulse-width modulator. It was operating, as about 0·8V was measured at the collector of Tr7656 – there would normally be zero or a slightly negative voltage here. As the line output stage had been disconnected, the first three feeds could be ignored. Only the sound protection system was still in operation, via the LLZ-C20 diode D6657. A check on this chip diode showed that it measured 500Ω both ways. The set worked normally when a replacement was fitted, the short was removed from the optocoupler and the line output stage was reconnected. **R.N.**

Goodmans 2180

A nice easy one for a change. This set, which was dead, uses a Nikkai chassis. The power supply didn't work and checks soon showed that R801 (270kΩ) in the start-up section was open-circuit. A replacement restored normal operation. **R.N.**

Philips G110 Chassis

I've had a couple of cases where the BUT18AF chopper transistor fails again a few hours, days or even weeks after fitting the recommended power supply repair kit. There's a further recommended modification that can be carried out. It consists of fitting two BYD73B diodes (Philips part no. 4822 130 60778) in series between the base and emitter of the BUT18AF transistor, with the anodes on the base side. You must also ensure that Tr7654 is a BC817, not a BC847. This modification certainly seems to work: I've had no further problems after doing it. **R.N.**

Philips FL1.0 Chassis

This set came in dead. There was 300V at the collector of the BUT12AF chopper transistor but no sign of oscillation. Further checks showed that the 17V start-up supply was missing. This comes from a separate power supply, which is also active in the standby mode, called micro SOPS. Checks here showed that Tr7201, Tr7250 and Tr7251 were short-circuit, also D6201 and D6251. Not surprisingly, fuse F1250 was open-circuit. When replacements were fitted the micro SOPS supply made some effort to run but the start-up supply was low at 3·2V. Further checks in this area showed that R3250 had risen in value from 68Ω to about 3kΩ. Replacing this restored the correct start-up supply voltage but the main power supply still refused to work. Philips supply a repair kit but you have to make sure that you order the correct version. When this had been obtained and fitted the set powered up.

My problems were not over however. There was a good picture but no sound. Pressing the install button showed that the receiver was set for the wrong system. To get it to the UK system you have to call up the service menu by briefly shorting together pins S23 and S24 on the signal panel. When I did this the set promptly went to standby and refused to operate further!

After checking around I decided to replace the X2404 EEPROM chip under the control module. This restored operation and I was able to call up the service menu and reset the options to complete the repair. The question remains as to why there were so many faults on a fairly new set and what did what to whom and why? We'll never know! **R.N.**

Nikkai NT20

"Only snow" it said on the card that accompanied this set. In addition to the snowy raster there was no on-screen display of the channel number or customer controls and the search tuning didn't operate. A check showed that the 5V supply was missing at pin 52 of the microcontroller chip. It comes from a sub power supply, where the 220Ω safety resistor R830 was open-circuit. There was quite a scorch around it, indicating that it had blown violently. A lot of dry-joints on the pins of the sub power supply transformer and transistor may have been the cause of the failure as no other fault was found. **C.W.**

Philips K35 Chassis

This set produced a very dark picture. Checks on the c.r.t. base panel showed that the cathode voltages were a little high. C583 (4·7μF, 250V) which is the reservoir capacitor for the h.t. supply to the RGB output stages was open-circuit. **C.W.**

Finlux 3021F

The problem was intermittent loss of signals: in addition the set would sometimes go dead. Its cause was traced to Du21 in the power supply. This BY299 diode provides the 7V supply but was going open-circuit intermittently. **C.W.**

ITT Compact 80R/90° Chassis

The electronic fuse in this set was operating, though it ran all right with a 15kΩ resistor connected between test points 701 and 702. The cause of the trouble was that the 20V feed to the drive circuit on the primary side of the power supply was low at about 13V. C703 (100μF, 40V) was to blame. **C.W.**

Hitachi 14P218 (G7P Mk 2 Chassis)

There are two 82kΩ, 0·5W resistors (R902 and R903) that provide base bias for the BUT11AF series chopper transistor Q903. It is quite common to find that these are either open-circuit or high in value, the result being a dead set. **C.W.**

Toshiba 258T7B

Although this set had no field scan the cause of the fault was not in the field circuit. Its supply resistor had failed, but the cause of the failure was the TDA8145 chip IC361 on the DPC panel – it was dead short from pin 6 to chassis. **C.W.**

Ferguson TX85 Chassis

Repeated failure of the line output transistor can be caused by a break in the track of the h.t. preset control. As a result the h.t. suddenly goes sky high. This seems to be a common fault, so it would be wise to replace the preset as a precaution whenever one of these sets comes in for repair. **R.B.**

Panasonic TX2284 (U3W Chassis with teletext)

This ex-rental set had every stock fault going. We were finally left with this odd fault: although the LED channel indicator displayed the selected channel, and the channel appeared on the screen, the on-screen display was wrong. Selecting teletext revealed all. One produced five, two produced six etc. We accused the text decoder but a swap with one from another set proved that it was innocent.

The cause of the fault was obviously after the point where the LED is driven by IC1104, in other words where the parallel data is converted back to serial form for the text decoder. This led us to plugs/sockets U4 and U5 on panel U. Plug U4 hadn't been pushed fully home – in fact judging from the dust and the fact that that these connections clip home quite firmly it would seem that it had never been assembled correctly. **R.B.**

Teletopics

HDTV BREAKTHROUGH

The three consortia that had been working on rival digital HDTV systems in the USA have agreed to establish a joint standard for submission to the FCC. Testing of the four separate proposals put forward by the consortia had been due to start just before the business and technical agreement was announced – the FCC had for some time been pressing the consortia to agree to a single system. The agreement should speed up the start of HDTV in the USA – it's hoped that HDTV broadcasting could be ready to go in time for the Atlanta Olympic Games in the summer of 1996. The three consortia consist of GI with the Massachusetts Institute of Technology; NBC with Philips, Thomson, the David Sarnoff Research Centre and Compression Laboratories; and Zenith with AT&T.

JAPANESE SETMAKERS SUFFER

The effects of the recession in Japan and elsewhere on the profitability of consumer electronics manufacturers are clear from annual figures recently announced by Matsushita, Sony, JVC and Pioneer. The companies do not expect any significant improvement in the present year.

Matsushita's pre-tax profits fell 54 per cent to Y168·4bn on sales down five per cent at Y7,055·9bn. Net profits decreased 71 per cent. Sony's pre-tax profits declined by 57 per cent to Y92·6bn on sales up 1·6 per cent at Y3,993bn. Net profits fell 70 per cent. Sony has a higher export ratio than Matsushita – 66 per cent of sales and 36 per cent respectively. Both companies report difficult audio and video markets and are engaged in cost cutting exercises. Sony's capital expenditure is to be almost halved while Matsushita is reducing product lines. Matsushita is forecasting flat sales in the present financial year while Sony expects a two per cent drop.

JVC reported a consolidated net loss of Y43·1bn on sharply reduced sales in all product areas. The dividend is being passed for the first time since JVC became a public company. JVC's exports, almost half of turnover, declined 26 per cent. Sales in the domestic market fell by one per cent. The company has been reducing stocks and aims to reduce staff levels by 3,000 in the present year.

Pioneer reported a 50 per cent fall in pre-tax profits to Y16·5bn on sales down eight per cent. Exports increased 0·4 per cent but domestic sales fell by 17·7 per cent. The company expects a further 60 per cent fall in profits in the present year with sales down 3·9 per cent.

THE IEEIE SURVEY

According to the latest biennial IEEIE survey, average earnings of members have increased by 9·28 per cent since 1991. This compares with an increase of 7·7 per cent for non-manual workers in industry. The annual salary of the highest earners has increased by £5,000 to £39,000. For senior IEEIE membership grades average earnings are now £24,000 – over 47 per cent of those surveyed earned this amount. The 1993 survey showed that those in electricity generation and distribution, and chemical and allied processing, received the best pay: in 1991 broadcasting, telecommunications and the postal services offered the best remuneration. Only a small number of members reported that they were unemployed. A copy of the survey is sent to each of the IEEIE's 28,000 members. Others can obtain a copy of the *IEEIE 1993 Survey of Members* from The Secretary, IEEIE, Savoy Hill House, Savoy Hill, London WC2R 0BS for £25.

SAFETY RECALLS

Sharp has announced that the mains on/off switch used in Model C1407, which was on sale in the UK for three years from October 1983, can become faulty after use over a long period of time. There's a risk of overheating. Users are advised to disconnect the set and call freephone 0800 262 958 to arrange for a replacement to be fitted.

Mitsubishi has announced that due to a production fault a small number of its 21in. sets were fitted with a plastic back that has an excessive gap between the cover and the set itself. Details of the sets are as follows: Model CT21M2BM, serial numbers from AH003001 to AH007000; Model CT21M2TX, serial numbers from AJ006001 to AJ026000. The sets were on sale from August 1992. It's emphasised that very few sets are involved – only three have been found to date. Call freephone 0800 444 000 to arrange an inspection and replacement if necessary.

BT BRAND SATELLITE TV

British Telecom is to enter the Astra satellite receiver/dish field with a range that will be on sale at its own 93 outlets and through dealers, probably starting in the pre-Christmas sales period. The company has been in negotiations with two manufacturers to produce the equipment – one is understood to be Cambridge Computers. BT has been seeking new markets: it is banned from offering TV services via its telephone network until 2001, with a possible review in 1998.

BSkyB IN PROFIT

The latest report from News Corporation, covering the nine months to the end of March, shows that BSkyB is now in profit. At the end of the period BSkyB was making a weekly operating profit of £1·7m on a weekly income in excess of £7m. BSkyB now has 1·9 million subscribers to its film channels and 1·6 million subscribers to its sports channel. News Corporation has a 50 per cent interest in BSkyB.

REMOTE-CONTROLLED LEARNING

The Cardonald College, Glasgow, is now using a computer-operated system that enables it to teach students at remote locations – even North Sea oil rigs. The courses include a TV servicing one that has been given HNC status. Initially students use a training PCB connected to a personal computer. This makes it possible to follow trouble-shooting steps detailed in a work book, guiding the student through a series of hands-on exercises. The training PCB has its own on-board computer so that lessons can be programmed in. It also has a modem that links it to the college via a phone line.

The TV servicing course uses a set so modified that a series of faults can be switched in and out. A monitor panel connected to the set shows signal paths through a block diagram. Test points are brought out at the back of the set, giving safe access to the circuitry. This makes it possible to simulate faults and diagnose the causes externally. Thus practical work can be combined with written notes and multi-choice revision tests. The college can monitor progress via the computer: a truly interactive system.

Digital Television Broadcasting

Geoff Lewis

The announcement that a group of European broadcasters and electronics companies has approached the EC for funds to develop digital Terrestrial Television broadcasting (dTTb), together with the limited use of D2 and other MAC systems, suggests that the development of HD-MAC is now virtually at an end. It's hardly realistic to expect a technology dating from the late Seventies to provide a means of introducing new and better services in the next century. In addition, there has over the last decade been a progressive convergence of telecommunications, broadcasting and computer technologies.

Broadcasters and telecommunications providers have recognised the flexibility that comes when computing power is added to a system or application. As a result broadcasters now make extensive use of digital processing in studios and post-production areas. This has been accepted because of the almost complete lack of noise and distortion, a situation that's particularly advantageous for multiple passes through mixers, VTRs and editors. The only spurious effects occur during analogue-to-digital conversion (ADC) and digital-to-analogue conversion (DAC). They can be made negligible by using a high enough sampling rate and a large enough number of bits per sample.

Digital field stores are today available at consumer electronics prices. They can be added to a PAL set to contribute to doubled line and field scanning rates.

Bit Rate, Bandwidth and Power Requirements

Use of a digital sampling rate of 13·5MHz and eight bits per sample for the luminance (Y) signal plus four bits for the chrominance (U and V) signal means a bit rate of 216Mbits/sec with a standard PAL TV system. If you consider instead an HDTV system with 1,250 lines, a 25Hz field rate, 2:1 interlacing and an aspect ratio of 16:9 the bit rate becomes about 1·2Gbits/sec.

Although analogue signal transmission reduces the channel bandwidth requirement, a change to digital processing confers a number of important advantages.

The luminance, chrominance, sync and audio signals can be included in a common time-division multiplex and modulated on to a single carrier, producing a smoother power distribution throughout the bandwidth with reduced intercarrier beat problems. Many of the channels that are at present left empty to prevent interference between transmissions could become available for use with the adoption of duch digital techniques. Since digital signals are more robust under noisy conditions, transmitter power levels can be reduced, giving the broadcaster a cash benefit. Conventional sync pulses can be replaced with a digital framing word. Once frame or field sync has been obtained, line sync can be achieved simply by counting.

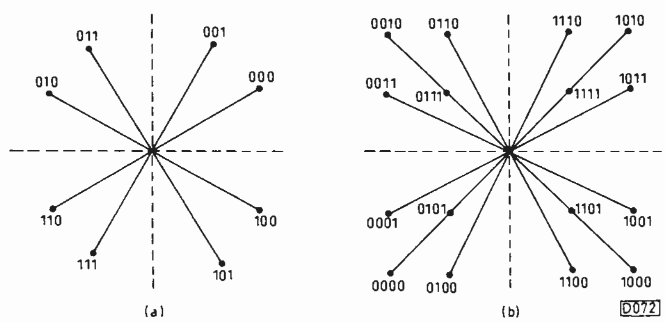

Fig. 1: Comparison between 8PSK modulation vectors (a) and 16QAM vectors (b).

Work carried out by study groups operating under the auspices of the ISO, the CCITT and the CCIR shows the inter-industry co-operation that's already taking place and the extent of the research work being carried out on digital image processing and bit-rate reduction (compression). These study groups operate under various acronyms: JBIG is the Joint Bi-level Image Group (monochrome images); JPEG is the Joint Photographic Expert Group (still colour images); while MPEG is the Motion Picture Expert Group (colour and moving images). Phase II MPEG has been responsible for developing the algorithms for Full Motion Video (FMV). Phase III MPEG has been set up as a theoretical group to investigate future image-compression applications in multimedia systems. From this work the CCITT has produced a standard algorithm, called H261, that's being used in video-telephony and -conferencing applications with the current 525/625-line TV systems.

A compression ratio of about 70:1 is required to squeeze an HDTV signal into a standard 8MHz European TV channel. A further small allowance is required to cater for error correction and system synchronisation. Digital signal processing in several stages can be used to achieve such compression. Let's see how this works out.

Compression

First, redundancy. Because large areas of most of the images transmitted by an analogue broadcast system don't change significantly from frame to frame there's a great deal of redundant, i.e. repetitive, information that doesn't need to be transmitted. By successively storing the digital codes of consecutive frames in two memories and calculating the corresponding pixel difference values, a form of differential pulse code modulation (DPCM) can be used.

Next there's transform coding. The image pixel data can be manipulated using a suitable two-dimensional (2D) matrix transform: by scanning the matrix in a controlled manner, long runs of zero or near-zero values are created, reducing the amount of data that needs to be transmitted.

The 2D array of matrix coefficiants can be quantised to reduce the number of non-zero values that need to be transmitted: this is called adaptive quantisation.

The number of bits in each sample can be reduced by using a coding method such as Huffman (the binary equivalent of the Morse code). Short-code patterns are allocated to frequently occurring symbols. Furthermore a number of efficient run length codes can be used. For example the sequence 4,4,4,4,4, could be coded 4,5, i.e. 4, five times, giving additional saving.

Modulation Systems

There are a number of modulation systems that allow each transmitted 'symbol' to represent more than one binary digit. For example a form of 16QAM (Quadrature Amplitude Modulation) provides two possibilities, see Fig. 1(b). Eight code vectors of the same carrier frequency plus four code vectors amplitude modulated to one of two possible levels give sixteen unique code vectors each of which represents a four-bit binary number. Fig. 1 shows a comparison between 8PSK (Phase Shift Keying) and 16QAM. With further development of this technique it's expected that 256QAM will eventually allow each transmitted symbol to represent eight bits.

The JPEG, MPEG and H261 Algorithms

These algorithms all start from the same basis. Red, green and blue coloured space is encoded in YUV (luminance plus two colour-difference signals) form. The image is then processed in 8 x 8 pixel blocks by a Discrete Cosine Transform (DCT) processor (you'll find the mathematical equations in the second edition of my book *Communication Services via Satellite*, published by Butterworth-Heinemann). The coefficients obtained for each block represent the amplitudes of the various frequencies present, the top left-hand element in the matrix representing the d.c. level for the whole block. Although the transform equations are formidable even to those who are mathematically aware, dedicated chips can perform forward and reverse transform operations in real time.

The fractal and wavelet transforms that are being developed promise even higher compression levels. But the MPEG algorithm is the only one for which hardware that can process images with motion in real time is currently available. It's effectiveness can be judged by the CD-I system: a five inch CD-I disc can store 74 minutes of FMV whose quality is better than that provided by domestic VCR systems.

H261 Codec and Processing

The H261 CCITT standard is ISDN (Integrated Services Digital Network) compatible. It's used for digital audio and video signals at bit rates between 64kbits/sec and 2·048Mbits/sec. Each codec (transmitter and receiver) carries out pre- and post-processing of the local TV signal. A Common Image Format (CIF) for the transmission channel is formed from either 625/25 or 525/30 TV signals. The CIF is based on 288 non-interlaced lines per picture, i.e. sequential or progressive scanning, and 30 pictures per second. A 625-line system has 576 active lines per frame, so that 288 lines form one field. So a 625/25 codec has to perform a conversion only to meet the 30Hz picture rate. A 525/30 codec already operates at the correct frame rate and thus has to convert between 240 and 288 active lines. The advantage of the CIF is that all transmissions are to a common standard. Thus core codec design is to a world standard, which is not only a significant achievement but is also a considerable aid to interconnectability.

The CIF is formed by sampling the luminance signal at 6·75MHz and the chrominance signal at 3·375MHz, producing 352 8-bit samples per line. This is equivalent to an analogue signal bandwidth of about 3·4MHz, so the processed image is only about 30 per cent below full studio quality.

A lower image resolution is acceptable for applications such as videophones. For this application a second standard is incorporated in H261. It has 176 samples per line and 144 lines per picture. Since this represents half resolution in each dimension, it's known as Quarter Common Image Format (QCIF).

The basic processing system is shown in Fig. 2, which shows how the previously coded image data (4) is subtracted from the current data to produce a difference image (1). The sampled YUV video signal components are processed separately but in the same way. The image is divided into 8 x 8 pixel blocks which are then DCT processed. The matrix values are next scanned in a zigzag fashion (see Fig. 3) to produce a serial bit stream. At this stage only the d.c. component and a few low spatial frequencies have any significant magnitude. The following quantisation stage sets all the very low values to zero and reduces the others to a set of preferred levels, further reducing the number of values that need to be transmitted.

Motion compensation is used to minimise the frame-to-frame differences that have to be transmitted. It operates by taking four blocks (16 x 16 pixels) from the current image, which has been reconstructed by the inverse DCT processor, and searching over ±15 pixels vertically and horizontally to find the best match. The variable-length store is then adjusted so that the best-match section of the image is used for subtraction (4). The vertical and horizontal translations derived from this block matching are later included in the transmission multiplex as motion-correction factors.

Since the data bits are generated at a variable rate and must be transmitted as a constant rate, buffer stores are required in both the encoding and decoding stages. Control signals are added to ensure that the receiver's decoder uses the data bits at the correct variable rate.

The decoder in the receiver uses the DCT coefficient values and the motion vectors with a block matching technique to reconstruct the image, the process being similar to that shown in Fig. 2.

Run-length coding (RLC) is used to obtain data compression for transmission. It operates in the following manner. The quantised a.c. coefficients usually contain many runs of consecutive zeroes. These are indicated by two 4-bit nibbles as follows. The upper four bits indicate the number of

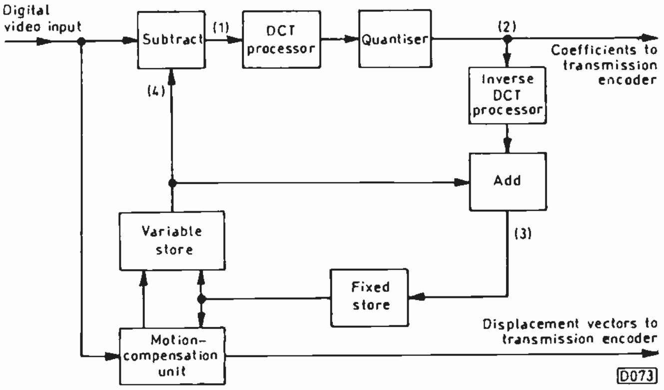

Fig. 2: Basic MPEG processing.

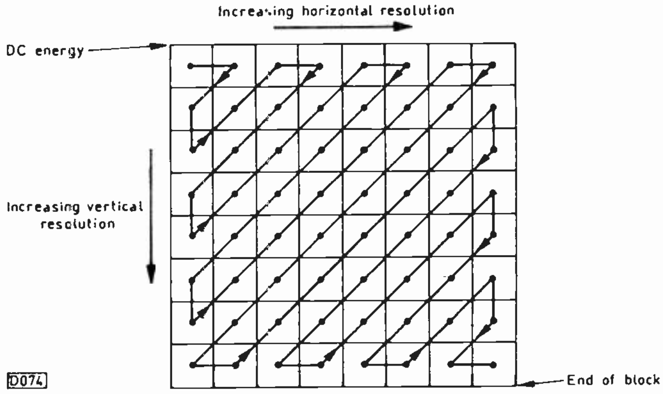

Fig. 3: Zigzag scan of an 8 x 8 pixel block.

consecutive zeros before the next coefficient while the lower four bits indicate the number of significant bits in the next coefficient. This code symbol is followed by the significant bits of the coefficient, whose length can be determined from the lower four bits of the code symbol.

The inverse RLC decoder in the receiver translates the coded bit stream into an output array of a.c. coefficients by taking the current code and inserting the number of zeros indicated by the RLC. The coefficient entered into the array has the number of bits indicated by the lower four bits of the RLC and a value determined by the number of trailing bits.

With a still picture a further degree of bit reduction can be achieved by using a modified Huffman code. In this case shorter code words are used for frequently occurring symbols and longer codes for the occasional ones. This can be based on a look-up table stored in a ROM, or alternatively operated in an adaptive manner for specific images. The latter involves creating a data table, stored in a RAM, based on the frequency count of each symbol in the image. It's used in a similar way to the ROM look-up table.

Developments in North America

The present intention is to start off by using the simulcast principle for HDTV services in the USA and Canada. A station wishing to start HDTV transmissions will be allocated an additional 6MHz channel so that its HDTV and NTSC services can be broadcast in parallel. The idea is that as the NTSC system becomes obsolete its frequencies will become available for new applications. The FCC (Federal Communications Committee) has stated that NTSC will cease to be a broadcasting standard after June 29th, 2008.

Of the six original HDTV systems presented for testing at the North American Advanced Television Test Centre (ATTC), four digital systems passed the first hurdle. Two of them employ 1,050-line interlaced scanning while the other two use 787·5 lines with progressive scanning. The former provide the best pictures but the latter have the most robust transmission capabilities. It thus appears that the debate will revolve around whether to interlace or not. The ATTC delayed making its decision on which system to adopt as the future North American standard until the end of the year. More recently work started on a compromise, composite system which will be put forward for testing.

We'll take a look at the DigiCipher system proposed by a consortium led by the General Instrument Corporation because it represents a good example of the application of the above approach to HDTV.

The DigiCipher System

The system has been designed for transmission within a 6MHz channel bandwidth and can operate at relatively low power. Error-free reception is claimed even when a small aerial is used and the carrier-to-noise ratio is less than 20dB. The coding system produces a digital multiplex that includes the vision and sound signals and teletext type data. Thus neither a sound carrier nor a colour subcarrier is required. Use of digital 16QAM, with four carrier phases each of which can be amplitude modulated to four different levels, results in a peak-to-average power variation of only 5dB. So the system has an even power spectral distribution and as a result there's a very low level of adjacent channel interference.

The RGB video source components are encoded in YUV form, with Y and UV bandwidths of 22MHz and 5·5MHz respectively. The image format is based on 1,050 lines at a field rate of 59·94Hz, with 2:1 interlacing and an aspect ratio of 16:9. Samping is at 51·8MHz, with 8-bit resolution for both the Y and UV components. The video bit stream is then compressed to 13·83Mbits/sec.

The 15kHz baseband audio signal is pre-emphasised, sampled at 44·056kHz, quantised to ten bits and then instantaneously companded to ten bits. There's provision for four such channels within an audio bit rate of 1·76Mbits/sec.

These video and audio bit streams are then multiplexed with data and text (126kbits/sec) and system control data (126kbits/sec again) to produce a total effective bit rate of 15·84Mbits/sec. When this is passed through a forward error correction (FEC) circuit using a Reed-Solomon (154, 130) code the final transmission bit rate rises to 19·43Mbits/sec. By using 16QAM, with its four bits per symbol, the bandwidth of the transmitted signal works out at about 4·86MHz.

The video signal is processed in the MPEG manner, but the chrominance information is compressed by averaging pixels in groups, four horizontally and two vertically. The Y signal bypasses this operation, being multiplexed with the processed UV components one block (8 x 8 pixels) at a time. The lot is then passed through the DCT processor.

The information for the next frame is predicted and compared with the current frame data, only the differences being DCT coded. A good predictor is simply the previous frame. The output forms an 8 x 8 matrix of coefficients, of which the top left-hand element has a value that's twice the average of the 64 elements, representing the d.c. energy in the whole block. As Fig. 3 shows, the horizontal elements represent increasing horizontal frequencies in the original image while the vertical elements represent increasing vertical frequencies. The elements along the diagonals thus represent the energy in the diagonal frequencies. Generally the magnitude of these higher-order elements rapidly tends towards very small or zero values.

The quantisation stage sets all the small values to zero and reduces certain coefficients in an adaptive manner in accordance with a look-up table stored in a ROM. The matrix of coefficients is then scanned in the zigzag manner shown in Fig. 3. This leads to long runs of similar values, enabling amplitude/run-length coding to be used. This takes the form of a modified Huffman code, using a two-dimensional code book. If a block that ends with a long run of zeros is detected, an end-of-block code is added after the last non-zero value, providing further bit-rate compression.

Table 1 shows how DCT processing of a typical pixel block produces this run of zero or near-zero values. It also shows that the application of inverse transform reproduces pixel values that are very little different from the original ones.

Motion estimation is used to compensate for some of the errors introduced by compression, images being compared on a frame to frame basis to detect areas of movement and predict how they will appear in the next frame. Motion vectors for transmission to the decoder are derived from this data. To reduce the information needed to describe motion, a block matching technique, using a superblock of pixels (32 x 16), is used for estimation.

This is compatible with four times horizontal and two times vertical subsampling of the chroma signal. Thus a

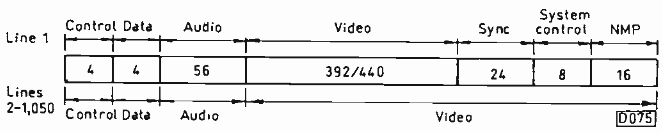

Fig. 4: DigiCipher system digital multiplex format.

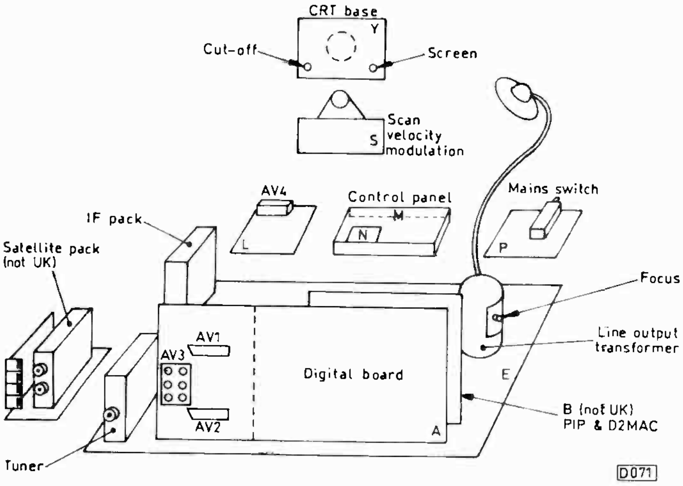

Fig. 5: Arrangement of OFDM carriers (a), OFDM frequency spectrum (b).

single vector can be used to describe the movement of the Y, U and V signal components, reducing the bit rate needed to describe motion.

The variable bit-rate output from the Huffman coder has to be matched to the constant bit rate required for transmission. Buffer memories in the encoder and decoder are used for this purpose. The buffer is able to hold data for one frame ± one field variation. To avoid underflow and overflow of the memory the level within it is continuously monitored to derive a control for the adaptive quantisation process.

The control, data, audio, video and sync bit streams are multiplexed in the manner shown in Fig. 4. Video lines two through to 1,050 contain four control bits, four data bits, 56 audio bits and 440 video bits. For line one, which is concerned chiefly with system synchronisation, the last 48 bits are allocated to frame sync, system control and Next Macroblock Position (MNP) – a macroblock consists of 256 x 16 pixels. Once the decoder clock has been synchronised, the 24 sync bits in line one provide frame sync. The last 16 bits (NMP) are used to cater for user channel changing and system recovery from error conditions: the data is used to signal the number of bits from the end of the NMP to the beginning of the next macroblock.

The digital multiplex is FEC coded before being applied to the QAM transmission system. This reduces the 19·42Mbits/sec rate resulting in a bandwidth of about 4·86MHz.

European Developments

The pan-European VADIS (Video Audio Digital Interactive System) and NTL's SPECTRE (Special Purpose Extra Channels for Terrestrial Radiocommunications Enhancement) projects have demonstrated that Orthogonal Frequency Division Multiplex (OFDM) shows great promise as a way of conserving spectrum space. It uses a large number of carriers with equal frequency spacing. Each carrier can be modulated with a sub-band of frequencies, the result being that the total spectrum behaves like a parallel transmission bus.

Each modulated carrier is filtered to obtain the response shown in Fig. 5(a). The spectra of the adjacent carriers then overlap in the orthogonal manner shown. When they are combined, the total spectrum becomes virtually flat, as indicated in Fig. 5(b). Thus the channel capacity approaches the Shannon limiting value.

For Digital Audio Broadcasting (DAB) the channel is divided into N carriers with each modulated by one sub-band of P programmes. Thus there are N/P interleaved programmes in the transmission multiplex.

Table 1: Forward and reverse DCT processing of an 8 x 8 pixel block.

Original 8 x 8 block

139	144	149	153	155	155	155	155
144	151	153	156	159	156	156	156
150	155	160	163	158	156	156	156
159	161	162	160	160	159	159	159
159	160	161	162	162	155	155	155
161	161	161	161	160	157	157	157
162	162	161	163	162	157	157	157
162	162	161	161	163	158	158	158

DCT processed block

315	–0·26	–3·02	–1·30	0·53	–0·42	–0·68	0·33
–5·65	–4·37	–1·56	–0·79	–0·71	–0·02	0·11	–0·30
–2·74	–2·32	–0·39	0·38	0·05	–0·24	–0·14	–0·02
–1·77	–0·48	0·06	0·36	0·22	–0·02	–0·01	0·08
–0·16	–0·21	0·37	0·39	–0·03	–0·17	0·15	0·32
0·44	–0·05	0·41	–0·09	–0·19	0·37	0·26	–0·25
–0·32	–0·09	–0·08	–0·37	–0·12	0·43	0·27	–0·19
–0·65	0·39	–0·94	–0·46	0·47	0·30	–0·14	–0·11

Quantised coefficients

315	0	–3	–1	1	0	–1	0
–6	–4	–2	–1	–1	0	0	0
–3	–2	0	0	0	0	0	0
–2	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
–1	0	–1	0	0	0	0	0

Reconstructed 8 x 8 pixel block

139	145	150	154	154	153	154	153
145	150	154	157	157	155	156	156
150	155	158	161	160	157	157	155
159	161	161	163	161	158	159	159
159	160	161	163	161	157	156	155
163	162	160	162	161	157	157	158
162	161	159	162	161	157	157	157
164	162	160	163	162	158	159	160

Courtesy of General Instruments Corp., VideoCipher Division.

For television transmissions the video baseband is filtered to produce sub-bands to modulate each carrier. The BBC and Thomson-CSF Laboratories have demonstrated that this technique makes it possible to squeeze 60Mbits/sec of digital signal into an 8MHz channel. Two 30Mbits/sec signals were transmitted, using horizontal and vertical polarisation. The spectrum was divided into 512 close-spaced carriers: to avoid interference with conventional PAL transmissions 64 of the carriers were not used. To maximise channel capacity, 64QAM was used for each carrier.

HD-DIVINE

A system called HD-DIVINE (High Definition Digital Video Narrow-band Emission) has been demonstrated by a Scandinavian consortium. It uses 1,250 lines, a 50Hz field rate, 2:1 interlacing and OFDM with 16QAM and 448 carriers. Digital compression is carried out in a hybrid manner to provide a transmission multiplex that includes 24Mbits/sec of video, four 128kbits/sec audio channels, 64kbits/sec of data and 2Mbits/sec for error control.

Hierarchical System

The VADIS group has also demonstrated an 'hierarchical' compression technique for digital HDTV signals. This enables a small receiver to extract 6Mbits/sec of data to provide a Standard Definition Television (SDTV) display while a larger receiver can process the full 14Mbits/sec for HDTV.

Japanese Developments

To give viewers an impression of widescreen TV JVC has demonstrated a 4:3 aspect ratio image that was stretched to 16:9 using scan velocity modulation. Beam velocity changes smoothly between the edges and the centre of the picture, so that the geometry of most of the picture is virtually unchanged. Since viewers pay attention mainly to the centre area of the picture, the technique was found to be acceptable for the purpose.

Displays

Adequate HDTV displays can be achieved only by using a large receiver that cannot be accommodated easily in most homes. Development of a flat display is therefore vital. To date the LCD panel has been limited to a maximum diagonal dimension of about 14in. Sharp recently demonstrated an LCD projection system however, using a 100in. diagonal polarised screen and a new metal-halide lamp. If the rest of the hardware can be reduced to a suitable size, this could be an appropriate way of achieving HDTV displays in domestic settings.

Ultra Definitation TV

The Japanese Ministry of Posts and Telecommunications and the National Broadcasting Authority (NHK) are investigating Ultra Definition Television (UDTV) systems with a resolution of more than 2,000 lines. The aim is to produce a system that's compatible, through standards conversion, with 1,125-line MUSE, using either 16:9 or 4:3 aspect ratios. A target date has been set for the year 2005. Initial usage would be for film production and printing purposes. This should at any rate ensure that the TV debate will continue well into the next century!

Saving Network 1400 Series Receivers

Denis G. Mott

In the early Eighties Network Industries produced a series of 14in. colour TV sets based on a chassis supplied by GoldStar. Model numbers were NWC1402, NWC1410 and NWC1430, with both remote-control (R suffix) and non remote-control versions. As with most chassis from most manufacturers there's an Achilles' heel. In this case the problem relates to the M193 tuning memory chip IC1601. This SGS device was also used in a Lowe Opta and an Hitachi chassis, and by some other setmakers. It's no longer available from SGS and stocks have dwindled to virtually zero. As a result it's now almost impossible to obtain the device as a service spare.

I recently had a call from an engineer who had a couple of these sets in, each with a blown M193 chip. It struck me that there were probably many other people in the same predicament, i.e. with one of these sets that was in perfect working order apart from the fact that the M193 chip had failed. Here's a solution to keep the TV set in use, though without the tuning memory facility.

Tuning System

An article of mine in the March 1986 issue of *Television* described the operation of the tuning system used in these sets. Basically the purpose of the M193 chip IC1601 is to convert an analogue voltage to a digital word that's stored in one of sixteen memory locations. A DAC chip (HIC1601) converts its output word to the appropriate tuning voltage. The memory locations are selected by a four-bit word generated by IC1301. This arrives at IC1601 via HIC1301 and IC1302. A two-digit LED display, driven by the M192 chip IC1501, shows the selected channel.

Faults and Cures

The usual faults with the M193 chip are either that it gets hot, pulling down the 5V line, or that it fails to memorise channels.

Failure to memorise is the easiest fault to deal with. Simply push in the mode button (SW1702) and tune in manually, using the multiturn potentiometer VR1701. Remove diodes D1714 and D1713 to stop sound muting.

The more difficult problem is a hot chip. Remove the M193 i.c. then bin it. Reroute the link from the wiper of the multiturn potentiometer, disconnecting it from pin 3 of IC1701 (LMN324) and taking it directly to pin 5 of the DAC chip HIC1601 instead. If you live in an area where the transmitters operate in the lower part of the band it may be necessary to remove R1703 (1·2kΩ) to allow the potentiometer to reach down to chassis potential. The variable voltage obtained from the potentiometer is approximately 0-5·5V. This is amplified by the HIC1601 chip to the 0-32V level.

The nice thing is that the a.f.c. is not affected as it's fed to a separate tuner pin. To deactive the a.f.c., push in the mode switch. Then tune in the required station and release the mode switch.

With remote-control TV sets the volume and on/off functions are not affected by this change.

I know that this solution is not perfect, but it's better than having a useless TV set.

Camcorner

Reports from Eugene Trundle, David C. Woodnott and Simon Bodgett

Panasonic MS50

If this little treasure is dropped, the pin can jump out of its groove in the loading mechanism's main cam. This immobilises the deck but leaves some telltale play in the loading guide poles. **E.T.**

Panasonic MS50

This machine came in with the audio hi-fi indicator (green LED on the top surface) lit up whenever a battery or external power supply was connected: in this state it drew 45mA with the power switched off. The culprit was transistor Q4521, an 8·4V stabiliser on the hi-fi audio PCB – it had developed internal leakage. **E.T.**

JVC GR45E

'A colour problem' the job ticket said. That was true, but there were two separate faults in different parts of the circuitry. The first one was a distinct lack of B – Y, producing a picture with only red and cyan casts. The vectorscope showed this quite clearly. But where to start looking? After much searching I discovered an intermittent dry-joint at pin 24 of IC4 on the Video 1 PCB. With this corrected the camera was put on test – only to discover that after a short period the playback colour disappeared. The cause was failure of IC4 on the Y/C PCB when warm. This chip is the THE045A that's used (and fails) in other JVC models. Replacement and setting up completed the repair. **D.C.W.**

Sony CCDV8AF

The cause of no viewfinder picture is generally a break in the print on the viewfinder socket PCB. **D.C.W.**

JVC GRC1E

We've had two of these early machines in recently with a failed lower drum motor. Instead of running the drum twitches. Replacement cures the problem – coincidence, or are these camcorders just getting old? **D.C.W.**

Sony CCDV800E

This Hi-8 camcorder had me puzzled for a while. It worked all right in the standard-8 mode in both record and playback, but when switched to Hi-8 only the record function operated correctly. Playback of one of its own recordings or a known good tape in this mode produced the effect of one head giving little output. The playback equalising circuits were checked but everything here was in order. There was nothing for it but to change the upper drum. This solved the problem. **D.C.W.**

Ferguson 3C03

Don't get caught as I have (twice!) when working on the camera section of this model using patch leads. If you leave the audio lead connector between the camera and deck sections unplugged you'll find the camera operation controls acting very strangely: the fader and WB controls are inoperative while the BLC button fades the picture! The reason for this is that the controls are earthed via the audio lead's screen connection (CN14 on the main PCB). **D.C.W.**

Amstrad PSI AC Adaptor

The cause of failure to charge with the power on LED flashing was a defective NE555 timer chip (IC2). Other types of 555 chip may produce different fault symptoms if used as a replacement. **D.C.W.**

JVC GR45

There was flickering on the picture, more noticeable during playback of the camcorder's own recordings than in the E-E mode. Two separate faults contributed to the problem. First a d.c.-d.c. converter was not to specification – it produced ripple on the camera signal processing supply, as a result of which the amplitude of the luminance signal fluctuated. Secondly the a.g.c. circuit in the luminance recording chip seemed to over-react to the signal variations. Replacing the d.c.-d.c. converter and the chip cleared the problem. **S.B.**

Ferguson 3C03

The problem was no auto-focus operation: a new auto-focus sensor assembly plus resetting the focal plane put matters right. **S.B.**

Panasonic NVM5B

There was no zoom and no power-up reset on the deck – only a sort of soft-shoe shuffle. We found that the zoom controls had been unplugged, which indicated that our local Jessie James had been at it. A new loading motor drive chip restored the deck reset and loading drive but there was no capstan drive. Two further i.c.s (MN6170 and MN3805) cured that problem and I now found that I had playback but no camera pictures. I suspected that this was the original fault. Its cause was quickly traced to a BA6149LS CCD delay line in the camera signal processing circuitry. **S.B.**

Ferguson FC06

The cassette housing opened when power was first applied but not thereafter, which obviously affected cassette removal after filming. I found that there was some slight corrosion on the main PCB. Cleaning it off with ammonia and relacquering cured the fault. **S.B.**

JVC GRAX5

The loading mechanism was inclined to jam when unthreading the tape. More seriously, during threading the top of the entry guide caught on the upper drum. Both loading rings and the entry guide had to be replaced, then aligned. Not a job for the faint-hearted. **S.B.**

Panasonic NVM7B

The colours from the camera head were incorrect – very bluey/greeny/yellowy. The cause was a dry-joint on the R – Y level control VR316. **S.B.**

Letters

TIMER MODE

It's interesting to read about the problems people have in tracing the causes of intermittent faults. This one wasn't a fault as such, but nevertheless caused more than enough trouble. The complaint was that a modern, remote-controlled TV set would switch itself off once a week, once a month or maybe twice a day, i.e. when it felt like it! Sometimes it would be o.k. for months. The set would always start up again without any trouble.

This went on for about ten months, with me soldering, bashing, fitting mains filters, replacing the remote control system and dreading the telephone when it rang. The set always behaved itself impeccably in my workshop. One day I was at the house on another matter and asked whether the set was giving any trouble. Whilst talking I picked up the remote control unit and pressed a few buttons. The on-screen display appeared and informed me that the set was in the timer mode. A few seconds later it shut down. A massive penny then dropped!

It seems that the youngster of the house was allowed to turn on the TV set with the remote control unit. Being only four, he would press every button until something happened! As is usually the case, the parents hadn't the faintest idea that the set had a timer mode or what it did, and naturally assumed that the set was faulty.

David C.J. Tilley,
Tiverton, Devon.

NICAM FOLLOW-UP

I'd like to make a couple of points to clear up any confusion that may have arisen following Michael Harris's article in the May issue and my original Nicam on a Shoestring article in the February issue.

When I did the original work on the decoder I used the Nicam Mk II kit module, which is for system B/G. The filters and crystal had to be changed as described in my article. Since then a cheaper decoder has become available from Sendz. It doesn't need filter and crystal replacement, being ready for use with the addition of only a 3·3kΩ bias resistor and an input coupling capacitor. The PCB is the same, but some components are not fitted. The circuit diagram supplied with the cheaper decoder is a photocopy of the diagram for the system B/G decoder.

I've had a decoder fault that may be of interest to other readers. The symptoms were that after forty minutes to an hour short bursts of noise, at about one second intervals, came from both channels. Adjusting the trimmer connected to the 16·384MHz crystal provided a temporary cure, as did cooling the crystal. A new crystal provided a permanent cure.

Keith Wevill, B.Sc.,
Ratby, Leicester.

MICROWAVE TOUCH PADS

We now take on microwave ovens in addition to our normal run of TV/video/audio work. As I think that most small workshops now take on this kind of work, here's a tip that may well save time and money. We've found that a number of units have failed where the touchpad ribbon plugs into the front panel PCB. The ribbon is usually bent over quite severely. It literally cracks, though not visibly. Check the first centimeter with the beep range of your ohmmeter. The affected tracks can be repaired using electroconductive paint. It's quick, simple and very effective. A refreshing change!

Now maybe someone can help me. My Ford Orion Encore, limited edition, registration J206 PBA, which has flambean red metallic paint and alloy wheels, was stolen from outside my house one night recently. Should anyone spot it, please let me know.

Steve Leatherbarrow, 71 Fir Lane,
Royton, Oldham, Lancs OL2 6TF.

LATEST FAD

The current economic climate seems to have brought with it an abundance of instant training agencies, many of which seem to have little understanding of the subjects. The latest fad is National Vocation Qualification (NVQ) training. Without such a certificate you may come to be regarded as being incapable of carrying out tasks at even a basic level of understanding. To complicate matters, the Catch 22 situation is that you cannot obtain the qualification unless you are already carrying out the job. Those doing the training/assessing are on to a good thing – especially as the certificate is valid for only three years, after which you have to be assessed again.

Some training companies are trying to get their certification verified by a university – having its name on the certificate is more impressive than C + G. In this ludicrous situation many managers are trying to be assessed for level 5. Sorry lads, but the best you can hope for is level 3.

I suggest that like everyone else we start to make up our own rules – before someone does it for us. Here's an idea. Make up a wall chart and divide it into 100 squares. For each item repaired, tick one square. When you have a full chart, post it to yourself along with a competence certificate at level 1. Repeat for every 100 until you attain level 5. Stop at this level until something else is invented. Oh, and start to talk about "cost effectiveness" and "time management", and always carry your tools in a briefcase as a toolbox is unprofessional.

Jim Fenton,
Hull, N. Humberside.

SERVICING MATTERS

I'd like to comment on a couple of matters that came up in the April issue. First the Matsui CTV2055 mentioned by Geoff Fardon in the TV Fault Finding column is actually a Jackson chassis. The circuit diagram bears the number 20R. The set seems to be almost identical to the Tashiko 20E911/20E912, which may also be called a Saikou and is similar to the Harwood 14. I understand that the same chassis can be found in some Triumph models.

Secondly, with reference to Chris Watton's restoration of an old Hitachi VT11E it's nice to know that others believe in taking the time to do the job properly. Before you withdraw the capstan shaft however it's a good idea to scrub off the accumulated dirt and tape oxide with an ink rubber. This prevents the muck being drawn into the motor bushes. Once these have been cleaned they can be lubricated with further pipe cleaners soaked in oil. I store these in a flat, plastic oil-filled bag that stands in a jam jar.

A selection of old toothbrushes is useful for scrubbing reel turntables, dismantled clutches, etc. Medium bristles seem to be best for reaching into milled plastic surfaces.

Rubber items such as belts and pressure rollers should be cleaned with a mixture of isopropyl alcohol and distilled water – use of an excessively volatile cleaning fluid can cause hairline cracks in the surface. Very fine wet and dry can be used to remove the glaze from the surface of pinch rollers.

You often find that the loading arm slots are bone dry. This must subject the loading motor and belt to unnecessary stress. I always lubricate them, using black Castrol graphited grease for metal arms and slots or white Molykote grease where either or both surfaces are plastic. When the correct types of grease are available it's a good idea to apply some to the loading and master-cam gears, as well as the front loading mechanism. White Molykote is available from Willow Vale Electronics under Philips part no. 4822 390 20027. Use it sparingly – it's expensive.

Dave Mackrill,
St. Leonards-on-Sea, East Sussex.

FOR DISPOSAL

I have for disposal a Ferranti TP1026 transportable TV receiver. It's available at no charge but must be collected or carriage arranged.

B. Ross, 85 Cornwallis Rd., Rugby CV22 7HL.
0203 303080 ext. 8138 (day), 0788 816 326 (evenings).

B & K TUBE TESTER REPAIR

Our B & K 467 tube tester developed a fault recently. The problem was that we couldn't set the first anode voltages correctly. When we opened the tester we found a PCB with about five thousand wires that connected it to the operating panel. I didn't fancy taking this off! Anyway a look at the circuit diagram showed that there are three 620kΩ, 1W resistors (R46/7/8) in the first anode circuit. Two had gone high in value while the other one was open-circuit. Replacing them all enabled the first anode voltage to be set up correctly. They can be replaced without removing the PCB: they are in the middle of the panel and can be reached with very thin long-nosed pliers.

Chris Watton,
Boston, Lincs.

HAVE YOU HAD THESE?

We have a Bush Model 2020 with a black line down the left-hand side of the screen, about 1·5in. in and 0·125in. wide. Replacing the TDA3562A chip has made no difference. We also have a Sentra STX200 which produces a blank screen with no sound when a strong signal is reached whilst tuning. It will hold a snowy picture. Both chips in the a.g.c. section have been changed. Has anyone else come across these symptoms and managed to find the causes?

G. Nicholl, Home Services,
Lochwinnoch, Renfrewshire.

FINLUX 3000 CHASSIS

An article in the August 1992 issue mentioned the following fault with the Finlux 3000 chassis: inhibited video but sound and a teletext page number present. The solution with my 3621F was to replace the SDA3202 chip ICi1 in the tuner. There was a response to hand control channel changes at the SDA and SCL input pins 4 and 5 of this chip but no voltage alteration was detected at the collector of transistor Ti4 at the output.

Six weeks later a similar fault occurred. This time there was a response at the collector of Ti4 but a check on the voltages around the TDA2450 chip ICi2 produced low readings at pins 15 and 16. Some other voltages here were incorrect. A new TDA2450 put matters right.

Thanks are due to my mate Vic and to Arch Crawford at Finlux Technical Services for help with these faults.

Kevin Parkinson,
Stanley, Wakefield.

GRUNDIG TECHNICAL ADVICE

I'm writing this letter to let all small businesses know about Willow Vale's technical advice on Grundig products. As we all know, Willow Vale is the main supplier for Grundig, Philips and Sharp spares. It's nice to know that the company offers this service to its account customers.

It's easy to open an account with Willow Vale: just phone and they'll gladly assist you. If only all suppliers offered this type of service small businesses would have peace of mind. Thank you Willow Vale, and Alan Dyson. A great combination.

M. Cordner, M & M Videos,
West Norwood, London SE27.

SATELLITE REPAIR MANUAL

In the May TV Fault Finding column Mark Ward mentioned a fault with an Amstrad SRX200 satellite receiver, adding the comment that "it took a lot of searching". He would have saved himself a lot of time and trouble if he'd consulted our *Eurosat Repair Manual*, where the fault is listed on page 1 of the Amstrad section (Models SRX100/200).

The manual includes repair and modification details for various satellite receivers, plus 'secret' factory codes. It's available from satellite installers and shops that deal with a Eurosat trade warehouse.

Martin T. Pickering, B.Eng., Technical Manager,
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Unit 4, Bentley Lane Industrial Estate,
Walsall, West Midlands WS2 8TL.

Long-distance Television

Roger Bunney

Conditions during April are often thought to be a good pointer to what we can expect during the subsequent Sporadic E season. I sincerely hope that this April's reception is not an indication of what's to come. Conditions were dreadful! Very few long-distance signals were received and there was certainly nothing that could be called an SpE opening. We shall just have to hope that conditions improve. Here's the bleak log:

- 5/4/93 Early morning auroral effects in Band I following a larger event the night before.
- 15/4/93 A small tropospheric lift produced Band III/u.h.f. signals from Scandinavia/Denmark along the E/NE coast.
- 22/4/93 The Lyrids meteor shower produced Band I signals.
- 26/4/93 Tropospheric conditions improving.
- 27/4/93 SpE reception of RAI (Italy) on chs. IA and IB. Excellent tropospheric activity with Band III/u.h.f.signals from Scandinavia, Denmark, Germany and the Benelux countries.
- 28/4/93 High-level tropospheric activity as on the 27th.
- 29/4/93 Tropospheric conditions decline.

My thanks to Simon Hamer, Ian Menzies, Tim Anderson, Peter Schubert and David Glenday for letting me know what sort of month they had!

Miscellany

Todd Emslie (Sydney, Australia) is wondering about a 'sleigh bells' sound that's heard when signals from several Band I TV transmitters are received simultaneously via transequatorial skip (TE) propagation from the north. The effect is usually heard during late night (2100-0200) TE reception. Channels C1/R1/C2 are affected most, chs. E2 and E4 being affected at other times – usually this means Thailand. Todd thinks that the bell noises could be caused by irregularities in the ionosphere, possibly as the F layers break up when the effect of the sun ceases. They are not heterodyne offset noises, as Todd has heard them with s.s.b., a.m. and both wide- and narrow-band f.m. transmissions. Can anyone throw any light on this mystery?

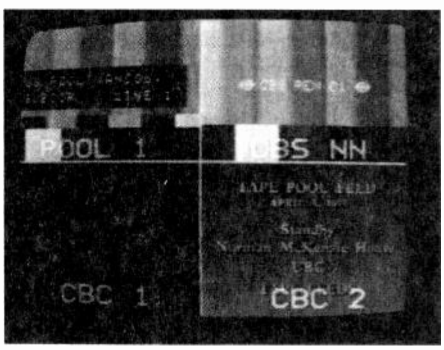
The FCC has decided to allow the use of line 19 in the NTSC TV signal for ghost cancelling reference data. Ghosting is a considerable problem in many areas of the USA.

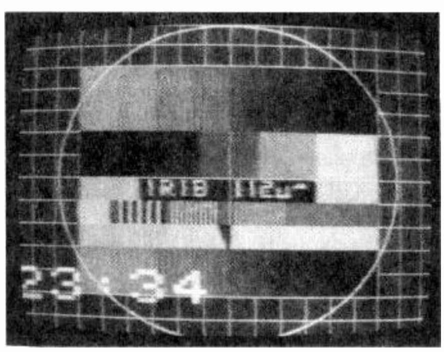
An article in the March 1993 issue of *Cabling World* suggests that the use of screened cables may not be the answer to interference radiation from digital communications equipment. The DTI has recently produced new EMC standards that must be followed in commercial installations. It has established that screened cables may be ineffective in preventing interference radiation. The trend now is to reduce/prevent r.f. radiation by using balanced pairs of cables (twisted) with baluns. Installation engineers are advised to plan cable routeing and lengths carefully and minimise on parallel conductors. Correct matching of cables and equipment terminals is of great importance, with due regard paid to common earthing points. Though coaxial screened cable can reduce radiation, the correct procedure is to ensure that network cabling is correctly routed, earthed where appropriate and matched to the equipment at each end.

Mediarama UK Ltd., Griffin House, 58-62 Hockliffe Street, Leighton Buzzard, Beds LU7 8HE has introduced a TV tuner panel that enables a personal computer to tune in v.h.f. and u.h.f. TV signals. The PAL signal output provided by the panel can be fed to a TV set or used, via a digital PC/AT video panel, to drive the PC's display. The system operates to CCIR standards, with three Band I, eight Band III and 49 u.h.f. channels, also 57 CATV channels. Other panels can provide freeze frame, digitising effects, etc. Note that the units are not exactly cheap. Mediarama can be contacted on 0525 383 222 (fax 0525 851 563).

The latest version of Andrew Emmerson's *Exotic TV Idents* tape includes fifteen more unusual test cards and captions – there are nearly 100 items on the tape, which runs for 49 minutes. Two more tapes are now available, *Idents Tape 1* and *Idents Tape 2*. They contain a historical collection of slides from 1936 through to the latest satellite TV patterns. This massive collection is housed in two full E180 tapes. All tapes cost £9·99 each. They are available in PAL VHS form only from Andrew at 71 Falcutt Way, Northampton NN2 8PH. Allow fourteen days for delivery.

Another tape, *Vintage Test Cards on Video*, is available from HS Publications, 7 Epping Close, Mackworth Estate, Derby DE3 4HR (0332 381 699). It contains a fascinating collection of test cards and identification captions used by various TV companies around the world during the Sixties and early Seventies. There are monoscope patterns (no elec-





Left: A mix of satellite news feeds from the Vancouver Superpower summit, seen in band C (NTSC) via the Intelsat craft at 53°W. Centre: The Asiavision news feed from Malaysia via Eutelsat II F4 at 7°E – with sound in syncs. Right: The Iranian test pattern received at 10·99GHz, 63°E by Ian Waller.

tronically generated ones) and slides in both monochrome and colour. This one is available in either VHS or Beta form at £14·95 plus 85p UK postage or £1·75 air mail postage worldwide. Send three first class stamps for a DX-TV catalogue and details of other videos.

Missing Colour

Fred Pilkington, who recently moved to Malaga, Spain, has a problem with his reception of Gibraltar TV. After mounting his ch. E12 Yagi aerial on a new, slightly higher mast he retuned his GaAsfet preamplifier and obtained almost perfect reception from the low-power GBC transmitter some 75 miles away. Next day however there was no colour, and the only way in which any locked colour could be obtained was to reorientate the aerial inland, about 25° off the correct bearing. Further experimentation over two weeks produced no improvement, neither did the use of a different receiver. Excellent results were obtained when the receiver, decoder (for BBC WSTV) and aerial were taken along the coast to a friend's house. After a further three weeks of fluctuating colour he found that neighbours were suffering from the same problem, critical colour lock.

First thoughts were that a local phase-shifted reflection was causing chroma signal cancellation, possibly aided by non-linearity somewhere in the receiving chain. One afternoon however GBC went off-air for a minute, during which a weak Algerian (RTA) signal was seen in the otherwise empty channel. Fred now wonders whether the RTA signal is of sufficient strength to cause colour drop-out at times. A larger aerial system is planned, with a narrower forward beam width and reduced sidelobe pickup. If anyone has any ideas on the cause of this interesting problem and how to deal with it, do please write in to us.

Digital Audio Broadcasting

The Crystal Palace DAB transmitter is to come into operation this summer, relaying the network f.m. radio services in the 230MHz band. At a later stage the tests will be expanded to include two-three further DAB transmitters covering the capital. The BBC is unlikely to start regular DAB transmissions before 1996. The long-term aim is to convert all the Band II f.m. services to DAB, something that may take anything up to 25 years. Other countries are developing DAB: as with TV, several different standards could come into use.

News Items

Moscow: Andrew Emmerson reports that TV-6 is now operating an MMDS (microwave distribution) system in the city. Present power is 100W but this is to be increased to 1kW.
Czechoslovakia: A twelve-year licence for a commercial TV channel with national coverage has been awarded to a group called Central European TV for the 21st Century (CET-21). The service will open early next summer. There are also to be two commercial radio services.
Hungary: Government restrictions on TV station ownership are to be relaxed. There are plans for a local commercial TV station run by the Budapest City Council and for other local TV services in the larger towns. A commercial TV channel with national coverage is also on the drawing board.
Austria: The ORF-2 network may be moved to the

commercial sector or alternatively a third network may be launched.
Berlin: A new station Shamoni-TV is to open, offering regional news coverage and local programming.
China: A commercial station, Oriental Television (OTV), is to be launched operating on channel C20. Coverage will include Shanghai, Yangtze and Northern Taiwan.
Ireland: The government has allocated nearly £4m to set up a Gaelic TV service.
Fiji: A new TV service is to be introduced: five groups have applied for the operating licence.
The Netherlands: Public-sector services are to start broadcasting from 0700 local time. The authorities are considering a ten-year extension of the licences held by the nine main public-sector broadcasters instead of the current practice of regular reviews.

Satellite TV

Andy James (Harrow Hill, Gloucestershire) reports a mystery reception on April 30th. He logged Ku band NTSC signals at 11·135GHz, with vertical polarisation, downlinking Shuttle flight STS55 information. Prior to this a Houston TV test pattern was present, with audio at 6·6 and 8·3MHz. The signals were received from about 32°W – but there's no Ku band transmitter here apart from Marco Polo 1 which uses only the DBS frequencies. On the following day the broadcast was seen as a recorded programme from Kopernikus II at 28·5°W. As my own satellite system was out of action due to failure of the positioner control box I was unable to check out the signal. Could it be from Hispasat?

Direct TV, the digital-compression satellite broadcaster planning to start a 150-channel (eventually) service in the USA next December, has signed an agreement with Columbia which will offer video release films to the channel on a pay-per-view basis.

Wire TV is downlinking via Intelsat 601 at 27·5°W: test patterns carry the identification 'The Cable Channel'.

Asianet has launched a u.h.f. satellite TV service across India from the Ekran craft at 99°E, with reserve craft dotted at 48, 64, 69, 84 and 95°E. Although the 48°E slot is above the horizon in Europe, hopefully someone may be able to resolve signals.

The 'France-2 16/9' HDTV service via the Telecom 2A satellite is now called 'France Supervision'. It's in D2-MAC stereo with up to three hours of 16:9 aspect ratio signals nightly.

Launch of the Astra 1C satellite was delayed by up to a month because of damage and a bent aerial system. CLT's RTL-5 is the latest channel to book a transponder on it.

BBC WSTV is to use digital compression to offer a full service to the Americas via CBS facilities. Transmission will be in C band via Intelsat 513 at 53°W. CBC will use a single transponder to relay four vision and sixteen audio channels.

An American company, SatelLynx Corp., is planning to use digital compression to offer a service with up to 60 channels across S.E. Asia and Australasia.

Some real satellite DX reception is being reported. At least two enthusiasts in the UK have received signals at 12·08GHz (vertical) from the North American Hispasat craft. Ian Waller (Lincoln Satellite Ltd.) confirms that with a TAD board the TVE-1 service can be received on a clear night – a large dish must be used. It's an NTSC signal transmitted in real time.

Finally Colin Paton (Greenock) comments on LNB interference. He has noticed that satellite audio is picked up when he tunes his Realistic Pro 2006 base scanner to 34·225MHz. The audio content varies daily – Sky Movies, the Movie Channel or MTV for example. I suspect that this is i.f. radiation from a nearby TV receiver rather than LNB radiation. Taking a walk with a small scanner should rapidly locate the source.

What a Life!

Donald Bullock

"We had a story today about Mr. and Mrs. Cobbler" said my daughter Rebecca. "They had so many shoes to mend that they went to bed weary each night. One night, after an awful day, they crawled into bed really worn out. Next morning, to their delight, they woke up to find that all the shoes had been done and their workshop had been thoroughly tidied up and was sunny. This happened every night thereafter, and they lived happily ever more."

I smiled suitably and thought of Weary Willy and his untidy workshop that was full of lots of nasty sets he couldn't mend. There was the Salora J chassis set with the hard to get at power supply that kept blowing up, the old Ferguson hi-fi video with the chain-driven cassette housing that eats fingers and turns them into new faults, and that wicked Sentra VCR that wouldn't spring to life whatever he did.

Willy started to think about switch-mode power supplies and TDA4600 chips. He wondered how big a boat it would need to take them all to the middle of the Atlantic and how much gunpowder would be required to send them to the bottom. Then he crawled off to his workshop, clambered over all the sets he couldn't mend, had a drink of meths and curled up under the bench.

When he awoke there was this fog. As it cleared he looked around his workshop and his eyes opened wide. Could this be the workshop he'd gone to sleep in? Where was the nasty J chassis, the pulled-apart Ferguson and that wicked Sentra video? Willy rubbed his eyes in astonishment. They were nowhere to be seen. In fact all that he could see were the shiny sides of piles and piles of TVs and videos.

Then Greeneyes clopped in. Her upside-down face smiled at his, under the bench. "Come on Weary Willy" she breathed. "You've been asleep for ages. Loads of sets have been brought in. I've put them all on top of the others. And they're all tricky ones that have already been pulled about by Snoddies and Gumboils."

Weary Willy grabbed for the meths. But Greeneyes was there first. She snatched it and made to depart. "Wake up and get cracking Willy" she said, "they won't mend themselves you know!

A Ferguson TX85

Weary Willy made some room on the bench and pulled up the nearest set. It was a Ferguson 14J9 – a 14in. colour set fitted with the TX85 chassis – and was as dead as could be. He decided to check the voltage across the mains bridge rectifier's reservoir capacitor C69, but his fingers slipped. His eyeballs lit up and shot out, telling him that some 340V was present. Then he caught sight of the TEA2018A chopper control chip IC4 and its start-up resistor network – two series-connected 82kΩ resistors, R89 and R91, with a 390kΩ resistor (R60) in parallel with them. He was certain that one or other of them would be the cause of the problem. But they were perfectly all right. A tear slipped down Willy's face.

A voice sounded in Willy's head. "See if the chopper circuit is inhibited" it said. "Disconnect the output from the h.t. rectifier D12 then connect a 75W bulb between its cathode and chassis. If it lights up when you switch the set on, the power supply is o.k. and you can start to think nasty things about the line output stage.

Weary Willy did so and the lamp didn't light. So he disconnected the other two rectifier diodes on the secondary side of the circuit, the ones that provide the 13V and 17V supplies. The lamp still refused to glow, and another, larger tear slid down Willy's face. He was saddled with yet another nasty switch-mode power supply fault.

The thing to do, he decided, was to check the start-up voltage at pin 6 of the TEA2018A chip. He knew that 5·8V was required here for the set to spring to life. There was no voltage and the hunt was on. Maybe the 330μF reservoir capacitor C71 was short-circuit? It wasn't. Willy looked long and hard at his next suspect, the TEA2018A chip itself. He fitted a replacement and switched on. Up came the starting voltage, which immediately rose to 12V as the chopper circuit broke into self-oscillation. Brightness appeared on the screen, and Willy also felt a bit better.

The Hitachi G6P

"Next" he shouted, just as Mr. Thicke picked his way in with a Hitachi TV set in his arms. "It's dead" he said. "Do it if it's cheap, otherwise ring me."

Weary Willy sighed. He really should think of a way of getting paid for his time when the customer decided against going ahead. He put the set on the bench and switched it on. It was a CPT2176 (G6P chassis) and its little beacon was out. There was h.t. across the mains bridge rectifier's 150µF reservoir capacitor C906 but nothing much else. He checked the chopper transistor (Q901) which had MN650 printed on it. He found that it was dead short, then discovered from his little book that it was a BU508A in disguise. Weary Willy sighed and wished that transistors all wore proper numbers. He fitted a BU508A and, whilst at it, decided to check the 2SD1453 line output transistor Q781. This was also dead short. After replacing it he reached for his variac, 'cos he doesn't like repeatedly blowing up transistors in hard to get at places.

The set failed to spring to life and the ammeter on his variac began to creep up as he increased the voltage. He thought he detected a nasty, warm smell and felt the line output transformer. It was hot. So he disconnected all the diodes it supplies and tried the set again. The variac's ammeter began to creep up and the nasty smell returned. So he phoned Mr. Thicke and told him fifty pounds.

Mr. Thicke said he wished he still had his old voltmeter so that he could have mended it himself, and that he too could earn fifty pounds an hour fiddling with wires. And his wife had arthritis, and couldn't Willy do it cheaper because he'd another set that needed repairing?

Willy ordered a new transformer from SEME. It arrived next day in a sturdy yellow box marked HR Components: Willy noticed that it was made in Spain, where he wished he was. The original transformer's first anode voltage output was contained in the screened outer of the focus lead, but the replacement had a separate, green wire for this. He soon fitted the new transformer, and when he switched the set on it came to life with a good picture. This cheered him up. As he stepped back to look at it he tripped over a set on the floor and banged his shin on the edge of another one. At this very moment Mr. Thicke showed up for his Hitachi.

"I'm in agony with my missus. Her says you never shoulda done it" he said.

The Microwave

As Mr. Thicke departed Mr. Roughouse came in, looking as though he'd just sorted Popeye out. He was carrying a Matsui microwave minus its cover. This came behind, carried by his weedy wife Olive.

"He works, but he don't heat up. Where's the valve?" He prodded about in the works with his fingers. Weary Willy gibbered and tugged at his arm.

"Don't touch" he shrieked. "It can floor, even kill you."

Mr. Roughouse repeated his message, stabbing his finger at the capacitor. Willy retreated, still gibbering, but Mr. Roughouse flagged him down.

"He ain't on" he said, pushing his thumb on to the positive terminal of the capacitor. Willy stepped to one side, closed his eyes and awaited the crash. There wasn't one.

"You chaps gets too excited" Mr. Roughouse said. "Mend 'im if it's up to fifty quid. New 'uns at Crubb's Foodstore are only seventy quid, an' you gets an oven set an' a basket o' groceries."

Lots of big tears slid down Weary Willy's face and he wished he was somewhere else.

ITC Report

Eugene Trundle

The Independent Television Commission held an exhibition in May to demonstrate a whole range of new British television technologies – most of them long-term research projects undertaken in conjunction with contractors like National Transcommunications Ltd. (NTL), the private company created from the engineering division of the former IBA.

The highlight was a live demonstration of high-quality digital TV (DTV) from the Crystal Palace transmitter. Other displays and exhibits ranged over a wide field, from aids for viewers with impaired vision to microwave propagation studies.

Spectre

The Spectre project is concerned with digital TV broadcasting, the current state of the art being demonstrated by the live transmission a few miles across London from a specially-installed 50W e.r.p., ch. 28 transmitter at Crystal Palace to the ITC's headquarters in Brompton Road. The signal source was a D1-format VTR, whose 216Mbits/sec digital video output was compressed to about 10Mbits/sec by a digital compressor designed and built by NTL. An OFDM (Orthogonal Frequency Division Multiplexing) modulator was used. A conventional group A receiving aerial picked up the signal, after which it was demodulated, decompressed and then fed in RGB form, after scan doubling, to a large-screen, 1,250-line, 16:9 aspect ratio Sony monitor.

The results were impressive indeed: in terms of picture detail and texture conventional TV was left far behind. A 625-line widescreen PAL TV set of the type that can be bought over the counter was fed with a transcoded PAL composite video signal derived from the digital decoder. The pictures it displayed benefited from the low noise and greater aspect ratio but didn't stand up to such close examination as those displayed by the HDTV monitor. This was a plain demonstration that the forthcoming systems offer a trade-off between cost and performance.

This digital TV system uses AD conversion of the camera's analogue signal output, typically to a 216Mbits/sec digital data stream, followed by compression in which the redundant parts of the picture (those that can be predicted by the information in previous frames) are discarded, only the difference information being passed on (see page 634 for further information on this technology), and finally OFDM modulation. The latter employs over 400 separate carriers, each handling digital data at a relatively low rate.

Picture Quality

The picture obtained with a transmission bit-rate of 10Mbits/sec is, to this reporter anyway, indistinguishable from a high-quality analogue one and is better than anything currently seen on domestic TV screens.

A second demonstration showed, on ordinary TV screens, pictures derived from digital signals transmitted at a 3·5Mbits/sec rate – three such signals can be accommodated in the bandwidth currently occupied by a single terrestrial, analogue TV channel. As an example of how this could be used in practice we saw, on adjacent screens, the three sub-regional news programmes provided simultaneously by Meridian TV on weekday evenings. The on-screen results were remarkably good, with very little noise and picture instability on only fast zooms and pans and jump-cuts to busy pictures.

Terrestrial DTV

A great deal of research has been done on bit-rate parameters and error-correction techniques since the first Spectre tests were carried out in Devon over a year ago. It's becoming apparent that a terrestrial DTV service could be established using transmitter e.r.p.s a thousand times less than those currently used for the PAL services. This opens the way to using u.h.f. slots that cannot be used for PAL because of interference and multipath reception problems. But satellite DTV, using the same compression and modulation techniques, would be easier and quicker to implement – indeed there are plans for DTV broadcasting via Astra within two years.

Whether the signals come from Earth or space, the establishment of a DTV service giving enhanced pictures will depend on the availability, at an acceptable price, of a large-screen HDTV display device: the monitor used in the demonstration cost several thousand pounds.

The Mosaic Project

A characteristic of DTV bit-rate reduction is that the resultant image quality is dependent on picture content and the amount of movement present in the picture. The degree of impairment depends on the data rate assigned to the transmission channel and the algorithm used by the computer-controlled digital compressor. While the characteristics of the human eye and brain are well known, and much research has been carried out on the effects of shortcomings in conventional TV systems, the viewer's response to distortion caused by digital compression and to the effects of signal corruption in a digital system are not yet fully known.

The Mosaic Project has been set up to investigate this. A demonstration involving thousands of scenes from current broadcasts showed that with one system under review 84 per cent were considered to be good, 15 per cent good to fair and one per cent poor. It must be remembered however that the scenes represent very fleeting moments during a programme, and that most viewers are more interested in programme content than the picture's technical quality.

Enhanced PAL

Since the original development of the PAL system in the Sixties there have been many advances: a demonstration of current PAL Plus technology by NTL showed how much progress has been made. The aim is to develop an enhanced PAL system that could be in operation by 1995.

PAL Plus is compatible with current PAL transmissions. It provides a widescreen picture in a 'letterbox' format. Existing TV sets display the full widescreen image with black bands at the top and bottom of the screen. Because UK viewers seem to dislike the black bands, a compromise solution has been developed – a 14:9 aspect ratio that reduces the depth and noticeability of the bands. The PAL Plus encoder and decoder on display were experimental types. We saw side-by-side displays on conventional 4:3 aspect ratio and PAL Plus 16:9 aspect ratio receivers. There was a vast improvement in the picture quality produced by the PAL Plus receiver when the 'helper' signal was switched in: all cross-colour effects disappeared and the sharpness of details was improved. Receiver manufacturers aim to introduce PAL Plus sets in 1995.

Echo-cancellation

Research is also being carried out on the elimination of ghosting with u.h.f. PAL signals. Since the building of the Canary Wharf tower, ghosting has become a problem in the Lea Valley in north London – an estimated 100,000 viewers are affected to some degree. The ITC, in conjunction with a receiver manufacturer, plans to build and test an echo-cancellation system by the end of the year. It involves the use of a high-energy 'chirp' reference signal that's inserted in the blanking interval and is processed by special circuits within the receiver. If the field tests are satisfactory it's hoped that the EBU will accept the reference signal standard next year.

Audetel and Talking Teletext

Another new project, being developed by a consortium that includes broadcasters, chip manufacturers and the UK electronics companies Speka and Portset, is a picture-description system to enable those with impaired vision to get more from TV programmes. An extra speech channel, carried as data within the teletext signal, provides a description of what's happening on the screen. This commentary would be slotted into 'quiet' periods between dialogue and over music, describing actions, scenery, facial expressions etc. – rather like a friend whispering in your ear.

Audio description has already been introduced by over fifty public broadcasting stations in the USA. The European Audetel project is supported by EC funding. Several programmes have been provided with descriptions, and successful on-air tests have been carried out. It's hoped to start a pilot service within the coming year, for which fifty free-standing receivers will be produced and distributed for field trials.

One of the partners in the Audetel project has had a teletext reader on sale for two years: 'talking teletext' decodes the text data and reads it out in a clear, synthesised voice. A talking keyboard can be used to select data and hear the contents a page at a time. An oral facility scans each page line by line, word by word – and even spells out individual words. The basic model costs about £600: a version that also offers TV sound is available at about £650. Registered blind people are exempt from VAT on these products and if the unit is used without a TV set there's no need for a TV receiving licence. Further details can be obtained from Portset Systems – phone 0489 893 919.

In Conclusion

Several other projects were on display. They included studies of microwave propagation at frequencies from 37GHz to visible light wavelengths, carried out by the Rutherford Appleton Laboratory; TV broadcast spectrum planning and computer-generated coverage maps, especially relevant to the possibility of starting fill-in DTV broadcasts; and Colour Fidelity, a computer-based and quantified study of all the factors relevant to accurate colour rendering by the TV system as a whole, from the studio to the viewer's eye.

All in all the exhibition was an eye-opener in every sense and a fascinating glimpse into the future of TV broadcasting.

TEST CASE 367

As he told her about the problems he was having with his rented JVC VCR, Major-general Anderson's voice boomed so loudly that our receptionist Pam held the handset at arm's length. Was there interference about, he wanted to know? Pam told him that there was, what with high pressure and low pressure and goodness knows what else. The General had had the same trouble with his shower, he said, ringing off satisfied.

It wasn't long however before the retired warrior's voice was again rattling the window pains of the little office. He described strange disembodied voices and picture interference during playback of his own recordings. Could we send someone along to sort it out? We could indeed. Next Monday morning our Allan was at the General's door with his little box of tools.

The interference was clearly spasmodic, because all the recordings made over the weekend were fine and a test recording done there and then played back without problem. Allan asked for a sample tape with a faulty recording so that he could check it and get a clearer idea of the symptom. It then transpired that the General had only the one tape, a three-hour cassette that was as old as the machine itself. He used it to record all the programmes he wanted to time-shift. So Allan had to be satisfied with a verbal description, the gist of which was that the sound from another transmitter was sometimes recorded along with the required picture, which suffered from some form of colour interference. Allan decided that it was best to install a loan machine and take the offending JVC one back to the workshop.There was no doubt that the problem, whatever it was, was confined to the record mode. But record-only faults are difficult to diagnose, mainly because you cannot see what's happening until the tape is played back. When the fault is an intermittent one and you don't know exactly what you are looking for anyway it's a frustrating business. In a parting shot to Allan the General had suggested that if it wasn't due to high pressure it might be caused by a loose wire, a suggestion that was duly passed on to those in the workshop.

The VCR ran all day on the test bench, alternately recording and playing back three hours' worth of broadcast programmes. Each playback was o.k., with the correct sound track. The only interference on the picture was the usual breakthrough patterning whenever Pam keyed the RT transmitter to talk to the roving Allan or Philbert. On day two Real Technician took the top cover off the machine and, with a screwdriver, beat a tattoo on its PCBs and other delicate bits and pieces. He blasted the tuner and sound receiver with hot air from a hairdryer, then covered selected areas of the PCBs with a layer of ice from an aerosol freezer can. When he played back the five minutes of tape he'd recorded during this ferocious thermo-mechanical assault on the machine he found that, apart from the picture and sound disturbance because of the mechanical vibration and banging, there were no effects on the recording!

By now the General had had his loan VCR for a few days, so Real Technician gave him a ring to see if the replacement machine had given him any trouble. None at all thundered the voice. It was arranged that Allan would call and collect the General's tape, lending him another one. Perhaps some clues would be obtained from it. When this had been done the tape was played back. Towards the end of it a section that showed the fault was found: wrong sound track, with a drifting multi-colour overlay on the picture. The cause was soon found. What was it? For the solution turn to page 663.

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	Part No	Price
AIWA		
AV-66		
Video Head	VID 2546	£15.34
Pinch Roller	VID 1755	£3.83
Belt Kit	VID 7519	£2.03
Idler Replacement Set	VID 1001	£3.65
Idler	VID 1005	£2.12
Capstan Motor	VID 2160	£25.00
Tension Band	VID 1423	£3.65
Reel Table Rubber Tyre	VID 1335	£1.19
CTL Unit	VID 2637	£61.55
AV-77		
Video Head	VID 2546	£15.34
Pinch Roller	VID 1755	£3.83
Belt Kit	VID 7509	£1.33
Idler Replacement Set	VID 1000	£5.69
FWD Limiter	VID 1002	£3.83
Idler	VID 1004	£1.19
Idler	VID 1005	£2.12
Capstan Motor	VID 2118	£29.36
Tension Band	VID 1423	£3.65
CTL Unit	VID 2567	£47.83
AKAI		
VS 9800		
Video Head	VID 2511	£9.18
Pinch Roller	VID 1756	£3.23
Belt Kit	VID 7506	£1.78
Take Up Idler	VID 1025	£5.27
REW Idler	VID 1026	£6.71
FF Rubber Tyre	VID 1029	£0.85
FF Rubber Tyre	VID 1030	£0.85
Unloading Idler Rubber Tyre	VID 1207	£0.93
Capstan Motor	VID 2119	£25.34
Drum Motor	VID 2120	£20.20
Cassette Lamp	VID 1943	£0.27
Tension Band	VID 1391	£3.65
Repair Kit	VID 7911	£15.27
Take Up Rubber Tyre	VID 1028	£0.94
ALBA		
VCR-4000		
Video Head	VID 2713	£16.30
Pinch Roller	VID 1787	£3.74
Belt Kit	VID 7596	£3.81
Idler	VID 1049	£3.31
Cassette LED	VID 1981	£1.53
Tension Band	VID 1399	£2.04
AMSTRAD		
VCR-4600		
Video Head	VID 2676	£14.79
Pinch Roller	VID 1758	£3.15
Belt Kit	VID 7593	£1.75
Clutch	VID 1226	£4.76
Gear Holder	VID 1227	£13.14
RF Clutch	VID 1231	£7.78
Cassette LED	VID 1981	£1.53
VCR 9000		
Video Head	VID 2502	£15.61
Pinch Roller	VID 1758	£3.15
Belt Kit	VID 7592	£1.19
RF Clutch	VID 1225	£4.33
Clutch	VID 1226	£4.76
Gear Holder	VID 1227	£13.14
Cassette LED	VID 1981	£1.53
BANG & OLUFSEN		
VHS-65		
Video Head	VID 2506	£14.14
Pinch Roller	VID 1788	£3.15
Belt Kit	VID 7538	£1.27
FF×REW Idler Arm	VID 1020	£1.79
Clutch Plate	VID 1211	£9.27
Capstan Motor	VID 2147	£23.15
Cassette LED	VID 1981	£1.53
DECCA		
VRH 8300		
Video Head	VID 2511	£9.18
Pinch Roller	VID 1814	£3.15
Belt Kit	VID 7812	£1.82
Reel Idler	VID 1036	£2.63
Take Up Clutch	VID 1037	£2.38
Take Up Idler	VID 1038	£1.07
Brake Pad	VID 1361	£0.59
Reel Motor	VID 2169	£28.97
Capstan Motor	VID 2164	£33.80
Loading Motor	VID 2168	£12.84
Cassette Lamp	VID 1947	£0.51
Tension Band	VID 1389	£1.79
Repair Kit	VID 7913	£16.09
Take Up Reel Table Rubber Tyre	VID 1080	£0.68
Supply Reel Table Rubber Tyre	VID 1080	£0.68
FERGUSON		
3-V-30		
Video Head	VID 2647	£9.18
Pinch Roller	VID 1814	£3.15
Belt Kit	VID 7812	£1.02
Reel Idler	VID 1036	£2.63
Take Up Clutch	VID 1037	£2.38
Take Up Idler	VID 1038	£1.07
Brake Pad	VID 1361	£0.59
Reel Motor	VID 2169	£28.97
Capstan Motor	VID 2164	£33.80
Loading Motor	VID 2168	£12.84
Cassette Lamp	VID 1947	£0.51
Tension Band	VID 1389	£1.79
Repair Kit	VID 7913	£16.09
Take Up Reel Table Rubber Tyre	VID 1080	£0.68
Supply Reel Table Rubber Tyre	VID 1080	£0.68
3-V-36		
Video Head	VID 2647	£9.18
Pinch Roller	VID 1813	£3.15
Belt Kit	VID 7543	£1.16
Take Up Clutch	VID 1031	£2.11
Take Up Idler	VID 1038	£1.07
Reel Idler	VID 1039	£3.40
Brake Pad	VID 1361	£0.59
Capstan Motor	VID 2165	£25.16
Loading Motor	VID 2168	£12.84
Front Loading Motor	VID 2168	£12.84
Cassette LED	VID 1981	£1.53
Tension Band	VID 1389	£1.79
Remote Control	IR 9100	£11.01
Repair Kit	VID 7918	£12.51
Mains Transformer	VID 2223	£24.18
Take Up Reel Table Rubber Tyre	VID 1080	£0.68
Supply Reel Table Rubber Tyre	VID 1080	£0.68
Cassette Housing	VID 1099	£21.75
3-V-57		
Video Head	VID 2573	£14.66
Pinch Roller	VID 1813	£3.15
Belt Kit	VID 7540	£0.68
Clutch Mechanism	VID 1083	£15.00
Capstan Motor	VID 2188	£45.96
Loading Motor	VID 2167	£14.11
Front Loading Motor	VID 2168	£12.84
Cassette LED	VID 1981	£1.53
Tension Band	VID 1388	£2.13
Repair Kit	VID 7920	£21.85
Cassette Housing	VID 1315	£21.90
3-V-57		
Video Head	VID 2573	£14.66
Pinch Roller	VID 1813	£3.15
Belt Kit	VID 7540	£0.68
Clutch Mechanism	VID 1083	£15.00
Capstan Motor	VID 2188	£45.96
Loading Motor	VID 2167	£14.11
Front Loading Motor	VID 2168	£12.84
Cassette LED	VID 1981	£1.53
Tension Band	VID 1388	£2.13
Repair Kit	VID 7920	£21.85
Cassette Housing	VID 1315	£21.90
FV-108		
Video Head	VID 2580	£19.73
Pinch Roller	VID 1817	£5.50
Belt Kit	VID 7564	£2.81
Idler Arm	VID 1091	£3.08
Reel Motor	VID 2193	£16.24
Capstan Motor	VID 2190	£24.72
Loading Motor	VID 2412	£6.37
Front Loading Motor	VID 2412	£8.37
Cassette LED	VID 1981	£1.53
Tension Band	VID 1386	£0.85
Repair Kit	VID 7921	£9.97
FV-12L		
Video Head	VID 2581	£30.88
Pinch Roller	VID 1817	£5.50
Belt Kit	VID 7564	£2.81
Idler Arm	VID 1091	£3.08
Reel Motor	VID 2193	£16.24
Capstan Motor	VID 2190	£24.72
Loading Motor	VID 2412	£6.37
Front Loading Motor	VID 2412	£6.37
Cassette LED	VID 1981	£1.53
Tension Band	VID 1386	£0.85
Repair Kit	VID 7921	£9.97
FIDELITY		
VCR 100		
Video Head	VID 2502	£15.61
Pinch Roller	VID 1758	£3.15
Belt Kit	VID 7593	£1.75
Clutch	VID 1226	£4.76
Gear Holder	VID 1227	£13.14
RF Clutch	VID 1231	£7.78
Cassette LED	VID 1981	£1.53
FINLUX		
VR-1030		
Video Head	VID 2558	£44.82
Pinch Roller	VID 1803	£3.83
Idler	VID 1006	£3.46
Tension Band	VID 1432	£5.87
Remote Control	IR 9034	£14.52
Repair Kit	VID 7930	£12.58
VR-2010		
Video Head	VID 2578	£62.15
Pinch Roller	VID 1827	£5.70
Belt Kit	VID 7588	£1.09
Idler	VID 1252	£5.20
Loading Gear	VID 1253	£7.23
Modification Set	VID 1254	£10.61
Tension Band	VID 1431	£4.85
Remote Control	IR 9034	£14.52
FISHER		
FVH-P520		
Video Head	VID 2500	£17.39
Pinch Roller	VID 1788	£3.15
Belt Kit	VID 7532	£1.35
Take Up Idler	VID 1015	£3.65
FF×REW Pulley	VID 1016	£0.93
Idler	VID 1023	£3.46
Tension Band	VID 1378	£2.76
Take Up Reel Table Rubber Tyre	VID 1293	£0.77
Supply Reel Table Rubber Tyre	VID 1293	£0.77
FVH-P530		
Video Head	VID 2500	£17.39
Pinch Roller	VID 1788	£3.15
Belt Kit	VID 7532	£1.35
Take Up Idler	VID 1015	£3.65
FF×REW Pulley	VID 1016	£0.93
Idler	VID 1023	£3.46
Tension Band	VID 1378	£2.76
Take Up Reel Table Rubber Tyre	VID 1293	£0.77
Supply Reel Table Rubber Tyre	VID 1293	£0.77
FVH-P720×720K×721		
Video Head	VID 2500	£17.39
Pinch Roller	VID 1810	£3.04
Belt Kit	VID 7532	£1.35
Gear Idler	VID 1013	£4.51
Idler	VID 1014	£3.06
Loading Gear Set	VID 1230	£1.02
Cassette LED	VID 1981	£1.53
Tension Band	VID 1376	£2.38
Take Up Reel Table	VID 1295	£8.07
Supply Reel Table	VID 1294	£8.55
FVH-P722×725		
Video Head	VID 2501	£29.57
Pinch Roller	VID 1810	£3.04
Belt Kit	VID 7813	£1.19
Gear Idler	VID 1013	£4.51
Idler	VID 1014	£3.06
Loading Gear Set	VID 1230	£1.02
3-V-57		
Cassette LED	VID 1981	£1.53
Tension Band	VID 1376	£2.38
Take Up Reel Table	VID 1295	£8.07
Supply Reel Table	VID 1294	£6.55
FVH-P900K×KV		
Video Head	VID 2501	£25.17
Pinch Roller	VID 1818	£3.06
Belt Kit	VID 7568	£3.15
Idler	VID 1093	£4.85
Clutch	VID 1094	£14.59
Cassette LED	VID 1981	£1.53
Tension Band	VID 1377	£2.47
Supply Reel Table	VID 1296	£11.30
FUNAI		
VCR 4800		
Video Head	VID 2676	£14.79
Pinch Roller	VID 1758	£3.15
Belt Kit	VID 7593	£1.75
Clutch	VID 1226	£4.76
Gear Holder	VID 1227	£13.14
RF Clutch	VID 1231	£7.78
Cassette LED	VID 1981	£1.53
VCR-5843		
Video Head	VID 2708	£25.04
Pinch Roller	VID 1758	£3.15
Belt Kit	VID 7615	£1.70
Idler	VID 1364	£2.71
Cassette LED	VID 1981	£1.53
GEC		
V-4004		
Video Head	VID 2506	£14.14
Pinch Roller	VID 1788	£3.15
Belt Kit	VID 7538	£1.27
FF×REW Arm	VID 1020	£1.79
Clutch Plate	VID 1211	£9.27
Capstan Motor	VID 2148	£20.45
Cassette LED	VID 1981	£1.53
Tension Band	VID 1379	£2.38
Repair Kit	VID 7922	£17.24
GOLDSTAR		
GHV-8000×8200×8211×8215		
Pinch Roller	VID 1815	£3.15
Belt Kit	VID 7585	£1.53
Idler	VID 1052	£1.69
Bracket Centre	VID 1223	£13.51
Clutch Gear	VID 1228	£2.29
Limiter Roller	VID 1440	£1.53
Cassette LED	VID 1981	£1.53
Tension Band	VID 1399	£2.04
VCP-4100×4130		
Video Head	VID 2645	£27.24
Pinch Roller	VID 1815	£3.15
Belt Kit	VID 7585	£1.53
Idler	VID 1052	£1.69
Bracket Centre	VID 1223	£13.51
Clutch Gear	VID 1228	£2.29
Limiter Roller	VID 1440	£1.53
Cassette LED	VID 1981	£1.53
Tension Band	VID 1399	£2.04
VCP-4200×4326		
Video Head	VID 2645	£27.24
Pinch Roller	VID 1815	£3.15
REW Belt	VID 7234	£0.43
Cassette LED	VID 1981	£1.53
GRANADA		
VHS-EY1×EY2		
Video Head	VID 2539	£15.20
Pinch Roller	VID 1822	£3.31
Belt Kit	VID 7605	£2.63
Reel Drive Unit	VID 1255	£6.69
Loading Gear A	VID 1268	£1.95
Loading Gear B	VID 1271	£1.36
Capstan Motor	VID 2404	£46.16
Cassette LED	VID 1981	£1.53
Tension Band	VID 1414	£3.52
GRUNDIG		
VS-400		
Video Head	VID 2596	£15.75
Pinch Roller	VID 1757	£3.06
Belt Kit	VID 7567	£0.85
Idler	VID 1052	£1.69
Loading Gear	VID 1222	£1.57
Clutch Gear	VID 1228	£2.29
Limiter Roller	VID 1440	£1.53
Cassette LED	VID 1981	£1.53
Tension Band	VID 1400	£2.38
Remote Control	IR 8965	£20.79
VS-520 GB		
Video Head	VID 2595	£16.24
Pinch Roller	VID 1821	£9.52
Timing Belt	VID 1482	£8.16
Centre Pulley	VID 1482	£8.16
Cassette LED	VID 1981	£1.53
Tension Band	VID 1401	£0.00
HINARI		
VXL-30×35×4		
Video Head	VID 2518	£21.85
Pinch Roller	VID 1815	£3.15
Belt Kit	VID 7566	£2.38
Clutch	VID 1316	£8.21
Idler	VID 1317	£2.77
Loading Motor	VID 2167	£14.11
Cassette LED	VID 1981	£1.53
HITACHI		
VT-11		
Video Head	VID 2504	£15.84
Pinch Roller	VID 1788	£3.15
Belt Kit	VID 7538	£1.27
FF×REW Idler Arm	VID 1020	£1.79
Clutch Plate	VID 1211	£9.27
Capstan Motor	VID 2147	£23.15
Cassette LED	VID 1981	£1.53
Tension Band	VID 1379	£2.38
Repair Kit	VID 7922	£17.24
VT-16 S		
Video Head	VID 2505	£25.56
Pinch Roller	VID 1788	£3.15
Belt Kit	VID 7538	£1.27
FF×REW Idler Arm	VID 1020	£1.79
Clutch Plate	VID 1211	£9.27
Capstan Motor	VID 2147	£23.15
Cassette LED	VID 1981	£1.53
Tension Band	VID 1379	£2.38
Repair Kit	VID 7922	£17.24
VT-33×330		
Video Head	VID 2504	£15.84
Pinch Roller	VID 1788	£3.15
Belt Kit	VID 7538	£1.27
FF×REW Idler Arm	VID 1020	£1.79
Clutch Plate	VID 1211	£9.27
Capstan Motor	VID 2148	£20.45
Cassette LED	VID 1981	£1.53
Tension Band	VID 1379	£2.38
Repair Kit	VID 7922	£17.24
VT-61×62×63×64		
Video Head	VID 2628	£24.98
Pinch Roller	VID 1818	£3.06
Belt Kit	VID 7583	£1.61
FF×REW Idler Arm	VID 1020	£1.79
Clutch Plate	VID 1211	£9.27
Capstan Motor	VID 2154	£19.43
Cassette LED	VID 1981	£1.53
Tension Band	VID 1379	£2.38
Repair Kit	VID 7924	£15.35
VT-8000×8500		
Video Head	VID 2509	£15.76
Pinch Roller	VID 1788	£3.15
Belt Kit	VID 7803	£0.77
Take Up Idler	VID 1015	£3.65
Wind Roller	VID 1016	£0.93
FF×REW Idler	VID 1023	£3.46
Capstan Motor	VID 2155	£52.02
Tension Band	VID 1381	£2.21
Remote Control	IR 9097	£15.92
Repair Kit	VID 7928	£13.66
Take up Reel Table	VID 1302	£13.00
Supply Reel Rubber Tyre	VID 1300	£0.85
VT-9300×9500×9700		
Video Head	VID 2509	£15.76
Pinch Roller	VID 1788	£3.15
Belt Kit	VID 7802	£0.94
FF×REW Idler Arm	VID 1019	£2.89
Play Idler	VID 1075	£3.99
FS Brake	VID 1212	£1.99
Capstan Motor	VID 2156	£50.55
Cassette Lamp	VID 1951	£1.02
Tension Band	VID 1382	£2.20
Remote Control	IR 9096	£16.95
Repair Kit	VID 7927	£15.67
Take Up Reel Table	VID 1303	£9.43
ITT		
VR-3913		
Video Head	VID 2511	£9.18
Pinch Roller	VID 1814	£3.15
Belt Kit	VID 7812	£1.02
Reel Idler	VID 1036	£2.63
Take Up Clutch	VID 1037	£2.38
Take Up Idler	VID 1038	£1.07
Brake Pad	VID 1361	£0.59
Reel Motor	VID 2169	£28.97
Capstan Motor	VID 2164	£33.80
Loading Motor	VID 2168	£12.84
Cassette Lamp	VID 1947	£0.51
Tension Band	VID 1389	£1.79
Repair Kit	VID 7913	£16.09
Take Up Reel Table Rubber Tyre	VID 1080	£0.68
Supply Reel Table Rubber Tyre	VID 1080	£0.68
VR-3983		
Video Head	VID 2647	£9.18
Pinch Roller	VID 1814	£3.15
Belt Kit	VID 7523	£1.27
Reel Idler	VID 1036	£2.63
Take Up Clutch	VID 1037	£2.38
Take Up Idler	VID 1038	£1.07
Roller Bar	VID 1363	£4.67
Brake Pad	VID 1361	£0.59
Reel Motor	VID 2169	£28.97
Capstan Motor	VID 2187	£47.57
Loading Motor	VID 2168	£12.84
Front Loading Motor	VID 2168	£12.64
Cassette Lamp	VID 1946	£0.59
Tension Band	VID 1389	£1.79
Repair Kit	VID 7914	£13.42
Take Up Reel Table Rubber Tyre	VID 1080	£0.68
Supply Reel Table Rubber Tyre	VID 1080	£0.68
JVC		
HR-3300		
Video Head	VID 2511	£9.18
Pinch Roller	VID 1756	£3.23
Belt Kit	VID 7506	£1.78
Take Up Idler Large	VID 1025	£5.27
REW Idle	VID 1025	£5.27
Unloading Idler	VID 1027	£10.54
FF Rubber Tyre	VID 1029	£0.85
Unloading Idler Rubber Tyre	VID 1207	£0.93
Capstan Motor	VID 2119	£25.34
Drum Motor	VID 2120	£20.20
Cassette Lamp	VID 1943	£0.27
Tension Band	VID 1391	£3.65
Repair Kit	VID 7911	£15.27
Take Up Rubber Tyre	VID 1028	£0.94
HR-D110 111×120×121		
Video Head	VID 2647	£9.18
Pinch Roller	VID 1813	£3.15
Belt Kit	VID 7543	£1.16
Take Up Clutch	VID 1031	£2.11
Take Up Idler	VID 1038	£1.07
Reel Idler	VID 1039	£3.40
Brake Pad	VID 1361	£0.59
Capstan Motor	VID 2165	£25.16
Loading Motor	VID 2168	£12.84
Front Loading Motor	VID 2168	£12.64
Cassette LED	VID 1981	£1.53
Tension Band	VID 1389	£1.79
Repair Kit	VID 7918	£12.51
Mains Transformer	VID 2223	£24.18
Take Up Reel Table Rubber Tyre	VID 1080	£0.68
Supply Reel Table Rubber Tyre	VID 1080	£0.68
Cassette Housing	VID 1099	£21.76
MATSUI		
VX 850		
Pinch Roller	VID 1815	£3.15
Belt Kit	VID 7566	£2.38
Clutch	VID 1316	£6.21
Idler	VID 1317	£2.77
Cassette LED	VID 1981	£1.53
MITSUBISHI		
HS-307		
Video Head	VID 2606	£33.96
Pinch Roller	VID 1808	£3.15
Belt Kit	VID 7542	£1.45
Reel Idler Unit	VID 1040	£8.70
FF Idler Rubber Tyre	VID 1081	£0.77
Capstan Rubber Tyre	VID 1264	£1.36
Cam Gear A	VID 1274	£1.36
Gear 2	VID 1275	£1.53
Cam Gear B	VID 1276	£1.53
Gear 1	VID 1277	£1.45
Cassette LED	VID 1981	£1.53
Tension Band	VID 1393	£2.89
Take Up Reel Table	VID 1307	£4.23
Supply Reel Table	VID 1299	£3.54
HS-318		
Video Head	VID 2607	£43.65
Pinch Roller	VID 1808	£3.15
Belt Kit	VID 7559	£1.61
Reel Idler Unit	VID 1040	£8.70
FF Idler Rubber Tyre	VID 1081	£0.77
Capstan Rubber Tyre	VID 1264	£1.36
Cam Gear A	VID 1274	£1.36
Gear 2	VID 1275	£1.53
Cam Gear B	VID 1276	£1.53
Gear 1	VID 1277	£1.45
Cassette LED	VID 1981	£1.53
Tension Band	VID 1393	£2.89
Take Up Reel Table	VID 1307	£4.23
Supply Reel Table	VID 1299	£3.54
NEC		
N-830 EG×831×832×833		
Video Head	VID 2647	£9.18
Pinch Roller	VID 1813	£3.15
Belt Kit	VID 7543	£1.16
Take Up Clutch	VID 1031	£2.04
Take Up Idler	VID 1038	£1.07
Reel Idler	VID 1039	£3.40
Brake Pad	VID 1361	£0.59
Capstan Motor	VID 2165	£25.16
Loading Motor	VID 2168	£12.64
Front Loading Motor	VID 2168	£12.84
Cassette LED	VID 1981	£1.53
Tension Band	VID 1389	£1.79
Repair Kit	VID 7918	£12.51
Mains Transformer	VID 2223	£24.18
Take Up Reel Table Rubber Tyre	VID 1080	£0.68
Supply Reel Table Rubber Tyre	VID 1080	£0.68
Cassette Housing	VID 1099	£21.75
N-895		
Video Head	VID 2514	£31.84
Pinch Roller	VID 1813	£3.15
Belt Kit	VID 7540	£0.68
Clutch Mechanism	VID 1082	£15.84
Capstan Motor	VID 2166	£53.24
Loading Motor	VID 2167	£14.11
Front Loading Motor	VID 2168	£12.64
Cassette LED	VID 1981	£1.53
Tension Band	VID 1387	£2.55
Remote Control	IR 8947	£16.23
Repair Kit	VID 7919	£17.92
Cassette Housing	VID 1315	£21.90
N-9013×9014×9033×9034×9053×9054×9055		
Video Head	VID 2695	£20.10
Pinch Roller	VID 1828	£3.06
Belt Kit	VID 7601	£3.49
Reel Drive Pulley	VID 1265	£8.06
Cassette LED	VID 1981	£1.53
PANASONIC		
NV-2000×2010		
Video Head	VID 2520	£9.19
Pinch Roller	VID 1757	£3.06
Belt Kit	VID 7800	£1.79
Idler	VID 1054	£0.90
Idler	VID 1055	£8.95
Cam Gear	VID 1221	£0.82
Intermediate Gear	VID 1216	£1.27
Driving Gear	VID 1217	£8.50
Cassette Lamp	VID 1948	£0.25
Tension Band	VID 1397	£3.49
Repair Kit	VID 7901	£10.86
Take Up Reel Table	VID 1312	£11.47
Supply Reel Table	VID 1310	£7.57
NV-300×333		
Video Head	VID 2520	£9.19
Pinch Roller	VID 1787	£3.74
Belt Kit	VID 7521	£1.53
Play Idler	VID 1048	£2.81
Idler	VID 1057	£0.88
Idler Arm	VID 1220	£4.33
Cam Gear	VID 1215	£1.19
Intermediate Gear	VID 1216	£1.27
Driving Gear	VID 1217	£0.59
Reel Motor	VID 2158	£19.52
Capstan Motor	VID 2421	£40.62
Cassette LED	VID 1982	£1.78
Tension Band	VID 1399	£2.04
Repair Kit	VID 7903	£10.89
Take Up Reel Table	VID 1312	£11.47
PHILIPS		
Video Head	VID 2526	£10.41
Pinch Roller	VID 1757	£3.06
Belt Kit	VID 7530	£0.93
Idler	VID 1052	£1.69
Loading Gear	VID 1222	£1.57
Idler	VID 1370	£2.04
Idler	VID 1371	£6.12
Limiter Roller	VID 1440	£1.53
Cassette LED	VID 1981	£1.53
Tension Band	VID 1400	£2.39
Repair Kit	VID 7906	£8.22
VR 6540		
Video Head	VID 2537	£10.57
Pinch Roller	VID 1815	£3.15
Belt Kit	VID 7547	£1.18
Idler	VID 1060	£1.61
Master Cam	VID 1265	£8.06
Reel Motor	VID 2127	£26.85
Loading Motor	VID 2142	£16.70
Cassette LED	VID 1981	£1.53
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PYE		
DV 761		
Video Head	VID 2621	£57.10
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Belt Kit	VID 7588	£1.09
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FF×REW Idler	VID 1235	£1.87
Cassette LED	VID 1981	£1.53
Tension Band	VID 1394	£3.31
Take Up Reel Table	VID 1308	£5.37
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SAMSUNG		
VI-510×520×611×618×621		
Video Head	VID 2648	£17.88
Pinch Roller	VID 1815	£3.15
Belt Kit	VID 7598	£1.40
Idler	VID 1232	£1.53
Idler	VID 1346	£3.81
Reel Motor	VID 2407	£15.77
Capstan Motor	VID 2409	£29.25
Loading Motor	VID 2142	£16.70
Cassette LED	VID 1981	£1.53
VX-710×720×730		
Video Head	VID 2648	£17.88
Pinch Roller	VID 1759	£3.06
Belt Kit	VID 7608	£2.72
Cassette LED	VID 1981	£1.53
SANYO		
VHR-1100 EX×EE×6		
Video Head	VID 2583	£22.88
Pinch Roller	VID 1787	£3.74
Belt Kit	VID 7558	£1.27
Reel Drive Roller	VID 1076	£8.18
Reel Motor	VID 2198	£15.87
Cassette LED	VID 1981	£1.53
Tension Band	VID 1411	£2.72
VHR-1500 EX×6		
Video Head	VID 2585	£40.20
Pinch Roller	VID 1787	£3.74
Belt Kit	VID 7558	£1.27
Reel Drive Roller	VID 1076	£8.18
Reel Motor	VID 2198	£15.87
Cassette LED	VID 1981	£1.53
Tension Band	VID 1411	£2.72
VTC-M10×11×20×21		
Video Head	VID 2530	£20.45
Pinch Roller	VID 1758	£3.15
Belt Kit	VID 7809	£0.77
Reel Drive Pulley	VID 1079	£7.05
Idler	VID 1219	£2.82
Reel Motor	VID 2179	£20.44
Tension Band	VID 1408	£2.13
Supply Reel Table	VID 1319	£8.77
SENTRA		
VX-5000×8000		
Video Head	VID 2713	£16.30
Pinch Roller	VID 1787	£3.74
Belt Kit	VID 7596	£3.81
Idler	VID 1049	£3.31
Cassette LED	VID 1981	£1.53
Tension Band	VID 1399	£2.04

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VCR Clinic

Reports from Philip Blundell, AMIEIE, Brian Storm, Ronald Aranha, J.C. Priest, Simon Bodgett, Michael Dranfield, Hugh Allison, Geoff Fardon, Nick Williams, Chris Watton, Ronnie Boag and Nick Beer

Ferguson 3V55

There was an intermittent fault with this VCR: the drum would begin to go too fast, then the machine would shut down. In the fault condition the drum FG signal at TP414 went missing, though it was present at pin 6 of IC404. The supply to this chip was intermittent because R501 was dry-jointed. **P.B.**

Philips VR322

The problem here was that the remote control system didn't work. Nice squarewaves from the remote control receiver i.c. arrived at pin 41 of the operating panel microcontroller chip, but it ignored them. As the signal conditions at all the other inputs seemed to be o.k. we decided, with crossed fingers, to fit a new TMP47C1670N. This restored the remote control operation. **P.B.**

Ferguson 3V36/JVC HRD225

For weak E-E video check whether the 1kΩ E-E level control is open-circuit. **P.B.**

Panasonic NVJ35

This machine refused to accept tapes, throwing them out immediately. We found that the cassette housing was misaligned with the main deck. Realigning the housing rack gear with the main deck metal drive gear provided only a temporary cure – the machine relapsed into its previous state with a clattering of slipping gears. Inspection of the right-side section of the cassette housing showed that there were two broken plastic retaining lugs. The result was too much play on the rack gears. A new right-side assembly (part no. VXA3153) cured the problem. **B.S.**

Panasonic NV200

These VHS-C portable recorders sold well in our area. They are now coming back to us for repair. The most common fault symptom is perfect recording but intermittent playback. Tapping the middle of the top of the recorder, with the top on, normally aggravates the intermittency.

After removing the case, which is no easy task, up-end the unit with the front facing you. You are looking at the print side of PCB 600. Half a dozen components are tacked on to this side of the board. At the rear of the board there's a choke which is connected to two capacitors, the joins also being laid-on connections to the PCB. These two joints become intermittent. If you simply reflow them the unit will be back within six months. To make a reliable repair take an inch of thin, flexible insulated wire, bend it back on itself to make a narrow, half-inch long U, solder one end to the choke/capacitor joints and use the other as a soldered lay-on to the board. The U acts as a shock absorber between the heavy choke/capacitor and the board, preventing them tearing themselves off in the future. **H.A.**

Ferguson 3V29/JVC HR7200

This machine had an intermittent drum servo problem. There were no abnormalities in the waveforms on the servo boards but the tracking control had no effect. Transistor Q9 had 5·5V at its base, implying that it was in the search mode. This switching transistor is controlled by the voltage at pin 12 of the IR2403 chip IC4, where the reading was 0V. Pin 5 is the relevant input, which receives the search command from system control. The reading here was 6V. When pin 5 was disconnected it was clear that this voltage was coming from within IC4. A replacement chip (M54519P) restored Q9's base voltage to 12·5V. R10 and R207 were then readjusted as per the instructions in the manual. **R.A.**

Ferguson FV31R

The complaint with this machine was that it wouldn't tune to the local channels. On test we found that although all other functions worked correctly there were problems when the machine was put in the channel preset mode. The tuning display counted up through the channels numbers, but the monitor didn't display any sound or vision and the tuner wouldn't lock on to any of the channels as it passed through them.

After removing the case and raising the top PCB we took the screening cans from above and below the tuner/i.f. section and examined the area carefully for print cracks, dry-joints etc., something that's common in this range of machines. Everything seemed to be o.k. this time however. So checks were made at the tuner's base pins where we found that the tuning voltage (pin 11) was missing. We moved back to the tuning control transistor TT12, whose collector voltage was at 0V, then to pin 9 of the TD6316AP tuning control chip IT20 where the voltage was 3·2V. This was turning TT12 fully on, hence the absence of its collector voltage. A new TD6316AP chip restored correct tuning. **J.C.P.**

Sanyo VHR135

The complaint with this machine was that it wouldn't do more than two or three timed recordings in sequence. I called at the house and set it up to do five two-minute recordings at two-minute intervals. It went through the sequence without error, so I came to the conclusion that the problem was caused by operator error. I set up a further sequence of half-hour recordings and left to make other calls.

When I returned in the late afternoon the machine should have been half way through its last recording period. Instead it was off and the cassette had been ejected. On questioning the customer I discovered that on occasions when a blank cassette was inserted the machine would go into automatic play as though it was a protected cassette. Light dawned. The record protection switch looked o.k. and produced a good continuity reading when operated, but I fitted a temporary link across it and asked the customer what programs he wanted to record that night. I set up a full six timed recordings and warned the customer that the protection circuit wouldn't operate until I came back.

The following day I found that all six items had been recorded without problem. Obviously dodgy switch contacts persuaded the machine, when it had been in operation for some time, that a protected cassette was loaded – hence the eject. Removing the link and cleaning the switch contacts restored normal operation, but to be on the safe side a new switch was ordered and fitted. **J.C.P.**

JVC HRS5800

The remote control system worked all right but the on-deck controls didn't operate. There was also no change when the audio/mix switch was operated. IC1 was at fault – one of its scanning ports was down. **S.B.**

JVC HRD4700

This machine produced noisy pictures intermittently. The symptom looked like head clogging, but this wasn't the cause of the fault. I had to replace the lower drum assembly because of a problem with the ribbon cable that carries the signals to and from the heads. **S.B.**

Ferguson 3V42/JVC HRD455

"Won't accept a tape" the note said. The cause was failure of one or both of the cassette detect microswitches on the cassette housing. I decided to replace them both. **S.B.**

Sentra VX8400/Alba VCR5000/6000X

For no drum rotation check IC506 (BA6411) by substitution, especially if the print is discoloured and it looks as if the chip has been overheating. **M.Dr.**

Sharp VC9300

After fitting a new switch on the cassette housing and servicing the deck we found that the capstan motor would slow down intermittently. The cause was eventually traced to a dry-joint on the f.e.t. Q705. **M.Dr.**

Sharp VC9300

When we plugged this machine in the capstan motor ran for a couple of seconds then stopped. In the past we've had problems with the STK5725 power supply regulator I9002, so this is where we started. Its 13V and 18V outputs were o.k., but the 11V output at pin 1 was missing although the 12·7V input was present at pin 2. We next found that the power control input at pin 3 was permanently high: it should be low for power on. Shorting the base of Q9003 to chassis via R9021 brought some life back to the VCR. The power-on low signal comes from pin 24 of the main microcontroller chip I5002. Checks here showed that the 5V supply at pin 64 was missing. This comes from regulator transistor Q5002, whose 13V collector supply was missing. Yet the 13V rail was o.k. at the power supply end.

The syscon PCB in this model uses double-sided print. The track to Q5002's collector is on the component side, where the fault lay. Q5002 and the surrounding components were covered in brown glue that holds a passing bunch of wires. When we'd removed the glue we found that the track to Q5002's collector had been eaten away. A fine-wire link restored normal operation.

Now how's this for coincidence? A week later the same dealer brought in another of these machines, this time with a clock fault. The time could be set but the colons didn't flash and the clock didn't count. A check at pins 2-3 of I5002 showed that the 32·768kHz clock oscillator had stopped. We confidently fitted a new crystal but the clock still didn't work. Further checks in this area showed that R5047 (56kΩ) was open-circuit. Guess what? It's underneath the same blob of glue around Q5002! When we removed the glue we found that R5047 was without its leadout wires. A replacement put matters right.

It seems that this moisture-absorbing, corrosive glue is like a time bomb ticking away in these old machines. **M.Dr.**

Hitachi VT11

There was no response from front panel commands, i.e. no play/fast forward/rewind etc., though the machine worked normally when asked to make a timed recording. The remedy was to replace the BA6304 chip that interfaces the front panel to the microcontroller chip. **G.F.**

Samsung VI611/Logik VR950

The problem was no play, with no drum or capstan rotation. We found that there was no 12V supply to the servo panel. Transistor Q2 (2SA634) wasn't switching on because R7 (1·5kΩ) in its bias network was open-circuit. **N.W.**

Samsung SI1260

Failure to record when warm is becoming a common fault. The first report you may get is of poor recording in the LP mode, progressing to no LP or SP recording. It looks as if no signal is being recorded, just noise – as though the machine is off tune. In fact the cause of the fault is lack of the luminance record signal: a scope check at TR3201 will show that it is almost non-existent. Replace C3203 (68pF) which goes open-circuit. **N.W.**

Amstrad VCR4600

There was severe patterning on the TV channels, present only when the VCR was switched off. I suspected the booster module but a replacement made no difference and when the original one was tested out of the machine with a bench supply it proved to be o.k. As the only supply that's present when the machine is switched off is the always 12V line I checked the source of this. C508 (100μF, 16V) on the main panel was low in value. **C.W.**

Philips VR6520

The complaint with this machine was no colour. There was also a hum bar in the E-E mode. Replacing C1103 (1,000μF, 63V) provided a complete cure. **C.W.**

Akai VS22

The power supply in these machines can be a little trying to say the least. This one wasn't too bad however. The complaint was that the clock was out of sync: there were also hum bars on the picture in the E-E mode. I would normally expect to find some leaky transistors and over-heated print, but the cause was simply C6 (220μF, 10V). **C.W.**

Matsui VX820/Saisho VR1200HQ

When the mains supply was connected to this machine the motors gave a twitch and the operate LED came on for half a second. Checks showed that the 12V rail was low at only 3V. It's provided by the series regulator transistor Q02 whose base is biased by R06 (1·5kΩ) and the 13V zener diode D07. The zener diode proved to be leaky. **C.W.**

Grundig VS440

There were no E-E signals, only snow. By using the direct tuning method rather than search tuning the channels could be set in the tuner preset positions but there were still no signals. Checks on the tuner module showed that all voltages were present and correct. The other thing to check here is the I2C data and clock lines. These were at the correct d.c. levels, and pulses were present. Inside the can there's an SDA3202-2 PLL chip. We found that it had no output at pin 18. A replacement restored correct tuning. **C.W.**

Hinari VTV100

There was no playback colour. I checked the VCR section with another TV set and everything was fine. I then connected another VCR and found that the fault was present. After a lot of component replacement and adjustment checks I replaced the 4·43MHz crystal XTL301. This provided a complete cure. **C.W.**

ITT VR3918

The tape was thrown out when record was selected. At last a simple one! The erase prevention switch had become dislocated from the frame of the deck and thus failed to open. This told the microcontroller chip that the tab had been removed. I refitted the switch, using a tiny spot of glue so that it wouldn't fall off again. **C.W.**

Samsung SI1240

In the play mode the video level was fine. In the E-E mode however the picture was negative. A check at test point TP3202 (video output) produced a reading about twice the correct value (over 5V) while the top of the waveform was cut off. Adjustment of the E-E level control VR3205 made no difference. This potentiometer sets the d.c. level at pin 19 of the LA7323 video chip IC3201, but the voltage here didn't change when VR3205 was adjusted. The cause of the trouble was R3218 (2·7kΩ) which was open-circuit. When a replacement had been fitted and the E-E level had been set to 2V peak-to-peak at TP3202 we had normal results in both the E-E and the playback modes. **C.W.**

Finlux VR3300

The fault was an intermittent video rasp on playback of prerecorded tapes. The r.f. modulator couldn't handle high-content video. **R.B.**

Fisher FVHP5000

There was no playback or E-E picture, the r.f. picture being o.k. We found that there was a dry-joint on D203 which is near the green disc capacitor on the solder side of the bottom PCB. **R.B.**

Sanyo VHR4350/7250

A problem you can sometimes get with these machines is wear of the sub-reel brakes. The cure is to replace the old reels with new modified ones – part nos. 613 126 6148 and 613 126 6155. **R.B.**

Samsung VI710

This unit was dead. A check on the 30V supply at pin 10 of CN101 showed that the voltage here was low. The cause was that R109 (4·7kΩ) which biases the base of transistor Q102 was open-circuit. **R.B.**

Hitachi VT35

There was no clock display because R2711 (22Ω) on the back-up supply PCB was open-circuit. **R.B.**

Fisher VHFP5100

If there are no remote-control functions try fitting a three-core mains cable. If this doesn't cure the fault replace IC151. **R.B.**

Hitachi VT11

There was no E-E picture – but if playback was pressed the E-E instead of the playback picture came up. Voltage checks showed that the PB 9V supply was missing. We found that transistor Q905 was short-circuit base-to-collector, a replacement restoring normal operation. **R.B.**

Sharp VCA105HM

This machine badly damaged tapes because the loading arms/guide poles didn't return to their correct rest position when unlacing was complete – they sat directly below where the tape emerged from the cassette's flap. The timing between them and the sector gear was one tooth out. Retiming provided a cure but the gear had to be replaced as it was damaged. Following advice in a letter in the December issue I also replaced the back-tension post lever and gear – it's concievable that this was the root cause of the problem. **N.B.**

Panasonic NVJ30B

This machine, which uses the G mechanism, refused to accept a cassette because the capstan motor didn't move – with this deck front loading is performed via a rack that's driven by the capstan motor. Checks around IC2101 showed that the 12V supply was present but the 5V Hall bias supply was missing. In fact there was no 5V supply throughout the system control circuit. It comes from the 2SD1330 regulator transistor Q1102 which read perfectly when tested cold but went open-circuit under load. **N.B.**

Panasonic NVJ42/7/F55

Failure to transmit is a very common problem with the remote handset/scanner unit. The cause is a very high-resistance IR emitting diode. Another point is that the front flap is weak – it's easy to replace.

An interesting point is that the VideoPlus handset supplied with the brand new NVSD30 will work in the VideoPlus mode with all modern machines that use a scanner handset – while the scanner handsets will work with the NVSD30. **N.B.**

Sharp VC651HM

A cassette was jammed inside with the machine fully laced. This was unlike the more usual case where the deck can't shuffle because the reel idler is faulty. The cause of the trouble was a faulty loading belt. This would normally prevent completion of loading rather than prevent unloading. **N.B.**

Satellite Notebook

Nick Beer

Here we go again: my apologies to those who have missed the column because of its intermittent appearance in recent months. My workload has been particularly heavy and on top of that I've been moving house.

Astra Channels

The two Spanish Sogecable channels Cinemania and Documania, which are financed by Canal Plus, are now using Nagravision encryption. The sound is also encrypted, which can be irritating when you step through the channels as it produces a high-pitched, high-level squeak. It sounds very much like the system (SAVE) used by BBC World Service and Bravo on Intelsat.

Screensport's merger with Eurosport started off with the combined service using two transponders: subsequently Screensport's transponder on the 1A satellite was taken over by the German RTL2 channel. Vox took over Lifestyle's transponder when this channel ended. The predominantly sports channel DSF has taken over TELE5's transponder.

Series 07 Sky Cards

The reason for updating Sky's premium service subscription cards from series 6 to series 7 relates to the future use of a PPV (pay per view) facility. When the new cards are inserted from cold a twin line display of P, T and several 0s appears, giving a clue to the new facility.

It seems that some later Amstrad IRDs produce this display at regular intervals, apparently because the unit's system control strobes the authorise button.

A number of Sky subscribers have criticised the introduction of these new cards, complaining that little explanation was given as to when they should be used and why. Now I know that they should have seen Sky's numerous announcements on its premium channels, or simply swapped cards on receipt of the new ones, but many didn't. When they got "this channel is blocked" on the screen they simply phoned us! The announcements themselves alarmed some of our customers who thought they'd be cut off if they didn't do something within the next half hour. All in all the change was not well handled.

The Marconi Solo LNB

I've had several faulty Marconi Solo LNBs recently. A typical case was with a relative who had bought a Pace system with Lenson Heath dish and Solo LNB. Could I install it? Of course! All went well until I found that I couldn't set the i.f. offset for noise-free operation with both signal polarities. Horizontally-polarised signals produced terrible results at best. I altered the orientation of the LNB at the end of the arm - it should have been perfectly o.k. where it was. This improved matters, and some further mini-tweaking brought good results. But it was far too fussy. I warned my relatives and said that I couldn't do more as I didn't have a spare LNB with me.

Within days I was back out there with the same problem. A new LNB set up with no fuss whatsoever and has been fine for a couple of months.

The other problems have been of a similar nature.

Receiver Faults

We had a problem recently with a Cambridge RD480 receiver. Some months previously I'd replaced the LNB because of its very low output. On another call the saddle clamp that holds the LNB to the arm of the Lenson Heath dish had cracked. We've had this problem on two or three occasions. It meant that the LNB swung freely in the breeze. If left much longer it would have fallen from the clamp and been left suspended from the end of the coaxial cable. This time I called and found that reception was very weak though the incoming signal from the LNB was fine. So the receiver was faulty. We have to return these receivers to the distributor for service, so I can't tell you what was wrong. My guess would be a low-gain tuner.

A Ferguson SRV1 that came in had very much the same problem – extremely low output from the tuner. Nothing new about that, and the capacitor replacement won't cure this one. Unfortunately MCES doesn't rebuild this type of tuner, but a replacement is not prohibitively expensive.

No sound was the fault with a Ferguson SRA1. This mono-only unit doesn't use the U2829B f.m. demodulator chip that gives regular trouble with the SRA1S and SRV1, and checks showed that the sound signal went missing prior to the detector chip. In fact there was no output from the preceding ZTX314 sound i.f. amplifier transistor Q33. Shunting a suitable capacitor across its base and collector connections restored the sound. The cause of the problem was that the chassis end of the transistor's 220Ω emitter resistor R161 wasn't being earthed because of a break in the print.

This particular receiver hadn't had any of the modifications done to it. I carried out the power supply kit and the IR amplifier screening modifications. Most of the bulbs were open-circuit as well, and every pin of the mains transformer was dry-jointed – bet you wouldn't have guessed that!

Another of these receivers came in with black goo oozing through the vents in the top of the case, just above the mains transformer – much to the owner's horror. But remember that there is no heat problem with this model – Ferguson told us so.

Dealer Support from Pace

Some months ago Bill Fraser told me about a technical newsletter that Pace was preparing for service departments, to be distributed in the first part of 1993. It duly appeared and many of you will probably have seen it. Well worthwhile: the publication is packed with technical hints and fault cures.

We had returned and had replaced a number of newish PRD800/900s because of no on-screen displays. The newsletter confirms that this is a known problem with a cure – fit a different crystal and change the two loading capacitors, or simply replace the original crystal using the same type. Part numbers and explanations are included.

This is just one example of the useful information provided. Unlike so many of its competitors, Pace is clearly not afraid of providing us with information. The newsletter is an invaluable aid for those who service Pace products or their clones (Ferguson, Philips, Nokia, Bush, Alba etc.).

Panasonic's Digital TV Chassis

Ray Meadows

The first two TV models from Panasonic to use digital signal processing are the TX25W3 and the TX28W3. They are fitted with Panasonic's new Euro 1 chassis. The change from analogue to digital signal processing has been adopted because digital technology offers advantages in terms of performance, user features and cost. From the servicing point of view several built-in aids mean that repair of a digital TV set will not be as daunting as might at first be thought.

Resolution

Performance has been a problem with previous digital TV chassis, largely because of insufficient video data signal bit resolution. Seven-bit resolution has generally been employed to date. The Euro 1 chassis uses a new custom chip, called a Digital Features Unit (DFU), which has been developed by Matsushita in conjunction with ITT-Intermetall. It employs eight-bit resolution for both the luminance and chrominance signals, giving a vast improvement in the detail seen on the screen and a similar reduction in "contouring", which has always plagued digital video. Superior picture quality is obtained through the use of advanced digital comb filtering, noise reduction and other techniques. The audio signal is also processed digitally, using fourteen-bit resolution.

Features

The features familiar with the previous Alpha 3 analogue chassis are all available along with some new ones. Features that the customer sees are four AV links, Artificial Intelligence (AI) and on-screen menus.

The AV connectors are as follows:

AV1: Scart socket with full RGB and AV inputs/outputs.
AV2: Scart socket with AV in/out, monitor out and YC in (S-VHS).
AV3: S-VHS input via a Hoseiden connector and audio input via phones. Continental D2-MAC models also have an S-VHS output.
AV4: AV phonos and S-VHS Hoseiden input on the front panel.

AI, or 'scene control' as it is also known, provides active picture contrast adjustment to make full use of the screen's dynamic range. This task is performed within the DFU chip. The circuit continuously monitors the maximum, minimum and average values of the video signal over thousands of picture points. This is relatively easy to do once the signal is in digital form, since every pixel has a numeric value.

The effect of this processing is to maximise the contrast, improving the definition with overly dark or bright scenes. By maintaining the average luminance level while expanding at each side of this within the limits of peak white and the black level, undesirable pumping effects are avoided.

AI can be set to three conditions: normal (on), dynamic and off. The dynamic position is useful mainly for demonstrating the system to customers, as the dynamic to off change is the most readily apparent one. Incidentally AI has no effect with a test pattern where the signal varies from black to peak white.

The on-screen menus allow AV output selection, i.e. TV, AV1, AV3, AV4 or monitor, very useful for video editing.

Picture noise reduction and ambience selection are also available. In addition the picture aspect ratio can be preset to 4:3 or 16:9 or left in the 'auto' mode, in which the ratio is set by the level of the switching voltage at pin 8 of the scart sockets.

Continental variants of the chassis allow for on-screen language selection while satellite-equipped sets additionally have AV1's output selectable for use with descramblers, and D2-MAC, language and subtitle preference selection.

Internal features include a digital chroma transient improver, a digital luminance transient improver and a digital comb filter. The tube is a black-line super type.

Previous Panasonic models released in the UK have not incorporated colour transient improvement circuits because of the undesirable side effects they can introduce, namely colour-luminance registration errors (C-Y delay) and the effect that noise can have on the process. The digital CTI system works very well however, as can be seen by studying a pluge pattern with a 2T pulse.

The comb filter is also 'intelligently' controlled, so that dot crawl on horizontal transitions between h.f. luminance and chroma information is minimised.

Because of the extensive use of digital circuitry these features can be included with little added physical complexity and at relatively little cost. This means that the new models are no more expensive than their predecessors. They should be easier to manufacture and service. As the component count is reduced, reliability should be improved.

Construction

The chassis construction (see Fig. 1) is much simplified in comparison with the Alpha 3 chassis used in the W2 series models. Basically the Euro 1 chassis consists of a main analogue mother board and a plug-in digital pack. A few smaller boards are used for the front panel controls, sockets and of course the c.r.t. base.

The main board (E-PCB) contains the power supply, the field and line output stages, the audio amplifiers, the tuner and the i.f. module. All processing between the i.f. module and the output stages is carried out in the digital pack, board A-PCB, which is mounted in a metal screening can. It contains the signal switching, Nicam, video and audio processing, sync and timebase generator/driver sections. The AV switches and rear panel sockets are also on this panel. The majority of the chips it uses are from the ITT Digit 2000 series and are surface mounted.

Continental variants of the chassis use basically the same boards but may omit the Nicam chip or add a Secam processor. They may also have a different i.f. module. With satellite and picture-in-picture equipped models an extra panel B-PCB is fitted inside the same shield case as panel A-PCB.

The first thing one notices when the back cover is removed is the reduced number of interconnecting cables in comparison with previous Panasonic models. As with its predecessors, the Euro 1 chassis is put in the service position by hooking it on to clips near the back of the left speaker enclosure. This provides easy access to the conventional analogue circuits on panel E-PCB. To work on the digital pack the shielding case has to be removed. The A-PCB can then be probed from the top side. Extension cables are required to operate the set with improved access to the rear of the A-PCB. They are available as part of a service kit.

Also available is a surface-mount repair kit which contains various cutting and removal tools plus a gas soldering iron with special surface-mount soldering tips. A memory pack which plugs into the AV2 connector and a service remote control unit are also available – more on this in a moment.

Service Modes

As an aid to servicing, the Euro 1 chassis has several service modes that can be entered only by the service engineer. They are all protected against accidental customer operation because a combination of keys has to be depressed. For example to enter the basic service mode 1, which is used to adjust the scan sizes, picture geometry, colour reference oscillator, colour temperature etc., you first adjust the audio controls on the set simultaneously for maximum bass and minimum treble then depress the remote control text reset button whilst at the same time depressing the volume down button on the set.

Service mode 1 then appears and each function can be selected by using the remote control unit's red and green flof keys. Updown adjustment of the settings is done by using the yellow and cyan keys. The new setting must then be stored by using the tuning store button 's' on the TV set, otherwise moving on to the next item will result in the new value automatically reverting to the old one.

The service manual shows typical normal values, but these will vary slightly from set to set depending on screen size and the tolerances of the analogue components.

The first service mode 1 option enables all the preset program positions to be memorised in an external memory pack or, conversely, to be loaded: the memory pack must be plugged into the AV2 connector before the set is switched on and the service mode is entered. This is useful when a dealer has to tune large numbers of sets to the same channels – one set's presets can be learnt and transferred to all the others. There's a similar function in service mode 2, enabling a set's adjustment settings to be stored or copied. All the other adjustments in mode 1 can then be stepped through and adjusted if necessary.

Service mode 2 is entered from the last option of service mode 1 by pressing the text hold button. In this mode option bytes that define the set's characteristics appear, hardware permitting. These are best left alone, otherwise the software may be led to believe things that the hardware doesn't!

Leaving the service modes resets the receiver's customer presets to their last stored condition – including the bass and treble settings. Note that the surest way to hard reset the receiver is to turn off at the mains switch.

Other service modes enable basic fault diagnosis to be carried out, even with a dead set, by flashing the standby LED at different speeds. It's thus possible, by using different remote control keys, to find out on which internal bus a fault is present.

When the remote control unit's off-timer button is pressed at the same time as the set's volume down button, another self-check mode shows numerical values on screen for the main components. They can then be checked against the values specified in the service manual. After leaving this mode the user presets are all reset to the factory positions.

Finally, fixed-mode operation forces the receiver into the PAL, NTSC or modified NTSC mode. This requires the use of the service remote control unit which has one extra button compared to the standard unit.

Apart from these adjustments via the service modes the only adjustments available in the set are focus, c.r.t. cut-off and screen (first anode voltage) – the latter two are used in conjunction with service mode 1.

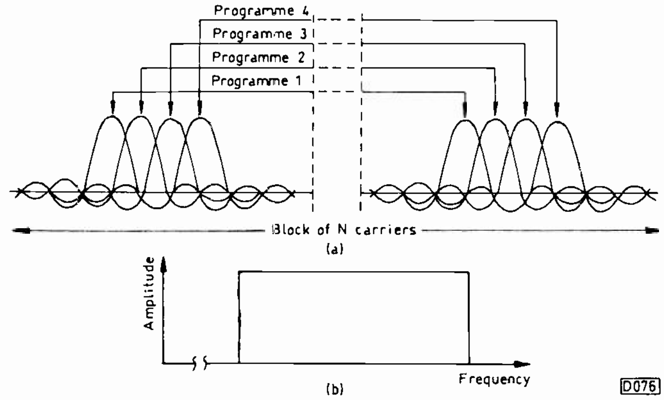


Fig. 1: The Panasonic Euro 1 chassis – positions of the main items.

Repairs

The main E-PCB panel is of conventional construction, using leaded components. Most of the semiconductor devices are fitted to heatsinks with snap-on retaining clips that are easy to remove. Replacement of semiconductor devices should rarely be necessary however as the set is protected by over-voltage and excess-current circuits in the primary side of the power supply and fuses in the secondary side.

Some of the more important supply lines, such as the 5V supply for the digital circuitry, have series-regulator circuits that use a field-effect transistor as the series element. The reason for this is the low voltage drop across the device. Thus in the worst possible case, an internal short between the input and output of the series element, the output voltage increase can be only small. This is important if you think of all the digital chips that are powered by the 5V supply: a voltage rise to 6V is not as catastrophic as a rise to say 12V, which could happen if a conventional regulator shorted internally.

The a.c. mains input glass fuse is on panel P-PCB along with the mains switch and the mains filter. The four internal supply line fuses are positioned near the centre of panel E-PCB. They are of the black, vertical Siemens type.

The idea of fault-finding on digital panel A-PCB, where the signal processing takes place, may worry some service engineers. By using the service modes described above and referring to the service manual it should however be relatively easy to isolate the bus on which the fault is present and thus the suspect chip. The recommended process is then to cut the chip's legs with a scalpel, remove the body and desolder the pins from the PCB. Most of the passive components on this panel are of the surface-mounted type, as are many of the components in the vision i.f. pack and on the c.r.t. base panel.

In Conclusion

In the past digital TV chassis have been notoriously unreliable, have performed poorly and been difficult to service. Time alone will judge the reliability of this chassis. But if performance and serviceability are anything to go by we should have few problems.

Future articles will look at the circuitry used in the chassis.

Test Report: Maxcom All-In-One

Eugene Trundle

It's seldom that a new concept in electronic test equipment comes along, especially one that's aimed at our side of the industry. The Maxcom Model MX9000 thus seemed to be well worth investigation. It's billed as an "all-in-one" instrument. Though not quite that it does encompass in one case a triple power supply, a signal generator, an eight-digit frequency counter and a digital multimeter with comprehensive facilities. They are all independent of one another, both in terms of functions and electrical connections.

It thus seems to be able to provide, in conjunction with an oscilloscope, all the test and measuring functions required in the day-to-day servicing of consumer audio, video and TV equipment. I discovered that it's also a very good teaching aid and demonstrator, but more on this later. In addition to spending some time in daily use on the bench it was examined internally and all its functions were given an intensive test. For specifications see Table 1.

I started by reading the user's instruction book. This is well written and easy to understand but does, with a few spelling and syntax errors, betray its Korean origins. Its 33 pages provide full operating and safety instructions but there's nothing on calibration, alignment or applications. The circuit diagram and parts list are in a separate manual – see later.

Signal Generator

The signal generator (the manufacturer prefers to use the phrase function generator) is particularly useful for audio work, providing sine, square and triangle waves at frequencies of 0·02Hz to 2MHz. Its four-turn rotary vernier control can be precisely set by pressing a button for readout in the frequency counter department. On test it met all its specifications easily and provided a rich variety of waveforms for testing logic circuits, filters of all sorts, servos, audio amplifiers – even loudspeakers. I found that the internal sweep (up to 100:1, lin/log selectable) and the control-by-external-frequency facilities are excellent for checking many of these.

This section of the instrument is outstanding for teaching and student demonstrations, providing a clear way of showing clearly such diverse things as switch-mode power supply operating principles, frequency modulation, loudspeaker response and resonance, the audible effects of distortion and many others.

An excellent, accurate tool and toy!

Frequency Counter

The frequency counter is in the top centre section of the front panel. It has an eight-digit LED readout, 100MHz capability and a gating time of up to 10sec. I found the red LED display easy to read in anything short of direct sunlight and the sensitivity adequate. Its performance in the presence of spurious signals (hum, hash) is comparable with that of the stand-alone Leader counter we use here, and I've always been happy with this item. The hold facility is useful for comparison tests, and there's an auto key that resets the counter to a standard mode of range 100MHz with a 1sec gateing time. All very good.

I was however disappointed with the counter's accuracy when I checked it against two references inside a colour TV set tuned and colour-locked to a BBC studio broadcast – 8·867238MHz (twice the colour subcarrier frequency) and 15,625Hz (the line frequency). The error averaged 25 p.p.m., way outside the quoted tolerance of 1Hz + 1 digit + TB error (5 p.p.m.). I'm sure that this was purely a matter of factory setting. Indeed I saw, but didn't touch, the crystal trimmer within the unit!

Digital Multimeter

The digital multimeter's specification and performance are adequate rather than spectacular. It's an autoranging type with a 3·5-digit LCD readout and a hold facility for comparison checks.

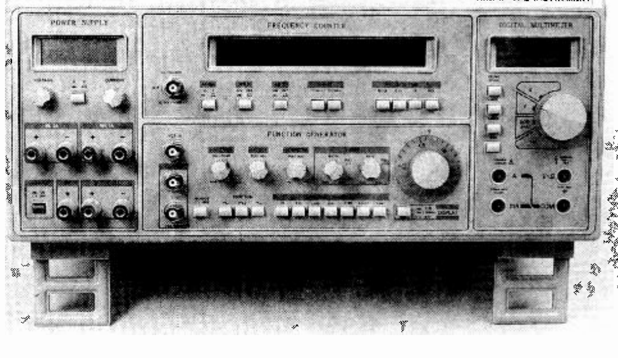
It met its not very demanding accuracy specifications in all modes and ranges. A higher resistance range than 2MΩ would have been welcome: many inexpensive and hand-held DMMs reach up to 20MΩ – mainly required for TV work. Two features of the resistance test facility are very good: the 'lo-Ω' mode for checking components that are shunted by a semiconductor device, and the '-MEM' switch for cancelling a standing resistance present such as that of the test leads and prods. These both make life easier! The DMM terminals are isolated from the rest of the instrument, permitting for example current readings in either leg of any of the power supply section's outputs.

The only drawback I found with the DMM is the difficulty in reading the display under most workshop lighting and bench conditions. Unless the display is viewed dead level the unused bits appear as shadows that are strong enough to confuse.

Power Supply Section

The power supply section provides three separate outputs: a fixed 5V/2A output for powering logic/digital circuits, a fixed 15V/1A output for analogue circuits and a variable 0-50V/500mA supply for general use.

I measured the two fixed outputs at 5·01V and 15·1V, dropping to 4·98V and 15·07V at the full rated loads of 2A and 1A respectively, with no more than 1·5mV of ripple on either of them. So full marks for stability and regulation.



The Maxcom MX9000 All-In-One instrument.

Foldback (constant-current mode) occurred at 3·35A and 1·99A respectively, well over the full rating but helpful in practice and harmless if not sustained. I would rather have had 12V than 15V, but there you are.

I was able to set the 0-50V variable supply within 500mV quite easily with the four-turn potentiometer provided, and the 3·5 digit LCD readout was sufficiently accurate for all my uses, with respect to both voltage and current. This supply had less than 1mV of ripple at 100Hz and was so well regulated that it dropped by only 100mV between zero and full load. I found it particularly useful for providing a tuning supply for a varicap tuner and 30V for a fluorescent display and for memory chips, as well as the more usual l.t. feeds. The only drawback was the over-current trip system. Whenever it trips out – this one went at 545mA – the only way to reset it is to turn the whole instrument off and on again. It's also difficult to set the current limit control, which instigates the trip action at any required level up to 500mA. I would have preferred a calibrated or meter-presettable limiter and foldback current limiting.

As all three power supply outputs are separate they can be connected in series using patch leads to give for example 20V at 1A, 20-70V at 500mA or ±5/15V at 500mA.

Construction and Accessories

The MX9000, which is finished in light grey, is a beefy instrument that's comparable in size and shape with a bench oscilloscope. It's not intended to be portable. The steel and plastic case is strong, but the front support legs are rather flimsy.

Inside the unit there are separate mains transformers for internal powering and for the power supply section. The functional parts are spaced well away from the heat-producing power sections. With the exception of the frequency-counter, which is built on a fibreglass panel, SRBP boards are used. The build quality is as good as in any instrument I've come across in the relative price range.

The test leads are of good quality but may need to be supplemented with an oscilloscope-type probe for the frequency counter and some banana-plugged patch leads for the power supply and DMM.

Conclusion

This combination of four test instruments in one package is a good one that offers excellent value for money: separate instruments of similar specification would cost over £400, so the saving is plain. The unit is very useful in the TV/video/audio workshop, is excellent for colleges and educational purposes, and is a good checker/calibrator for experimental, design and test work with transistor and i.c. circuits and modules.

Although a few critical comments have been made in this review they are not that important when you consider the very reasonable price of this unit in terms of its comprehensive facilities and specification. I would not hesitate in recommending it to all but the most exacting and deep-pocketed technicians!

The Maxcom MX9000 is available at £216.61 plus VAT (one-two off trade price) from CPC, 180-200 North Road, Preston PR1 1YP (telephone 0772 555 034). It has a one-year guarantee. A service manual/parts list and spares can be ordered from the supplier. My thanks to CPC for the loan of the review instrument.

Table 1: Abridged specification.

SIGNAL GENERATOR

Waveforms: Sine, square, triangle, skewed sine, ramp, pulse and TTL square.
Frequency: 0·02Hz-2MHz in seven ranges.
Amplitude: 2-20V peak-to-peak.
Sweep: External/internal, 20msec–2sec,width variable to 100:1, lin/log law.

POWER SUPPLY

Output 1: 0-50V, 0-500mA, 1mV max. ripple. Current limit trip. Display 3·5-digit LCD for voltage and current.
Output 2: 5V fixed, 2A max., 2mV max. ripple. Current limiting, 3A foldback. Lamp display.
Output 3: 15V fixed, 1A max., 2mV max. ripple. Current limiting, 2A foldback. Lamp display.

DIGITAL MULTIMETER

Display: 3·5-digit LCD.
Ranging: Auto.
D.C. voltage: Five ranges to 1kV, accuracy ±0·25% + 2 digits on the 200mV range.
A.C. voltage: Four ranges to 750V, accuracy ±1·2% + 3 digits.
D.C.: Two ranges to 10A, accuracy ±1% + 5 digits.
A.C.: Two ranges to 10A, accuracy ±1·5% + 5 digits.
Resistance: Five ranges to 2MΩ, average accuracy 1% + 4 digits.
Input impedance: 10MΩ.
Features: Overload protection, hold, high/loΩ, memory mode.

FREQUENCY COUNTER

Display: 8-digit LED.
Range: 1Hz–100MHz.
Resolution: 0·1–100Hz.
Sensitivity: 15–30mV r.m.s.
Gate time: Five steps, 10msec-10sec.
Accuracy: ±1Hz ±1 digit ±TB error.
Timebase: Frequency 10MHz.
Stability: Initial 5 p.p.m. ±5 p.p.m./year.
Input impedance: 1MΩ/100pF.

GENERAL

Power: 115/230V ±10%, 50/60Hz, consumption 120VA at full load.
Physical details: Size 375 x 160 x 340mm, weight 11kg.
Accessories provided: Power cord, fuse, instruction book, test lead and coaxial cable.

A Visit to Pace MicroTechnology

Nick Beer

Following various comments of mine on the subject of satellite receiver reliability I received an invitation from Bill Marshall, Pace Micro Technology's Service Manager, to visit the company and see it in action – from receiver design to servicing. Bill has since left the company, his replacement being another Bill – Bill Fraser.

It's not often nowadays that you come across a high-technology consumer electronics manufacturer in the UK with virtually all its operations under one roof. Pace subcontracts out only PCB manufacture, though a plant is being built so that much of this can also be done in-house. In addition to IRDs for the UK market, Pace's satellite product range includes non-IRD receivers, D2-MAC receivers employing Eurocrypt, and positioners. It has a considerable share of the Continental market for these products.

Bill Marshall acknowledged that there had been one or two weak points in earlier receivers. Because of time limitations with the introduction of the first receiver, Model SS3000 (Ferguson SRA1), a linear power supply that was more hurriedly designed than the company would have liked had been used. We all know what the outcome of this was: a heavy PCB-mounted transformer that becomes dry-jointed and has been know to melt, regulators riveted to heatsinks that were rather too small, and so on. The encouraging thing is that Pace learnt its lessons. The SS6000 (Ferguson SRA1S) was in a different class regarding reliability.

Pace also has major markets for its computer/telecommunications modems, and a large section of its building is concerned with this. My main interest however was in the satellite side of the business.

Design and Development

During my tour I visited a very large open-plan area in which design and development work is done. This includes work on software. At the time the PRD800 and PRD900 were in the final stages of development. It was interesting to see work on prototype boards, with engineers sorting out quirks and problems.

Something that was new to me was a PRD900 running with an interface and cable to a desktop PC in place of its microcontroller chip. A very clever engineer was using the keyboard to program the operational software for the unit. Fascinating!

Bill Marshall demonstrated the operation and facilities of the receiver which, as you will know, is menu-driven. I was particularly impressed with its ability to move the r.f. output anywhere within the u.h.f. band, swap preset channels which then shuffle down, and dump stored information from one receiver to another via the scart socket. These features prove that a good deal of thought, based on experience, has gone into the design. The r.f. output facility uses a specially developed ASIC (application specific integrated circuit) video control chip.

When the first units were delivered to us by Eurosat I was able to see that the one or two software anomalies I'd been shown had been corrected.

Cabinets and cases are all designed in-house by Pace. In fact even the boxes, packing arrangements and the instruction and service manuals are designed in that large open-plan area. On the subject of service manuals, it has to be said that many manufacturers could learn a thing or two from Pace on how to produce one.

Quality Control

In one area of the building a group of people unbox and thoroughly test piles of finished products from the factory. The idea is to pinpoint any production weaknesses – anything from a joint being missed during soldering to a faulty batch of components or the instruction book being left out. This area provided a graphic demonstration of the fact that Pace has become a major force in the satellite field. The boxed receivers bore a wide range of company names – Philips, Grundig, Nokia, Alba, Bush and so on. Ferguson was not a Pace customer at the time of my visit, when it was using in-house Thomson made units. Since then however Pace has been supplying the PRD800 as the SRD5 clone.

Back up

There's a workshop where units returned from distributors, dealers and customers are repaired. Several engineers are employed here, but some deal with modems. The layout and appearance of the workshop differ little from a good dealer's workshop. A service network based on the company's distributors is being set up.

Pace provides a telephone technical support service. The engineers that operate it are in a separate office beside the workshop. Their ready access to the workshops, spares stores and designers results in excellent back up for those requiring advice or help.

Spares

The Pace stores department contains just about everything: it supplies the factory as well as dealing with spares orders. No problems then with having to talk to someone in Japan where a unit was designed, or a contact somewhere in Europe where spares are held: instead, there's a direct link between the manufacturer and main dealers. Smaller dealers can order spares through CPC or HRS. Like most manufacturers nowadays, Pace is not able to handle small accounts. Hence the the service provided by CPC and HRS.

In Conclusion

Pace has established a quality, high-technology, go-ahead image. Its latest receivers, with their high quality, reliability and competitive prices, justify this. My visit showed me the effort that goes into ensuring the continued success of the business.

The company has learnt from its mistakes – those previously mentioned for example, and the connector failure with the first IRDs. The commitment to sort out problems quickly and effectively, ensuring that the next generation of products is not similarly afflicted, is something that's not always the case in this industry today.

My thanks to Bill Marshall, his successor Bill Fraser, and the team at Pace Micro Techology for arranging a fascinating and very informative visit and providing so much insight into how things can be done well.

Cowboys: Summing Up

Steve Beeching

Over the past few months the letters section has presented many arguments about who is and who isn't a cowboy.

Someone who does his best to carry out a repair to a standard that would be approved by the manufacturer of the product is most certainly not a cowboy. It doesn't matter whether the workshop is small with one or two technical staff or stands resplendent in an industrial estate, staffed to the hilt. The availability of appropriate test and soldering/desoldering equipment and the training that has been undertaken obviously has a bearing on ability to complete a repair properly: this is taken into consideration by any manufacturer when a service agent is appointed.

Even those who supplement their wages by doing jobs on the side fall outside the cowboy classification – provided they complete repairs without bodging, without creating further faults and without causing unnecessary damage.

So who is this cowboy we all agree exists? It's the person who fails to refit the right screws in the correct places, putting self-tapping screws in threaded holes and vice versa; the person who shorts out circuit protectors and fuses or in any way undermines product safety; and the person who bodges a repair in the misguided belief that he is saving his customer some money. In fact it's the person who fails to repair equipment to the standard required by the manufacturer. The manufacturer designed and built the equipment, so it's reasonable for a manufacturer to insist that repairs are in all respects consistent with the original specification.

A cowboy can exist in any organisation – or be a one-man band. The fact that a service department is small and is run cheaply does not automatically make it a cowboy outfit however. Neither on the other hand should smaller organisations be unduly critical of well-equipped, professional service departments that charge more than they do. The cost of running a more sophisticated service department is high: it follows that the charges made must be higher.

There are two more sinister threats to the cottage service industry. The first comes from manufacturers who are trying to reduce their costs. The second relates to advanced technology.

But first a comment on a letter in the May issue on large and small service departments. Large does not mean profitable. The overheads of a Service Centre are much higher than those of a small, dedicated one- or two-man operation. Premises in a high street or industrial estate location command relatively high rent levels: in addition there are business rates, power and communications costs, wages and vehicle costs. The profit element may be very small as a percentage of turnover. If turnover is high, profit can be significant in terms of actual cash received. As a camcorder repair specialist my own costs in terms of test equipment, special jigs and leads are very high, usually £150-£200 per camcorder model. As I operate from a country location however my rates and other overheads are much lower than those applicable to an industrial estate. But however one looks at it a specialist service centre must charge more to cover the extra costs involved.

One correspondent suggested that a self-employed person may not be able to afford to attend training courses. But this is not true in terms of cost: the time spent is simply another overhead that has to be recouped somehow. Training costs as an overhead are a significant drain on the resources of a competent, qualified manufacturer's service centre, where the need to keep up with ever-accelerating changes in technology and construction techniques is essential to its continued existence.

The Indians

Peter Murchison's criticism of Sony for failing to give technical advice when he in fact sells the company's products is typical of a growing problem. Manufacturers are trying to cut their costs.

To be fair there's increasing concern amongst some manufacturers about the damage to their products and reputations caused by unskilled attempts at repairs and the customer complaints that follow. Because of this such firms are adopting a policy of limiting the number of companies able to attempt repairs. The first step is to withdraw free advice. If the repairer needs detailed advice it follows that he has not attended relevant training courses. The logical outcome of this policy is that eventually only the manufacturer's own service department or an appointed agent will be able to carry out repairs. Withdrawal of advice can be complemented by limiting access to spares.

One problem is that Japanese consumer electronics manufacturers have never before experienced a recession as deep as the present one. They are not sure how to cope with the situation. Some are taking decisions that fail to take into account the British tradition of after-sales service.

Peter also mentioned difficulties with Grundig. At least Grundig has available its Technicover service account. For a £50 subscription the small, one-man band can have a spares account and access to technical advice. All right, so the advice isn't free, but you have the choice of subscribing or not. This is another example of an overhead that leads to increased service charges

Some service companies have found that Hitachi has been closing spares accounts where less than £250 is spent over six months. This is another cost-cutting exercise. As my account was closed I now have to obtain Hitachi camcorder spares from a distributor. For economic reasons many distributors don't stock slow-moving lines – which means that camcorder spares are not stocked in any depth. If I repair an Hitachi camcorder I now have to wait seven-ten days for parts instead of two, and have to pay 45 per cent more. So I tell the owner or dealer "yes, I can repair your Hitachi camcorder but it will take two weeks longer than previously and the cost of spares will be at least 30 per cent more". The customer then makes his decision whether to go ahead or not. What Hitachi seems to have overlooked is that owners will be unlikely to buy more branded equipment for which they cannot get immediate local service. Hitachi is not alone in this respect.

If you have been insulted by a manufacturer who won't supply you with spares or information, I suggest you make the situation clear to the owners of equipment requiring repair. This amounts to negative marketing, which can be more effective than the money manufacturers pour into advertising.

The situation is getting worse, and it's likely that many service people will be forced out of the industry because of manufacturers' withdrawal of spares and service facilities. The reason given is that manufacturers cannot afford to maintain hundreds of small accounts. But we all know that the cost to them will lie in loss of future sales.

Servicing Notes on the Bush 2114

Gordon Haigh

I've had several faults with these Turkish-made delights (?). Here are a few hints. There were a couple of other models in the series, the 2020 and 2321. Models with a T suffix incorporate teletext.

No Results

The power supply circuit is of the familiar self-oscillating chopper type, with a TDA4601 control/driver chip. If there's no output from the power supply, check for up to 340V across the mains bridge rectifier's 120μF, 400V reservoir capacitor C812 and that this high voltage reaches the collector of the BU508A chopper transistor Q801 via the transformer's primary winding. No output from the bridge rectifier should lead to checks downstream on the 4·7Ω, 5W surge limiter resistor R816 and the 3·15AT mains fuse F851. If either has gone open-circuit, check Q801 by making two legs dry or by removing it for resistance checks. Removal is best in any set because there's a low-value resistor across the base-emitter junction – a base-emitter breakdown only can easily be overlooked. Should Q801 have failed, check R808 (270kΩ) which is connected to pin 4 of the TDA4601 chip (IC801): this resistor tends to go high or open-circuit.

If the bridge rectifier is producing 340V or so, check thermistor TH801 and resistor R817 (5·6kΩ, 0·5W). These two items provide a start-up supply for pin 9 of the TDA4601 chip – the voltage at this pin is topped up to about 18V once the power supply comes into operation.

If these items are in order but there's a slight whistle and only meagre secondary d.c. voltages for a few moments are obtained at switch on, check D807 (RGP10J). This diode along with R810 (180Ω, 5W) and C804 (2,200pF) form a snubber network across Q801. A BY228 seems to be a suitable replacement for D807.

A capacitor that causes a fair share of trouble is C818 (1μF, 50V) which dries up. It's the reservoir capacitor for the negative feedback voltage that's fed to pin 3 of the chip via VR801 (set h.t.) and R805. The symptom when it goes open-circuit can be no results with a loud whistling from the chopper transformer. If the transformer seems to be in distress (fizzing etc.) replace C818.

Note the positions of the two separate two-pin connectors before taking off the plastic cage over the power supply. For easy access to the power supply components the metal heatsink frame can be removed by taking out the screw from the TDA4601 chip then slipping Q801 from its clip (take care – Q801 can be at 340V or so though there's a discharge path via R815). As soon as the power supply has been repaired, switch of and replace the heatsink frame.

Here are approximate working voltages at the pins of the TDA4601 chip, taken with respect to the negative terminal of C812: pin 1 4V; pin 2 very low d.c.; pin 3 2·2V; pin 4 2·2V; pin 5 7·5V (higher in standby); pin 6 0V; pin 7 1·8V; pin 8 1·8V; pin 9 18V. There should be 112V across the h.t. reservoir capacitor C810 (note that the associated rectifier diode is fed from the chopper transformer via the contacts of relay RL401). Resistance readings across C810 should be 50-60kΩ one way, 3·5kΩ the other. The reservoir capacitors for the other two secondary supplies obtained from the chopper transformer are C806 and C808. C806 should have 11-12V across it and a resistance reading of at least 450Ω both ways should be obtained. C808 should develop 24-25V, the resistance reading across it being at least 2kΩ both ways.

A digital capacitance meter may show that some of the electrolytics are low, but they are usually o.k. Pay particular attention to C818 though.

Safety resistors in series with rectifier diodes are always worth checking. For example there will be no results should R422 (1Ω, 1W) go open-circuit. This resistor acts as the surge limiter in the 16V supply obtained from the line output transformer. After regulation by the LM7812 chip IC701 the resultant 12V supply is used for various purposes that include powering the TDA2579 timebase generator chip IC401.

Other Fault Conditions

I've encountered a no raster fault at switch on, with the voltages at the collectors of the RGB output transistors Q901/3/5 all reading high. When I come across this situation with any set I usually take a resistor with a value of a few kilohms and connect it momentarily between one of the c.r.t.'s cathodes (or the collector of one of the RGB output transistors) and chassis to see what happens. This sometimes proves that the cause of the fault is field collapse – remember that with many sets the screen is blanked out when there's no field scan. You don't have to turn up the first anode voltage to see this: a disturbed first anode potentiometer has to be reset, and sometimes this cannot be done accurately without a test pattern and a very high-impedance voltmeter. The response with the Bush set was that the picture appeared and stayed there until the set was switched off. It was not present at subsequent switch on. Taking cathode voltage readings on the meter's 300V range also restored the picture.

The c.r.t. biasing arrangements are very simple. There's a complication however in that auto grey-scale tracking is employed. The RGB outputs are linked to the c.r.t. via emitter-followers, each of which is connected to chassis via diode D901. The voltage developed across D901 is returned via a screened cable to pin 18 of the TDA3562A colour decoder chip, which is mounted on a separate subpanel. A borrowed subpanel proved that the TDA3562A chip had an internal fault which was inhibiting the drive to the RGB output stages. The voltage across D901 was only 0·5V instead of the usual 0·8-0·9V.

The TDA3562A chip can also be responsible for loss of colour. Note that it's the Telefunken version of the chip (some other types are not compatible without minor modifications – see previous correspondence in *Television*). Another cause of no colour is R251 (18kΩ) going open-circuit – it's connected to pin 5 of the chip and is part of the colour control circuit.

When there's a command problem, with the push-buttons having wrong effects or misbehaving, the SAA1293 control chip IC1 is suspect. But not with a recent set, which would step channels upwards but not downwards and wouldn't sweep tune. The MDA2061 EEPROM chip IC2 was at fault. An MDA2062 was supplied and worked, the supplier assuring us that it was a substitute. Uncontrollable sound and the display stuck on one channel are typical SAA1293 faults: the set jumping into and out of standby on channel change is a MDA2061 fault.

Failure of the 12V reservoir capacitor C806 (1,000μF, 16V) causes bad patterning.

A vertical black line two inches from the right-hand side of the screen was traced to R419 (470kΩ, 0·5W) being open-circuit. It's in the pulse feedback feed to the TDA2579 chip.

A couple of interesting faults have been reported in TV Fault Finding recently. Geoff Fardon traced the cause of an intermittent blank screen to a dry-joint on C307 (April). This 0·33μF capacitor is in the field linearity circuit, so the field scanning was presumably being closed down. Chris Watton (May) reports that no picture or intermittent picture loss can be caused by poor soldering on the teletext module: the through-the-board links should be resoldered and the soldering to the crystal might also need attention.

Help Wanted

Wanted: Module CMR800 (r.f./i.f. unit) for the ITT Model 1600/1. Loan of the manual for the set would also be appreciated. V. Jeremy, 7 Tai Penyard, Penyard, Merthyr Tydfil, Mid-Glamorgan CF47 0LP.

Wanted: RGB input unit, part no. 760776, for a Barco CM51 or CRM2632 monitor. D. Mountford, Shelsley Villa, Haye Lane, Ombersley, Worcs WR9 0EJ. 0905 22 900.

Wanted: Circuit diagram for the Technicolor type 312E video recorder power adaptor. A. Rogers, 21 Pleshey Close, Thorn Church Meadows, Milton Keynes, Bucks MK5 6EP. 0908 504 657.

Wanted: Service sheet or any other information for the Tech Model T02 scope. It has two valves, a 12BH7A and a 6AV6. Donald Bills, 69 Greenfields Road, Kingswinford DY6 8EG.

Wanted: Panels for a Philips 2020/05 VCR or a complete machine, working or not. B.J. Lawler, 6 Chindit Close, Formby, Lancs L37 2JH. 0704 832 625.

Wanted: Good used A51-230X 20in. tube with scan coils (type FHA90-31) and neck components for the ITT Model CS0514/T (80 series 110° chassis). V. Jeremy, 7 Tai Penyard, Penyard, Merthyr Tydfil, Mid-Glamorgan, CF47 0LP.

Wanted: WYC-P WHD panel and lower drum excluding head for the Granada VHS-AH3 or equivalent (Hitachi VT17, VT19). New or secondhand. J.A. Slimmon, 30 Buzzacott Lane, Furzton North, Milton Keynes, Bucks MK4 1JE.

Wanted: Panels/parts for an Autovox TVC1608-2009/GB (chassis 112). The set takes a while to come on. Does anyone know why? Charlie McLeod Hall, 148 St. Andrew's Road South, Lytham St. Annes, Lancs FY8 1YA.

Wanted: Remote control handset for the Luxor Mk 2 satellite receiver. Peter Clarke, 28 Wentworth Gate, Linton Park, Wetherby, W. Yorkshire LS22 6XD. 0937 582 828.

Wanted a TIS69 f.e.t. for the Hameg HM307 scope. A. Fisher, Complex TV Services, 133 High Street, Princess End, Tipton DY4 9JE. 021 557 6636.

We have for repair a Polish manufactured monochrome set whose only identification is the model no. MTV2451. Can anyone supply a line output transformer for it? A. Slark, 61 Chapeltown Road, Bolton BL7 9NB. 0204 26 684.

Wanted: Service manuals for the Philips VCR Models N1500, N1700 and VR2020. All costs will be paid. T. Martini, 6 Levant House, Mile End Road, London E1 4RB. 071 790 6807 or fax 071 702 8774.

ANSWER TO TEST CASE 367

– See page 647 –

When they finally got to see it, the 'interference' effect that so troubled General Anderson consisted of big blobs of assorted unlocked colours which floated about on top of the recorded picture and playback sound that had no connection whatever with the picture it accompanied. In fact the sound track was that of the previous recording on the same tape while the colour blobs were remnants of the previous chroma signal not erased during the subsequent recording. Though most of the previous luminance signal on a tape is wiped out by the writing action of the heads when a new recording is made, lower-frequency components like the chroma and sound cannot be overwritten in this way: if the erase system isn't working they remain on the tape.

This of course was the problem with the General's machine. Intermittently, the full-erase head on the left-hand side of the deck was unenergised. Now it wasn't one of those ancient JVC machines with a lazy bias/erase oscillator, where fitting a capacitor with a different value restores reliable operation. It does however have a plug/socket connection to the full-erase head. As with so many VCRs, this turned out to be the weak link. Flexing and movement of the joint would produce the symptom – sometimes!

The problem was solved by cutting the flying socket from the wire and soldering the wire ends directly to the head terminations. The General was largely right with his off-the-cuff diagnosis of a loose wire!

Published on the third Wednesday of each month by Reed Business Publishing Ltd, Quadrant House, The Quadrant , Sutton, Surrey SM2 5AS. Filmsetting by Marlin Graphics, 2-4 Powerscroft Road, Sidcup, Kent DA14 5DT. Printed in England by BPCC Magazines Division, Carlisle Web Offset, Cumbria. Distributed by IPC Marketforce, Kings Reach Tower, Stamford Street, London SE1 9LS (071 261 5000). Sole Agents for Australia and New Zealand – Gordon and Gotch (Asia) Ltd., South Africa – Central News Agency Ltd. "Television " is sold subject to the following conditions, namely that it shall not, without the written consent of the Publishers first having been given, be lent, resold, hired out or otherwise disposed by way of Trade at more than the recommended selling price shown on the cover, excluding Eire where the selling price is subject to currency exchange fluctuations and VAT, and that it shall not be lent, resold, hired or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever. ISSN 0032-647X.

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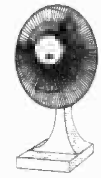

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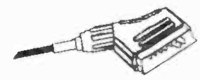

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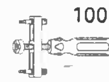

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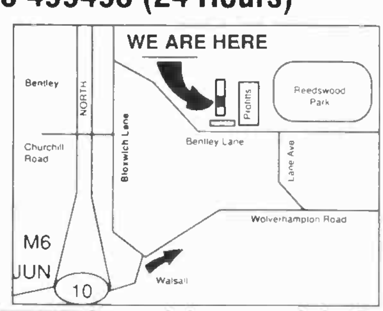

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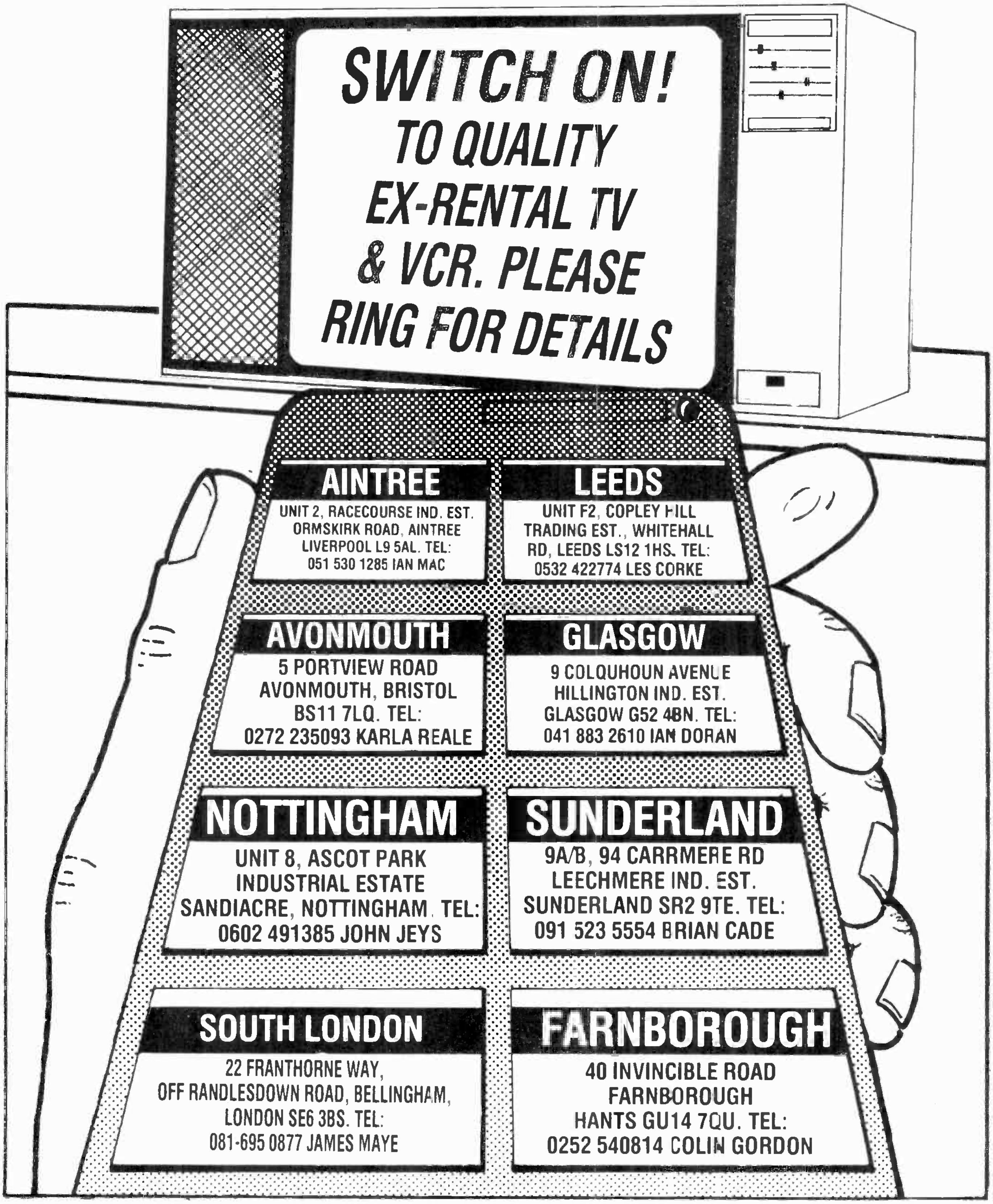

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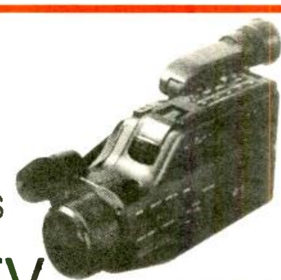

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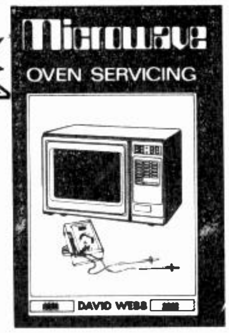

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BU 508A	90p
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BU 705	£1.00
BU 806A	£1.00
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BUK 454/600	£1.00
BU 824	50p
BUT 11	50p
BUT 13 600V-28A	£1.00
BUW 11	50p
BUW 84	60p
BYW 20-08-9	£1.00
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TIC 106a	30p
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TAG 226/600	30p
TIP 29	25p
TIP 30	25p
TIP 30A	25p
TIP 30B	25p
TIP 30C	25p
TIP 31	25p
TIP 32	25p
TIP 33B	50p
TIP 33C	70p
TIP 34A	50p
TIP 34B	60p
TIP 34C	70p
TIP 35B	50p
TIP 35C	70p
TIP 35D	80p
TIP 36	50p
TIP 36C	70p
TIP 41	15p
TIP 41B	40p
TIP 41D	70p
TIP 42	10p
TIP 42/BRC 6109	10p
TIP 48	40p
TIP 49	30p
TIP 57	30p
TIP 100	30p
TIP 102	30p
TIP 110	20p
TIP 115	50p
TIP 117	50p
TIP 125	35p
TIP 126	40p
TIP 127	40p
TIP 130	30p
TIP 131	6p
TIP 136	30p
TIP 140	50p
TIP 142	80p
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TMP47C 634N 2685	£3.00
ST6391 B1/B2 ICC7	£4.00

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BYV 96D	10p
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BPW 41	15p
BYW 56 2A/1000v G11	8p
BYW 29/50	15p
BYW 95C	10p
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2SC3973B	30p
2SC7350	15p
2SD180 TO3 80v/6A	15p
2SD200	£2.00
2SD401	£1.00
2SD716	£1.00
2SD787	30p
2SD789	30p
2SD820	£1.00
2SD868	75p
2SD880	30p
2SD1264	£1.00
2SD1266	£1.00
2SD1415	£1.00
2SD1427	£1.00
2SD1432	£1.00
2SD1576	£1.00
2SD1577	£2.00
2SD1878	£1.00
2SK30A	10p
BFX29	30p
BFX84	25p
BFY50	15p
BFY52	20p
BFY90	25p
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BRC116	25p
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BSY95a	10p
BTY80	20p
BSX19	17p
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FT3055	30p
TCE82	30p
TCE520	30p
2N930	5p
2N2221	8p
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2N2906	10p
2N3055	40p
2N3566	10p
2N3702	10p
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2N3904	10p
2N4355	15p
2N4442	£1.00
2N4444	£1.00
2N5278	20p
2N5296	40p
2N5983	30p
2N6099	40p
2N6109	40p
2N6130	50p
2N6133	20p
2N6348	20p
2N6399	10p
2SA437	20p
2SA673P	10p
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2SC643A	£1.00
2SA992	10p
2SB474	30p
2SB566	10p
2SB686	75p
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2SC381	10p
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2SC491	50p
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R2775=TIP41c	40p
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R4050	£1.00
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BC369	10p
BC384	10p
BC394	10p
BC413	10p
BC414	10p
BC416	10p
BC440	10p
BC454	10p
BC455	10p
BC456	10p
BC460	25p
BC462	10p
BC463	10p
BC478	10p
BC527	10p
BC532	10p
BC546	10p
BC547	10p
BC548	10p
BC556	10p
BC557	10p
BC558	10p
BC559	10p
BC635	10p
BC636	10p
BCX31	25p
BCX32	25p
BD116	25p
BD124	30p
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BD135	25p
BD136	30p
BD138	30p
BD140	30p
BD176	25p
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BD183	70p
BD202	30p
BD204	30p
BD207	60p
BD221	20p
BD222	20p
BD228	30p
BD226	20p
BD233	30p
BD234	25p
BD235	30p
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
BD139	30p
BD439	50p
BD544D	40p
BD650	50p
BD678	30p
BD681	30p
BD682	30p
BD507	50p
BD508	30p
BD509	30p
BD510	30p
BD517	30p
BD519	30p
BD534	30p
BD535	30p
BD544D	30p
BD562	30p
BD610	40p
BD676A	30p
BD807	20p
BD826	50p

BD646	50p
BD933	30p
BD939	30p
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NE555	60p
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SAA1074	£3.00
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SAA1124	£2.00
SAA1174	£3.00
SAA1176	£2.00
SAA1250	£3.00
SAA1251	£4.00
SAA1272	£3.00
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TA7117	50p
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6MHz	
8.867238	
11.059 000	
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TBA540	£1.00
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SN29772BN	£2.00
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SN76018	£1.00
SN76110N	£1.00
SN76115AN	50p
SN76131	50p
SN76141N	£1.00
SN76226	£1.00
SN76227N	£1.00
SN76228N	£1.00
SN76270	£1.00
SN76532N	£1.00
SN76545N	£3.00
SN76546	£3.00
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SN76552	30p
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SN76620AN	50p
SN76666	£1.00
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TDA1012	£1.00
TDA1013A	£1.00
TDA1060A	£1.50
TDA1035SB	£1.00
TDA1072	£1.00
TDA1150	50p
TDA1151	30p
TDA1154	50p
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TDA1180	£2.00
TDA1190	£1.00
TDA1200	75p
TDA1270	£1.50
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TDA1365	£3.00
TDA1512	£2.00
TDA1540P	£3.00
TDA1670A	£2.00
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TDA2003	25p
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TDA2522	£5.00
TDA2530	£1.50
TDA2532	£1.00
TDA2540	80p
TDA2541	£1.00
TDA2542	£1.00
TDA2545	£2.00
TDA2546	£2.00
TDA2556	£1.00
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TDA3565	£3.00
TDA2575A	£1.00
TDA2577A	£2.00
TDA2578A	£2.00
TDA2579A	£2.00
TDA2581	£2.00
TDA2591	£1.00
TDA2593	£3.00
TDA2560	50p
TDA2556	£1.50
TDA2600	£3.00
TDA2611A	£1.00
TDA2611AQ	£1.00
TDA3651A	£1.00
TDA2653	£4.00
TDA2640	£2.00
TDA2593	£1.00
TDA3047	£1.00
TDA3048	£3.00
TDA3083	£2.00
TDA3190	£1.00
TDA3300B	£5.00
TDA3301	£3.00
TDA3505	£3.00
TDA3506	£3.00
TDA3561	£3.00
TDA3560	£4.00
TDA3561A	£3.00
TDA3566	£3.50
TDA3564	£4.00
TDA3565	£3.00
TDA3571A	£2.75
TDA3581	£3.00
TDA3590	£3.00
TDA3591	£1.00
TDA3592A	£3.00
TDA3650	£7.00
TDA3651	£3.00
TDA3651AQ	£3.50
TDA3652	£3.50
TDA3653AQ	£2.00
TDA3654	£2.00
TDA3654Q	£2.00
TDA3710	£3.50
TDA3800	£4.00
TDA3180	£2.00
TDA4260	50p
TDA4501	£3.00
TDA4505N4	£3.00
TDA4420	£2.00
TDA4439	£2
TDA4600	£3.00
TDA4601	£2.00
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TDA8703	£3
TDA9403	£1.50
TDA9503	£3.00
TDB2033	£1.00
TDD1610S	50p
TD6306P	£2.00
TDA1000	£3.00
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SN16964AN	50p
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MJE511	25p
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MJE661	25p
MJE3055	£1.00
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MJE2955	50p
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A1233	25p	BF184	20p
AC106	25p	BF194	10p
AC121	25p	BF195	10p
AC124	25p	BF196	10p
AC128	25p	BF197	12p
AC137	25p	BF198	10p
AC151	25p	BF199	10p
AC131	25p	BF200	20p
AC138	25p	BF222	10p
AC152	25p	BF224	15p
AC153K	25p	BF238	20p
AC142K	25p	BF240	16p
AC169	25p	BF244	40p
AC176	25p	BF245b	20p
AC178K	25p	BF255	20p
AC179	25p	BF256	20p
AC186	25p	BF257	20p
AC188	25p	BF258	25p
ACY21	25p	BF262	15p
AD143	50p	BF263p	25p
AD149	50p	BF264	15p
AF17A	25p	BF271	10p
AF139	25p	BF273	10p
AF181	£1.00	BF274	10p
AF239	25p	BF324	25p
AF367	25p	BF337	50p
AL102	£1.75	BF355	30p
BLY49	50p	BF362	20p
BF115	20p	BF363	15p
BF121	20p	BF367	15p
BF127	20p	BF391	15p
BF137	20p	BF394	10p
BF157	20p	BF419	30p
BF160	20p	BF422	15p
BF161	20p	BF423	15p
BF164	60p	BF448	30p
BF179	30p	BF470	30p
BF180	20p	BF471	30p
		BF597T	10p
		BF694	10p

Thorn Transformers

DT2076/78	£10.00
90D3-035-003	£10.00
90D4-106-003	£1.00
90D3-038-001	£5.00
OT204130	£3.00

I.C.s

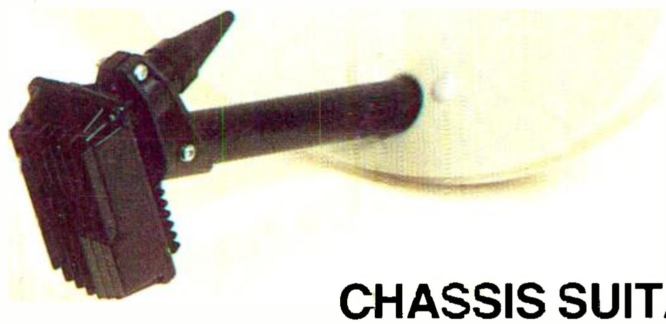
MA721PC	£1.00	UPD1141LC-2	£1.00
M50430-8505P	£1.00	MN1250BJC	£1.00
TD6359P	£1.00	M50441-5505P	£1.00
M58657P	£1.00	M491BB1	£4.00
PCD8572	£1.00	HA513385	£1.00
HD74HC86P	£1.00	14DN 728A	£4.00

DISH AND LNB SUITABLE FOR D2 MAC

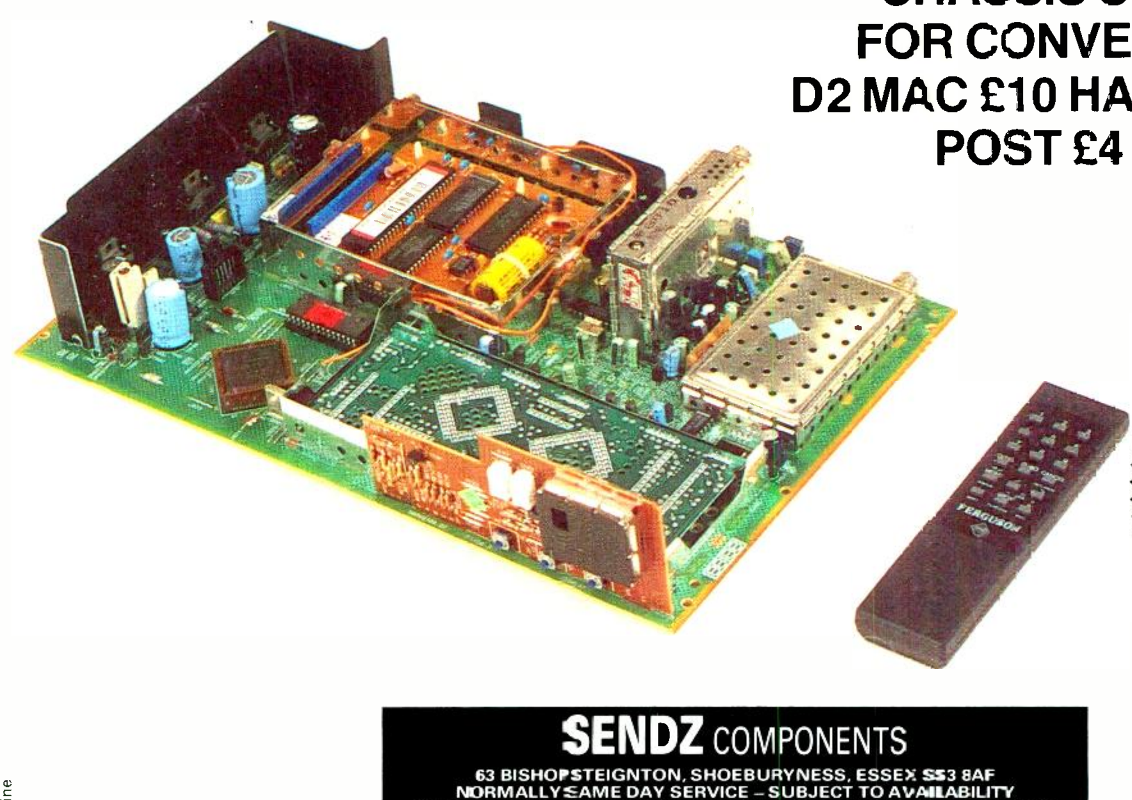
£15

POST £5 + VAT

New Eprom for converting Ferguson BSB Receivers to D2 MAC and PAL – 99 channel is tunable and each one can be put into memory – also has menu. £20
PAL panel (to convert to PAL) £20
SEND FOR DATA.



CHASSIS SUITABLE FOR CONVERSION TO D2 MAC £10 HANDSET £1.50 POST £4 + VAT



MARCONI LNBS 1·2dB NEW TYPE FOR ASTRA £30

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