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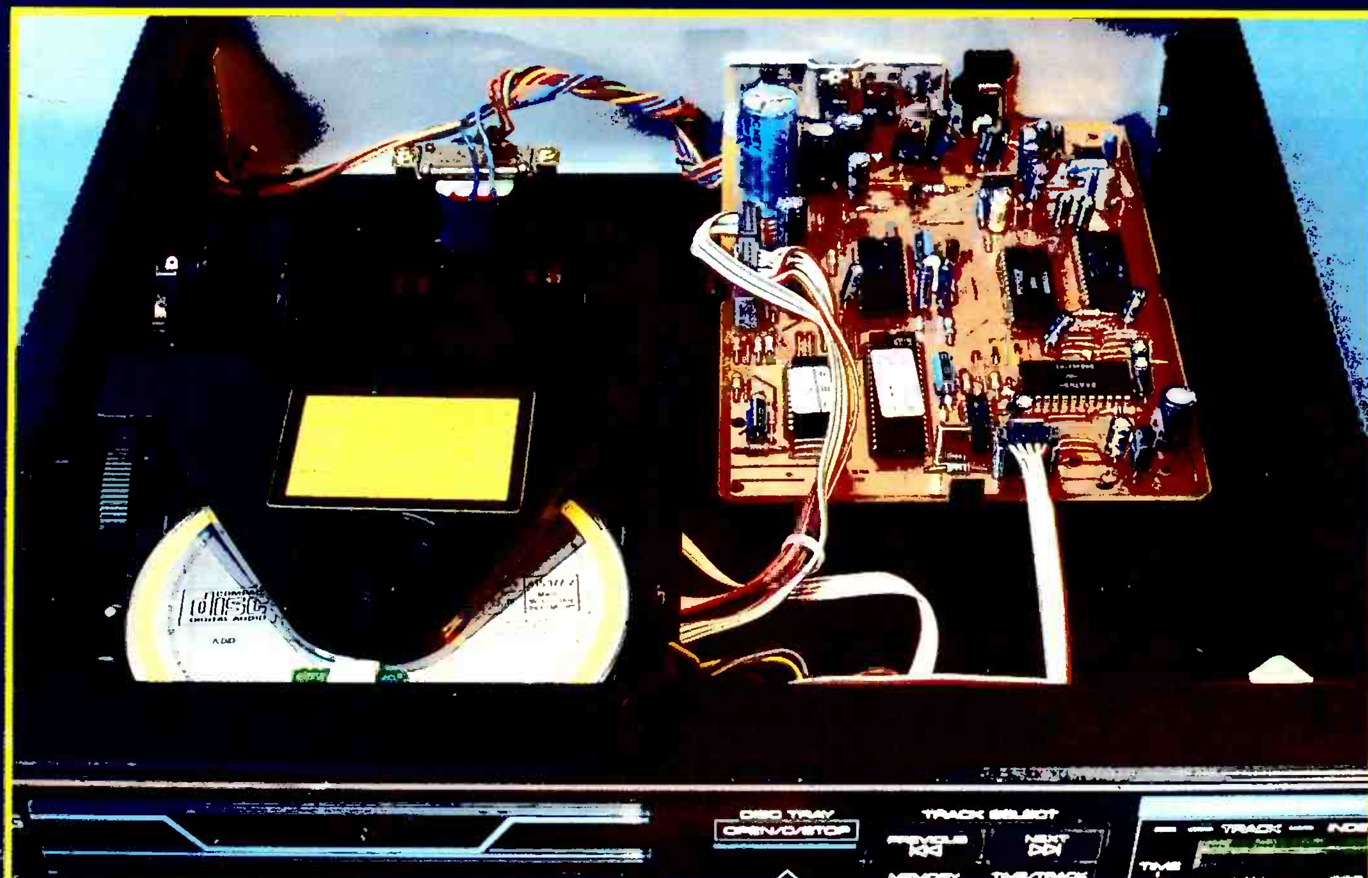

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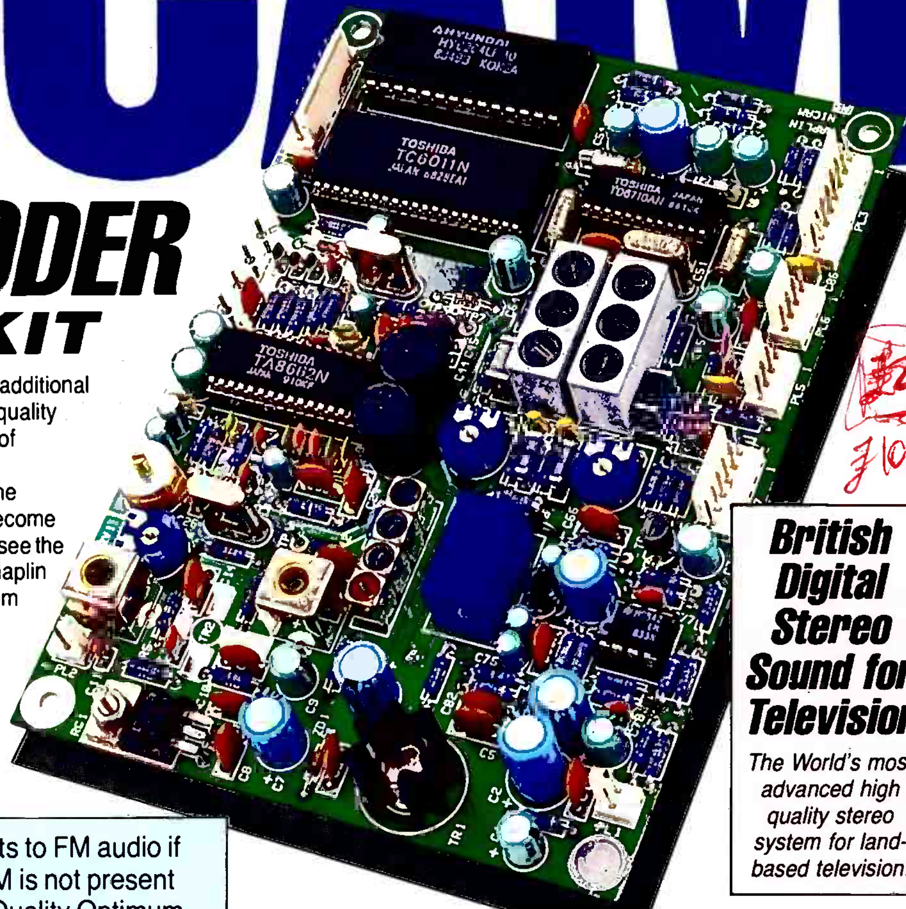
NICAM

728 DECODER
PROJECT KIT



The Maplin NICAM 728 Decoder converts the additional digital code present* in the TV signal to a high quality stereo soundtrack with a quality similar to that of Compact Disc.

This fully working system is based upon the Toshiba NICAM chip set which has only just become available. For full project construction details, see the December 1989 edition of Electronics – The Maplin Magazine (XA35Q price £1.20). It's on sale from November 3rd, so get your copy TODAY!

*Currently being transmitted from Crystal Palace and Emley Moor. See the Maplin Magazine Issue 34 for IBA launch schedule.

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December 1989

Vol. 40, No. 2
Issue 470

On sale November 15th

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

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this month

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BY297	25p
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OA91	6p
OA200	7p
OA202	7p
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IN.4003	4p
IN.4004	4p
IN.4005	4p
IN.4006	4p
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IN.4148	2p
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CRYSTALS

Freq in MHZ

1.00	260p
2.00	200p
2.45670	180p
2.5	200p
3.276	115p
3.5795	95p
4.0	110p
4.194	130p
4.43	95p
4.9152	150p
5.0	130p
6.0	115p
8.0	125p
8.867	125p
10.0	140p
11.0	250p
12.0	130p
14.0	125p
14.756	200p
15.0	160p
16.0	130p
18.0	130p
18.432	130p
24.0	250p
48.0	160p

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7808	35p
7812	35p
7815	35p
7818	35p
7824	35p
7905	35p
7906	40p
7908	40p
7912	40p
7915	40p
7918	40p
7924	40p
78L05	28p
79L08	28p
78L12	28p
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79L05	40p
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7824KC	100p
LM309K	100p
LM317K	220p
LM317T	180p
LM323K	420p
LM723	40p
78HGKC	570p
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78H12KC	700p

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78GH1C	215p
79HGKC	800p

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DY86	50p
DY87	60p
DY802	75p
EABC80	60p
EB91	44p
EBF80	45p
EBF89	50p
ECC82	80p
ECC83	80p
ECC84	70p
ECC85	80p
ECH81	100p
ECH84	70p
ECL80	65p
ECL82	80p
ECL84	70p
ECL85	70p
ECL86	90p
EF80	65p
EF85	65p
EF89	85p
EF183	75p
EF184	85p
EL34	250p
EL36	90p
EL84	75p
EL86	85p
EL500	100p
EL504	130p
EY86	45p
EY87	45p
EY88	65p
EZ35	66p
EZ80	70p
EZ81	55p
GZ34	200p
PC97	100p
PCC85	60p
PCF80	80p
PCF200	135p
PCF801	110p
PCF802	80p
PCF806	115p
PCH200	100p
PCL81	62p
PCL82	80p
PCL83	50p
PCL84	80p
PCL85	80p
PCL86	80p
PCL805	80p
PFL200	110p
PL36	120p
PL82	60p
PL83	60p
PL84	80p
PL95	180p
PL500	110p
PL504	120p
PL508	200p
PL519	450p
PY81	90p
PY88	70p
PY500A	190p

L.E.D.'S

LED 3MM RED	5p
LED 3MM YEL	10p
LED 3MM GRN	10p
LED 5MM RED	5p
LED 5MM YEL	10p
LED 5MM GRN	10p

RECTANG. L.E.D.'s

RED	10p
GREEN	15p
YELLOW	15p

LINEAR IC'S

AN-203	210p
AN-210	165p
AN-214Q	170p
AN-228	280p
AN-236	235p
AN-240P	150p
AN-241	135p
AN-245	290p
AN-247	230p
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LINEAR IC'S — Cont.	
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TLO-74	82p
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ULN-2002	70p
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ZNA-134H	2150p
ZNA-234E	920p

JAPANESE TRANSISTORS

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2SD-639	60p
2SD-640	350p
2SD-655	60p
2SD-661	60p
2SD-666	70p
2SD-667	70p
2SD-668	120p
2SD-669	40p
2SD-673	350p
2SD-676	250p
2SD-716	115p
2SD-717	180p
2SD-718	100p
2SD-722	240p
2SD-725	400p
2SD-734	50p
2SD-741	120p
2SD-743	130p
2SD-756	100p
2SD-757	120p
2SD-758	120p
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	650p
2SD-822	400p
2SD-826	100p
2SD-836	150p
2SD-836A	200p
2SD-837	80p
2SD-838	400p
2SD-841	160p
2SD-844	200p
2SD-845	250p
2SD-850	260p
2SD-856	80p
2SD-858	260p
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	100p
2SD-894	120p
2SD-895	200p
2SD-896	200p
2SD-900	400p
2SD-905	600p
2SD-916	130p
2SD-917	300p
2SD-921	320p
2SD-923	360p
2SD-946	120p
2SD-947	100p
2SD-950	300p
2SD-951	350p
2SD-957A	520p
2SD-958	60p
2SD-965	100p
2SD-970	170p
2SD-973	60p
2SD-973A	70p
2SD-985	120p
2SD-986	120p
2SD-1012	120p
2SD-1021	120p
2SD-1022	300p
2SD-1024	130p
2SD-1031	130p
2SD-1046	200p
2SD-1051	130p
2SD-1060	130p
2SD-1064	250p
2SD-1071	450p
2SD-1073	350p
2SD-1094	520p
2SD-1111	60p
2SD-1128	200p
2SD-1135	150p
2SD-1138	80p
2SD-1159	90p
2SD-1160	150p
2SD-1163A	220p
2SD-1164	120p
2SD-1168	425p
2SD-1169	280p
2SD-1185	400p
2SD-1186	400p
2SD-1189	125p
2SD-1190	150p
2SD-1196	150p
2SD-1207	50p
2SD-1210	280p
2SD-1211	120p
2SD-1225	120p
2SD-1229	250p
2SD-1237	300p
2SD-1248	270p
2SD-1251	180p
2SD-1266	180p
2SD-1272	200p
2SD-1273	100p
2SD-1275	160p
2SD-1276	200p
2SD-1277	190p
2SD-1279	300p
2SD-1289	300p
2SD-1291	400p
2SD-1292	60p
2SD-1297	425p
2SD-1308	140p
2SD-1309	140p
2SD-1310	140p
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-1390	350p
2SD-1391	450p
2SD-1392	150p
2SD-1395	150p
2SD-1396	240p
2SD-1397	260p
2SD-1398	210p
2SD-1399	300p
2SD-1400	280p
2SD-1402	280p
2SD-1406	120p
2SD-1407	160p
2SD-141[illegible]	190p
2SD-1[illegible]	190p
2SD-1[illegible]	430p
2SD-1426	350p
2SD-1427	380p
2SD-1428	450p
2SD-1429	410p
2SD-1430	280p
2SD-1[illegible]	400p
2SD-14[illegible]	600p
2SD-1433	750p
2SD-1438	140p
2SD-1439	320p
2SD-1441	440p
2SD-1448	140p
2SD-1450	60p
2SD-1451	290p
2SD-1452	170p
2SD-1456	320p
2SD-1457	220p
2SD-1459	120p
2SD-1468	60p
2SD-1496	450p
2SD-1497	450p
2SD-1505	[illegible]
2SD-1554	500p
2SD-1556	450p
2SD-1576	450p
2SD-1577	480p
2SD-1579	120p
2SD-1591	310p
2SD-1595	160p
2SD-1604	200p

2SD-1608	210p
2SD-1609	100p
2SD-1632	500p
2SD-1649	260p
2SD-1651	270p
2SD-1663	450p
2SD-1666	120p
2SD-1667	120p
2SD-1668	120p
2SD-1677	300p
2SD-1739	450p
2SD-1783	100p
2SD-1815	100p
2SD-1825	120p
2SD-1843	100p
2SD-1846	350p
2SD-1884	300p
2SD-1910	280p

2SD-1941	500p
2SD-1984	160p
2SJ-49	425p
2SJ-50	425p
2SJ-77	350p
2SK-19	45p
2SK-49	50p
2SK-55	100p
2SK-68	100p
2SK-134	415p
2SK-135	415p
2SK-147	160p
2SK-192	45p
2SK-195	150p
2SK-197	140p
2SK-312	750p
2SK-323	130p
3SK-88	70p

BRIDGE RECTIFIERS

W005	1A/50V	16p
WO1	1A/100V	18p
WO2	1A/200V	19p
WO4	1A/400V	21p
WO6	1A/600V	23p
WO8	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	160p
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	225p
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	52p

THYRISTORS (SCR's)

2N.5061	— 0.8A/60V	20p
2N.5062	— 0.8A/100V	28p
2N.5064	— 0.8A/200V	29p
C106D	4A/400V	28p
TIC116C	8A/300V	59p
TIC116D	8A/400V	70p
TIC116M	8A/600V	79p
TIC126D	12A/400V	75p
TIC126M	12A/600V	90p
2N.4444		76p
BR103		37p
BR303		85p
BT106		180p
BT116		80p
BT119		100p
OT121		120p
TIC44		22p
TIC45		27p
TIC47		32p
17088		200p
17089		200p
17127		200p
15/80H		230p
15/85R		230p
SG613		850p

UHF TUNERS

U322LO	600p
U341	500p
U342	500p

VIDEO LAMPS

UNIVERSAL VIDEO LAMPS 12V.60 mA (300mm WIRES) RED OR BLUE	30p
VIDEO LAMP FOR PANASONIC	60p

CASSETTE DC MOTORS

6V	240p
9V	240p
12V CW	240p
12V CCW	240p
13.2V CW	290p
13.2V CCW	290p

CASSETTE TAPE HEADS

MONO HEAD	90p
STEREO HEAD	150p
MINI HEAD	230p
AUTO REVERSE HEAD	260p

UNIVERSAL TRIPLERS	450p
SONY ON/OFF SWITCHES	200p
PHILIPS SWITCHES K30, K35, K40, KT3, KT4	150p

VIDEO HEADS

JVC/AKAI/FERGUSON 3HSS (For all Models)	£12.80
NATIONAL PANASONIC 4HSS = 3HSSN (NV322, NY332, NV340, NV2000, NV2010, NV7000, NV8170, NV8200, NV8400, NV8600, NV8610, NV8620).	£12.00

AKAI

VS-109/201/202/301/303	£24.00

AMSTRAD

VCR 4500, 5200, 9000 VCR 7000	£19.50

FERGUSON

3V32/JVC HR7655	£38.00
3V42/44/45/46/47	£21.00

FISHER

FVHP510/520/530/615/620/622/710/715/720/721/722/910	£20.75
FISHER VBS 7100/VBS 7500	£29.00
FISHER VBS 9000/VBS 9900	£29.00
FISHER VBS 7000	£30.00

HITACHI

VT11/14/33/61/63	£20.00
HITACHI VT7-17, VT35-38, VT39	£38.00
HITACHI VT19	£38.00
HITACHI VT120, VT 220	£31.50
HITACHI VT3000	£14.00
HITACHI VT5000, VT 5500	£20.00
HITACHI VT65, 7000, 8000, 8300, 8500, 8700, 9300, VT9500, 9700	£20.00

NATIONAL

NV 777/NV 330	£26.50
NV 430/NV 460	£21.00
NV 730 4 HEAD	£30.50
NV 366 4 HEAD	£30.50
NV 180 PORTABLE 4 HEAD	£41.00
NV 370/NV 380	£18.00
NV 788/NV 810	£43.50
NV 850/NV 870	£50.00
NVG 15	£41.50
NVG 30	£28.00
NVG 33, NVG 45, NVG 46	£41.00
NVG 40, NVG 130	£28.00
NVG 400	£42.00

SANYO

VTC 5000, VTC 5400, VTC 6000, VTC 6500	£28.00
VTCM10/11/20/21/25/30/31/35/40/50 VTC 5100, VTC 5150, VTC 5300	£28.00
VTC 5350/5370, VTCNX 10/15/20/30, VTC 5550	£28.00
VTC 5100, VTC 5150, VTC 5300	£28.00
VTC 9100/9300/9455/9500	£30.50
VTC 9350/9355	£30.50
VTC 5500	£30.50

SHARP

VC 381, VC 383, VC 386, VC 387, VC 388, VC 482, VC 483	£19.00
VC 486, VC 3300, VC 8381, VC 9100, VC 9300, VC 9500, VC 9700, VC 582, VC 583, VC 651, VC 681, VC 750, VC 781	£19.00

SONY

DSR-35R (FOR C20, 30, 40 SLF1, SLF1UB, SLF1E)	£19.00
DSR-43R (FOR SLC7 RANGE SL 5000, SL 5100, SL 3000)	£16.50

TOSHIBA

V21/V9600	£22.00

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We do not despatch on Saturdays.

THERE IS VAT ON P+P.
BOOKS AND MANUALS ARE ZERO V.A.T.
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We need expiry dates for credit card orders.
MINIMUM ORDER £5.

SURPLUS C.R.T.'s
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A51/110X	15.00
A51/510X	25.00
5102B22	25.00
5105KB22	25.00
A51/161X	20.00
A56/140X	15.00
A56/500X	15.00

TAKE UP IDLERS/CLUTCH ASSY

AKAI MI32773	5.63
AKAI BV327815	4.87
AMSTRAD 7000	2.20
VHS gen THORN/JVC	4.95
FISHER 490400900	3.95
FISHER 420400300/400	4.50
FERG 3292 F/F	1.46
FERG 3V00 F/F	1.46
FERG 3V00 TAKEUP	4.95
FERG 3V00 TAKEUP late	5.85
FERG 3V16 TAKEUP	4.95
FERG 3V16 TAKEUP late	5.85
FERG 3V22 TAKEUP	4.95
FERG 3V22 TAKEUP late	5.85
FERG 3V29 TAKEUP CL	2.08
FERG 3V29 TAKEUP SPL	2.13
FERG 3V29 TAKEUP IDL	1.44
FERG 3V35 SPL CARR	2.55
HITACHI F/F 6886971	2.90
HITACHI 6413663	2.68
HITACHI 6414221	5.04
HITACHI 6383531	0.70
HITACHI 6861471	2.43
HITACHI 6861482	5.02
HITACHI 6345173	0.40
HITACHI 6886971	2.90
HITACHI WIND ROLLER	0.78
NAT PAN VXP0463	3.20
NAT PAN VXP0243	1.10
NAT PAN VXP0401	1.08
NAT PAN VXP0344	1.22
NAT PAN VXP0331	1.28
NAT PAN VXP0521	4.08
NAT PAN VXP0433	5.50
SANYO RELL DRIVE PUL	5.10
SANYO 5000 RLR ASSY	1.85
SAMSUNG	1.75
SHARP 0005	2.20
SHARP 0006	2.20
SONY SLC5/7/3000	1.27

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PLEASE ASK FOR CATALOGUE

OFFERS

9V CW MOTOR	3.50
ASSTD SLIDER POTS	0.30
ASK FOR VALVES	

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CM7261	P.U.	12.39
CM7262	P.U.	13.50
CM7065	UHF/VHF HB	16.18
CM7066	UHF/HB	14.74
CM7268	VHF H.GAIN A/B/CD	17.57
CM7253	BEHIND SET (MAINS)	15.81
CM7243	SECOND SET AMP	14.73
CM7093	THREE SET AMP	18.55
CM7063	DIST.AMP VHF/UHF	25.77
CM7108/7298	8+1 DIST.AMP	49.96
CM9700	27MHz CB SUPPRESSOR	4.90
CM6011	OUTDOOR SPLITTER	8.63
CM9003/00	FLUSH SING.OUTLET	1.95
CM9003/01	FLUSH SING OUT.ISOLAT	2.36
CM9010	FLUSH TWIN OUTLET	2.47
CM9034	UHF FILTERS A/B/CD	8.89
CM9033	6 WAY PASS SPLIT	11.72
CM7042	TV GAMES COMBINER	3.24
CM9009	FLUSH TV/FM EMULATOR	3.88
CM9006	VHF/UHF DIPLEXER	4.17
CM7122	TELEVERTA UP VHF TO UHF	41.90
CM7057	TELEVERTA DOWN UHF/VHF	49.73
CM7294	DIST.AMP UHF/VHF	24.96
CM7274	4 WAY DIST.AMP	26.15
CM7082	UHF/VHF DIST.AMP	74.15
CM7080/10	UHF MHA	16.89
CM7271	UHF WIDEBAND 15 db	9.09
CM5004	4way VIDEO DIST.AMP	60.20

LABGEAR SATELLITE RANGE

CM5188	IF Interim Dist Pump	57.00
CM5110	IF Line Pump	17.00
CM5112	Block Converter with PSU	143.34

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THORN/FERG TV		13.00
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3V23	IR8817	14.95
3V31	IR8945	14.95
3V35	IR8946	14.95
3V43	IR8947	19.12
GRANADA UNIVERSAL		16.50
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G11 TXT IR8435		13.50
G11 TXT US31 BUTTON		29.42
G11 NON TXT US8263		16.50
G11 2 FUNC US8518 See Offers		16.50
KT3/30 NON TXT IR8331		15.85
KT3/30 TXT IR8420		16.50
RC5 REPLACEMENT		13.95

PLUS MANY MANY MORE!!!

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incl. DISH/LNB RECEIVER	199.00
RG59 CABLE 100M	19.95
RG6 CABLE 100M	29.95
4 CORE POLAR CABLE	10.50
F CONN RG6	0.18
F CONN RG59	0.24
F CONN SCREW ON	0.35
F LINE CONN	0.45
CRIMP TOOL	29.95
COMPASS	6.00
SAKURA STEREO SYSTEM	229.00
SIGNAL STRENGTH METER	53.92

AND A COMPLETE RANGE OF AERIALS AND ACCESSORIES ON PAGE 23 IN CATALOGUE

ANTIFERENCE

UNIVERSAL No. 1 CLAMP	1.30
SB11 SPLITTER	2.50
CS200 COMBINER/SPLITTER	3.94
CO811 OUTLET	0.96
PU1240 POWER UNIT	11.65
PU1300 MHA	9.09
27 MHz FILTER	2.10
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XS 4/6	43.13
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SILVER SENSOR AERIAL	7.40
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LOOP AERIALS	1.00
COAX CABLE S540 100m	33.70

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SHORROCK ACORN PANEL	32.50

IR DETECTOR INTERNAL

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ORION	24.00

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WE NOW HAVE A CONTINUOUS SUPPLY OF REFURBISHED TVs AND VIDEOS

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ALL IN EXCELLENT CONDITION COMPLETE WITH REMOTES AND ALL TRIMS.
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14" Portables. Standard	From £65	Philips KT3. Remote	£81
Pye. Standard	£69	Pye K30. Remote. Text	£112
Fidelity. Standard	£87	22". Standard. Toshiba	£65
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Ferguson. Remote	£95	Philips. Remote. Text. CTX	£139
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Due to an overwhelming response we have decided to retain this fabulous offer for one month more.

VIDEO HEADS
3HSSN 12.50
3HSSV 12.50

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WE **ARE** IN STOCK OF THESE AND MANY MORE TYPES. SEE CATALOGUE

THESE OFFERS WILL MAKE YOU SMILE

13A PLUG TOPS (10)	3.75	A34/510	10.00
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3HSSH
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VT4000/4200
5000/5500
VIDEO HEADS

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Sheila and the girls send their love and best wishes for Christmas and the New Year and say thanks to all their customers.

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VIC240	6.15	L750 Beta	3.35
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WE HAVE TRIPLERS, LOPTX, PUSH BUTTON ASSY CRTs, CAPACITORS, RESISTORS, POTS, FUSES, DROPPERS, STYLI, LEADS, CABLES, etc. **ASK US**

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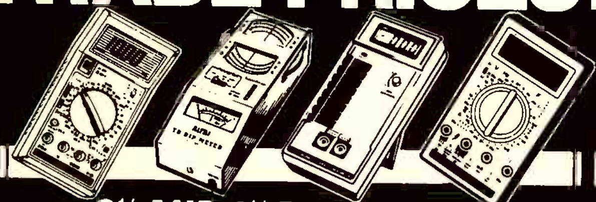

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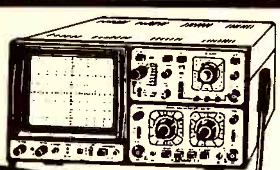

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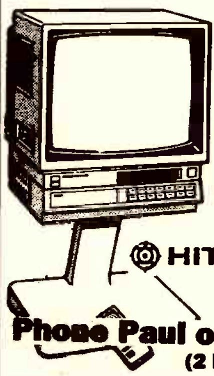

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BD13	12	30 watt reed switches, it's surprising what you can make with these – burglar alarms, secret switches, relay etc. etc.
BD22	2	25 watt loud speaker two unit cross-overs
BD29	1	B.O.A.C. stereo unit is wonderful breakdown value
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BD32	2	humidity switches, as the air becomes damper the membrane stretches and oeprates a microswitch
BD42	5	13A rocker switch three tag so on/off, or change over with centre off
BD45	1	24hr time switch, ex-Electricity Board, automatically adjust for lengthening and shortening day.
BD49	5	neon valves, with series resistors, these make good night lights
BD56	1	mini uniselector, one use is for an electric jigsaw puzzel, we give circuit diagram for this. One pulse into motor, moves switch through one pole
BD59	2	flat solenoids – you could make your multi-tester read AC amps with this
BD67	1	suck or blow operated pressure switch, or it can be operated by any low pressure variations such as water level in water tanks
BD103A	1	6v 750MA power supply, nicely cased with input and output leads
BD120	2	stripper boards each contains a 400v 2A bridge rectifier and 14 other diodes and rectifiers as well as dozens of condensers etc
BD128	10	very fine drills for p.c.b. boards etc. Normal cost about 80p each
BD132	2	plastic boxes approx, 3" cube with square hole through top so ideal for interrupted beam switch
BD134	10	motors for model aeroplanes, spin to start so needs no switch
BD139	6	microphone inserts – magnetic 490 ohm also act as speakers
BD148	4	reed relay kits you get 16 reed switches and 4 coil sets with notes on making c/o relays and other gadgets
BD149	6	safety cover for 13A msockets – prevent those inquisitive little fingers getting nasty shocks
BD180	6	neon indicators in panel mounting holders with lens
BD193	6	5 amp 3 pin flush mounting sockets makes a low cost disco panel – need cable clips
BD196	1	in flex simmerstat – keeps your soldering iron etc always at the ready
BD199	1	mains solenoid very powerful has 1" pull or could push if modified
BD201	8	keyboard switches – made for computers but have many other applications
BD211	1	electric clock mains operated put this in a box and you need never be late
BD221	5	12v alarms make a noise about as loud as a car horn. Slightly soild but OK
BD242	2	6" × 4" speakers 4 ohm made from Radiomobile so very good quality
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BD259	50	leads with push on ¼" tags – a must for hook ups – mains connections etc
BD263	2	oblong push switches for bell or chimes, these can mains up to 5 amps so could be foot switch if fitted into pattress
BD268	1	mini 1 watt amp for record player. Will also change speed of record player motor
BD283	3	mild steel boxes approximately 3" × 3" × 1" deep – standard electrical
BD293	50	mixed silicon diodes
BD305	1	tubular dynamic mic with optional table rest
BD667	2	4.7uf, non-polarised block capacitors, pcb mounting
BD400	4	Books. Useful for beginners. Describes amplifiers, test equipment and kit sets
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BD553a	2	3.5 volt operated relays, each with two pairs CO contacts
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There are over 1,000 items in our Bakers Dozen List. If you want a complete copy please request this when ordering.

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EXTRA SPECIAL CROC CLIPS. Medium size, just right for most hook-ups. Normally sell for around 10p to 15p each. These are insulated and have a length of wire connected to them but this is very easy to snip off if you do not need it. 20 for £1. Our ref BD117A.

COPPER CLAD PANEL for making PCB. Size approx 12in long × 8½in wide. Double-sided on fibreglass middle which is quite thick (about 1/16in) so this would support quite heavy components and could even form a chassis to hold a mains transformer, etc. Price £1 each. Our ref BD683.

FET CAPACITOR MICROPHONE EAGLE C1.200 Output equivalent to a high class dynamic microphone while retaining the characteristics of a capacitor microphone. Price £1. Our ref BD646.

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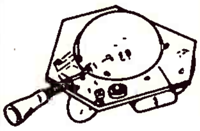

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12" HIGH RESOLUTION MONITOR. Black and white screen, beautifully cased for free standing, needs only a 12v 1.5 amp supply. Technical data is on its way but we understand these are TTL input. Brand new in maker's cartons. Price: £22.00 Post Free.

14" COLOUR MONITOR made by the American Display Tek company. Uses high resolution tube made by the famous Japanese Toshiba company. Beautifully made unit intended for console mounting, but top and sides adequately covered by plated metal panels. Full technical spec. on its way to us. We have a limited number of these. All brand new still in maker's cartons. Price: £89 each plus £6 insured carriage. Order ref: 89P/1.

BUSH RADIO MIDI SPEAKERS. Stereo pair. BASS reflex system, using a full range 4in driver of 4ohms impedance. Mounted in very nicely made black fronted walnut finish cabinets. Cabinet size approx 8½in wide, 14in high and 3½in deep. Fitted with a good length of speaker flex and terminating with a normal audio plug. Price £5 the pair plus £1 post. Our ref 5P141.

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JOYSTICKS for BBC, Atari, Dragon, Commodore, etc. All £5 each. State which required.

SUB-MIN PUSH SWITCHES. Not much bigger than a plastic transistor but double pole. PCB mounting. Three for £1. Our ref BD688.

NICAD CHARGER UNIT. Metal pronged, plastic case contains mains transformer and rectifiers with output lead and plug – made to charge two cells but no doubt adaptable or wonderful spares value. Only 50p each, two for £1. Our ref DB385.

EDGEWISE PANEL METER. If you are short of panel space then this may be the answer. It has a FSD of 100µA and a nice full vision scale. It fits through a hole approx 1¾in × ½in. Another feature is that it has an indicator lamp behind the scale which you could light up, it would then serve as an on/off indicator. Price £1. Our ref BD700.

AA CELLS. Probably the most popular of the rechargeable NICAD types. 4 for £4. Our ref 4P44.

20WATT 400HM SPEAKER. With built-in tweeter. Really well made unit which has the power and the quality for hi-fi reproduction. 6½in diameter. Price £5. Our ref 5P155. It is heavy so please add £1 to cover postage if not collecting. OHMS?

MINI RADIO MODULE. Only about 2in square with ferrite aerial and solid dia tuner with its own knob. It is a superhet and it operates from PP3 battery and would drive a crystal headphone direct but be better with our mini mono amp. Price £1. Our ref BD716.

BULGIN MAINS PLUG AND SOCKET. The old faithful 3 pin with screw terminals. The socket mounts through a 1½in hole and the mains is brought in by the insulated plug. Used to be quite expensive but you can have 2 pairs for £1 or 4 of either plug or socket for £1. You could make yourself a neat and compact bench panel with these. Our ref BD715, BD715S or BD715P.

MICROPHONE. If you want a low cost microphone then just arrived we have a very small hand-held dynamic mic with on/off switch in the handle, its lead terminates with one 3.5 plug and the other a 2.5 plug for remote control. Price only £1. Our ref BD711.

EXTENSION CABLE WITH A DIFFERENCE. It is flat on one side making it easy to fix and to look tidy. It is 4 core so suitable for telephone, bell, burglar alarms, etc. 50 yard coil for £5. Our ref 5P153.

MOSFETS FOR POWER AMPLIFIERS AND HIGH CURRENT DEVICES. 140v 100w pair made by the famous Hitachi Company. Reference 25K413 and its compliment 25J118. Only £4 the pair. Our ref 4P42.

BATTERY OPERATED TRAVEL MECHANISM. On a plastic panel measuring approx 9in × 3½in. Is driven by a reversible 12v battery motor, fitted with pulley and belt which rotates a threaded rod and causes a platform to travel backwards and forwards through a distance of approx 5in. Price £5. Our ref 5P140.

MAINS OPERATED WATER VALVE with hose connection for inlet and outlet suitable for low pressure. Auto plant watering, etc. Only £1 each. Our ref BD370.

20 VOLT 4AMP MAINS TRANSFORMER. Upright mounting with fixing feet. Price £3. Our ref 3P59.

16 OHM PM SPEAKERS. Approx 7in × 4in. 5 watts. Offered at a very low price so you can use two in parallel to give you 10 watts at 8 ohms. £1 for the two. Our ref BD684.

EHT TRANSFORMER. 4kv 2mA Ex-unused equipment. £5. Our ref 5P139.

4 CORE TINSEL COPPER LEAD. As fitted to telephones, terminating with flat BT plug. 2 for £1. Our ref BD639.

EHT TRANSFORMER. 8kv 3mA. £10. Our ref 10P56.

VERY USEFUL MAGNETS. Flat, about 1in long, ½in wide and ¼in thick. Very powerful. 6 for £1. Our ref BD274(a).

ACORN COMPUTER DATA RECORDER. Ref ALF03. Made for the Electron or BBC computers but suitable for most others. Complete with mains adaptor, leads and handbook. £10.00. Ref 10P44. Add £2 special packing.

SOLAR CELLS. Will give a good current (depending on size) from sunlight or bright daylight. Module A gives 100mA. Price £1. Our ref BD631. Model C gives 400mA. Price £2. Our ref 2P199. Module D gives 700mA. Price £3. Our ref 3P42.

SOLAR POWERED NI-CAD CHARGER 4 NI-CAD batteries AA (HP7) charged in eight hours or two in only 4 hours. It is complete, boxed ready to use unit. Price £6. Our Ref. 6P3.

METAL PROJECT BOX. Ideal size for battery charger, power supply etc: sprayed grey, size 8" × 4¼" × 4" high, ends are louvered for ventilation other sides are flat and undrilled. Price £3. Order Ref. 3P75.

13A PLUGS. Sleeved and complete with fuse, parcel of 5 for £2. Order Ref. 2P186.

CAPACITOR BARGAIN – axial ended – 4700uf @ 25v Jap made. Normally 50p each, but you will get 4 for £1. Ref. 613.

SINGLE SCREENED FLEX 7.02 copper conductors, pvc insulated then with copper screen, finally outer insulation. In fact quite normal screened flex. 10m for £1. Our ref BD668.

3 CORE FLEX BARGAIN No. 1 – Core size 5mm so ideal for long extension leads carrying up to 5 amps or short leads up to 10 amps. 15mm £2. Ref. 2P189.

3 CORE FLEX BARGAIN No. 2 – Core size 1.25mm so suitable for long extension leads carrying up to 13 amps – or short leads up to 25A. 10m for £2. Order Ref. 2P190.

ALPHA-NUMERIC KEYBOARD – this keyboard has 73 keys with contactless capacitance switches giving long trouble free life and no contact bounce. The keys are arranged in two groups, the main area field is a QWERTY array and on the right is a 15 key number pad, board size is approx. 13" × 4" – brand new but offered at only a fraction of its cost namely £3, plus £1 post. Ref. 3P27.

⅛TH HORSEPOWER 12 VOLT MOTOR. Made by Smiths, the body length of this is approximately 3in, the diameter 3in and the spindle 3/16th of an inch diameter. It has a centre flange for fixing or can be fixed from the end by means of 2 nuts. A very powerful little motor which revs at 3,000 rpm. We have a large quantity of them so if you have any projects in mind then you could rely on supplies for at least two years. Price £6. Our ref 6P1, discount for quantities of 10 or more.

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PROFESSIONAL WIRELESS MIC SYSTEM

A complete wireless microphone system comprising a G201 receiver with matching G202 microphone, windshield, 1.4m patch lead for connection of receiver to amp/mixer and one pair of racking brackets for the receiver. All packed in a tough vinyl case.

Receiver

Receiving frequencies	173.8MHz, 174.1MHz, 174.5MHz, 174.8MHz or 175.0MHz
Receiving system	Single super heterodyne conversion FM detector
Intermediate frequency	10.7MHz
Antenna impedance	75Ω
RF sensitivity	0.7μV
S/N ratio	Better than 90dB
Squelch threshold	Adjustable from 10dBμV to 40dBμV
Image and spurious rejection	At least −80dB
De-emphasis	75μS
Audio output level	250mV at 600Ω
Audio harmonic distortion	Less than 0.5%
Power	240Vac 50Hz/12Vdc
Dims	190 × 54 × 200mm

Transmitter

Receiving frequencies	173.8MHz, 174.1MHz, 174.5MHz, 174.8MHz, 175.0MHz
Frequency stability	00.5%
Modulation system	Crystal controlled FM
Harmonic and spurious output power	Less than −45dB below carrier level
Pre-emphasis	75μS
Max frequency deviation	±50kHz
Frequency response	70Hz-1200Hz
Distortion	Less than 0.5%
S/N ratio	Better than 87dB
Ambient temperature range	0°C-40°C
Operating voltage range	3.8V to 4.5Vdc

PRICE: £150.00 + Carriage £2.50

BRAND NEW — SURVEILLANCE EQUIPMENT

TYPE 1: Camera, Monitor, Camera Bracket, 40m Lead — Ready to use.

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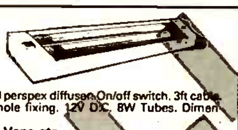
Hand held or hanging. Heat resistant poly-carbonate housing; highly polished reflector. Protective lens cover, doubles as base stand. With On/Off switch and 12ft curly cable terminating in cigar lighter plug. Produces 250,000 candle power – 5 times the intensity of average car headlamps.
Power: 12Vd.c. 4.5A. 55W. Dims: 160 × 88 × 110mm

£5.99

12V Twin Fluorescent Lamp



12" Double Tubes
Attractive white fitting, ribbed perspex diffuser. On/off switch. 3ft cable. Transistorised circuitry. Keyhole fixing. 12V DC, 8W Tubes. Dimensions: 368 × 67 × 43 mm.
Ideal for Caravans, Boats, Vans etc.

	1+	10+	50+
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SOLDER: 60% TIN 40% ALLOY

22g. Non-corrosive Multi-core Solder. 500gm Reel £[illegible] each.
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1/4W pack 10 each value E12 – 10R to 1M 610 pieces	5.10
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1/2W pack Popular – 2R2 to 10M 1000 pieces	10.75
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4 × AA Charger		£4.95 each

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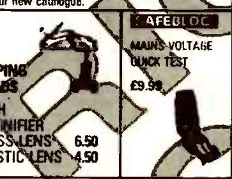

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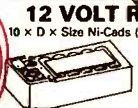

10 × D × Size Ni-Cads (4 Ah) encapsulated in a black plastic case. Fuse holder. Gives 12 volt output when charged. Ex-equipment. Fully guaranteed. Dimensions: 245 × 75 × 75mm.

£9.19 each + P&P £1.85
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CHARGING UNIT FOR THE ABOVE 12V UNIT

Manufactured by Saft, these chargers are suitable for the above battery packs (as advertised in the May issue of "WHAT VIDEO" — Page 6). The chargers are stated as we have modified them to a standard charger. Full charge of the packs is obtained after 10-12 hours (overnight) charging.
Supplied complete with main lead and charging lead fitted with a 4-pin plug (6-pin plug version available upon request). Although ex-equipment, these chargers are fully tested and guaranteed.
Dimensions 335 × 260 × 150 mm.

4-PIN £11.50 6-PIN £11.50 + £1.85 P&P

FM TRANSMITTER

Very High Quality 'MINI-BUG' – Ideal for Baby Alarm etc.!!
A Very good range is obtainable – we have obtained over 1/2 mile, but it does depend on conditions.
Simply remove cover – insert battery – and you're ready to go.
Reception can be obtained on any F.M. Radio.
Frequency: 105-109 MHz F.M.
Power: PP3 9V Battery (not included).
Dimensions: 4.25" × 2.25" × 0.75".
Order Code – SO/034

Price: **£9.99**

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SANYO: VTC-3000 £29.95; VTC-5000 £45.00; VTC-5500 £45.00

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SONY: SL-C5 £22.50; SL-C6 £22.50; SL-C7 £22.50; SL-C8 £48.60; SL-C20; SL-C24; SL-C30; SL-C33; SL-C44; SL-F1; SL-F30; SL-3000 — £34.50

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CASSETTE LAMP

– UNIVERSAL
High quality 12 Volt Universal Video Cassette Recorder Lamp and Head. Lead length: Approx. 30cm.
ORDER CODE: VID/LAMP
PRICE – 60p

20mm FUSE

QUICK BLOW – 80mA, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1A, 1.25, 1.5, 1.6, 2, 2.5, 3.15, 4, 5, 6.3 — 45p/10

TIME DELAY – 50mA, 60, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1A, 1.25, 1.6, 2, 2.5, 3.15, 4, 5, 6.3, 10 — 1.20/10

1" DOMESTIC MAINS FUSES

2A, 3A, 5A, 13A — £1.20/10

1 1/4 QUICK BLOW FUSES

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POWER SUPPLY

D.C. to D.C. adaptor. Plugs into car cigar lighter socket.
Outputs 3, 4.5, 6, 7.5, 9, 12V @ 800mA.
Has universal output spider plug, also 9V battery snap and polarity reversing facility.
ORDER CODE CAR/PSU/1
PRICE: £2.75

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	3V29/3V32	£5.25
HITACHI	ALL	£3.99
J.V.C.	HR2200/3300/3330/3660/4100/7700	£3.99
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PHILIPS	VR 6460	£3.99
	VR 6560	£3.99
SANYO	VTC3000	4.20
	VTC5000/5150/5300/5350/5400/5500/6000/6500/9100/9300/M10/11/20/21/30/31/M50	£4.25
SHARP	200/[illegible]/385/386/388/[illegible]/7300/[illegible]/7750/8000/[illegible]/9300/9700	£3.99
SONY	SL-C5/6/7	£4.20
TOSHIBA	V5	£3.99

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FISHER	GEAR IDLER 143-0-4904-00906	6.80
FERG/JVC	TAKE UP IDLER PU51402A	1.78
HITACHI	6886971	1.99
PANASONIC	VXP 0344	2.30
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SANYO	REEL DRIVE PULLEY VTC 5150 143-0-662T-01201	6.50
SHARP	NIDL 0005 GE22	1.90
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THORN/JVC	PU48967B	2.99

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TRIPLER Universal	5.75
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Reel Motor SHARP VC9300/9800 RMOTV 1008 GE22	18.95
Capstan Motor - FERG/JVC 3V35 PU55371V/M	27.50
Audio Motor Recorder 12V CW 34mm	4.20
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PB3005 PHILIPS G11	0.95
THORN TX90 00E2 158-001	0.95

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AKAI	VS 9300/9500	2.10
FISHER	MOST	2.50
HITACHI	VT5000E/5500/3000	2.75
	VT/7000/8000/8500/9300	
	VT/5500/9700	1.50
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JVC/FERG	3V00/3V22	2.10
	3V29/3V30	1.50
JVC/THORN	3V35/3V39	1.50
JVC	3300/3330/3360	2.10
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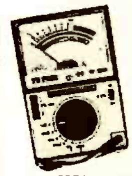

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CORRECTIONS

On page 42 last month (VCR Clinic) the B and O VCR60/70 should have read VHS60/70. On page 691, July (TV Fault Finding) the brightness problem with the Panasonic TC2211 (U3 Chassis) was due to C356 (1μF) on the c.r.t. base panel. D552/3 were responsible for the width problem, as stated.

COVER PHOTO

Our cover photograph this month shows an internal view of a Tatung CD player. A new CD player servicing feature starts this month on page 124.

Ways of Doing Business

Two recent company announcements highlight the different approaches to running a consumer electronics business in the UK and Japan, providing an insight into why the Japanese have been so much more successful. The news from Hinari, which was established in 1985 and had expanded rapidly, increasing market share until the middle of the year when its problems became apparent, is grim. Administrators have been called in to try to preserve the business in some form – a buyer is being sought. The company is understood to have debts of around £30m and was heading for a loss in the current trading year. Its problems have, fairly enough, been put down to the difficult trading conditions in the consumer electronics market in the UK. According to Brian Palmer, Hinari's founder and, until he was removed recently, its chairman and chief executive, the market downturn this year has not been great but competition has increased substantially with "everyone chasing the same orders". Hinari's margins were badly hit and the company was caught with too much stock. You can sense the fierce competition from the current rash of "mid-season" sales. A poor Christmas season, when business activity in this field usually accelerates substantially, could have disastrous consequences for many firms.

"Chasing the same orders" gives a clue to the problem. Hinari's customers include Dixons, Currys and Boots. Such multiples order in large quantities and make keen deals. But a supplier cannot get far without orders from Dixons/Currys, Rumbelows and/or Comet, all of whom are in turn chasing reduced business from a public with less money to spend. The retailers have also been reporting miserable results. The interesting thing however is the way in which trading has evolved over the years in the consumer electronics field in the UK. Long gone are the days when a manufacturer simply announced his model range for the year, with all its new features and technical advances, then hoped that the orders would flow in. If they didn't, the warehouse would fill up until production became unsustainable. The old stop/go cycle, when changes in purchase tax could overnight put a brake on business, led to the demise of many a well known UK radio/TV firm of yesterday. We don't have purchase tax now, but interest rate changes can have just as devastating an effect. Nowadays to succeed a supplier has to go after substantial orders for delivery over a period of months. This ensures a degree of business stability, but of course all still depends on the public's ability to go on buying and adequate financial resources being available when conditions get tough. A supplier such as Hinari relies on having a keen sense of what the public wants, getting large orders for particular models, and at the same time making arrangements to have the product manufactured. It seems that Hinari went so far as to borrow substantially from its bankers against retail trade orders. This is fine so long as business is booming, but is hazardous when a downturn sets in.

But it's the way in which the trading pattern has evolved. Where would Amstrad be without its long-term success in doing business with the Dixons/Currys group? Fidelity radio was one of the pioneers in this field, obtaining orders from the large retailers before going into production. It was said years ago that the output from Fidelity's production lines was always pre-sold. A good way of doing business if you can manage it. Fidelity, like Hinari and Amstrad, relied heavily on the trading sense and sales ability of its founder. To try to avoid excessive dependence on a few UK customers, Hinari and Amstrad both in recent years endeavoured to establish themselves in Continental European markets. This was a logical move, and is the way in which much of UK industry will have to go to survive, but in the consumer electronics industry it hasn't been all that successful. A flair for knowing what will sell in the UK's high streets is no guarantee of success in rather different markets. Yet in an industry that is increasingly a global one, excessive reliance on one particular market is a recipe for failure at some stage, especially when coupled with heavy short-term borrowing.

The other announcement came from Murata Manufacturing, a leading Japanese producer of electronic components. Murata is to start manufacturing at Plymouth and is to invest some £45m over the next five years. Commenting on the move Yasutaka Murata, vice president in charge of overseas operations, said that forecasts of slow growth in the UK's economy during the year ahead had no effect on the company's decision. "Our timescale for assessing the British economy is not over six months or a year but over five to ten years" he added. The contrast with UK firms could not be more stark.

You might wonder how any company could be so sure of what the situation will be ten years hence. One thing you can be sure of however is that, barring unforeseen disasters, consumers will go on buying electronic products and that provided you make what will sell there will be business to be done. This depends in turn on a commitment to maintain substantial product research and development. You can see in this the way in which Japanese industry has managed to be so successful. The emphasis is on the production side, with substantial investment in product development and quality standards, coupled with a global strategy on the sales side. It can be done and can be highly successful, but it seems that the UK's business leaders, in the consumer electronics field at any rate, have never had the confidence to take such a long-term view and to back it with the investment funds required. It's a sad contrast. Hinari and its likes will doubtless continue to come and go, highly dependent on individual entrepreneurial flare, while on the other side of the globe the Japanese manufacturers become more firmly ensconced as production-based generators of wealth.

Servicing Salora Colour Receivers

Part 4: The J Chassis

Nick Beer and Ian Bowden

As in later versions of the G and H chassis, the J chassis employs the Ipsalo-2 circuit with its common transformer for the chopper and line output stages. A few modifications were made, as a comparison between Fig. 1 and Fig. 1 of Part 3 in this series (October) will show. The main change is the use of a different chopper control chip, type LF0041. This incorporates a number of components that were external in earlier versions.

The Ipsalo Circuit

Since this circuitry can be confusing to those not familiar with Salora chassis, we'll start by outlining its operation. As before the chopper circuit provides mains isolation, the links with the rest of the chassis being via the chopper/line output transformer MB500 and the chopper driver transformer MB700.

The mains bridge rectifier DB708/9/10/11 produces some 320V d.c. across its reservoir capacitor CB721, which shares a common can with the smoothing capacitor CB722. The start-up action is provided by DB725/CB715/RB715. CB715 charges via RB715: when the voltage across it reaches approximately 35V DB725 fires, producing pulses to switch on the chopper transistors TB700/1. When DB725 fires, CB715 discharges. As soon as the voltage across it drops to some 15V DB725 switches off. TB700/1 are then without drive and also switch off. CB715 starts to charge again and the cycle is repeated. The sawtooth waveform developed across CB715 in this way is some 20V peak-to-peak at about 4·5kHz. As the two chopper transistors switch on and off, an output is developed across the close-coupled secondary winding 17-18 on the chopper transformer. During normal operation this is rectified to produce the 28V line. Under start-up conditions however you get about 18V. In the standby mode and when running normally the start-up circuit is disabled by DB714 and RB708, which keep the voltage across CB715 well below DB725's firing potential.

If the start-up circuit is working but there's a fault further along the chain, you'll hear a 4·5kHz scream from the chopper/line output transformer. As an example of the sort of fault that can produce this symptom, a faulty TDA2030 audio chip sometimes puts a short-circuit across the 28V line.

The 18V supply developed by DB504 during the start-up sequence is taken via DB525 and RB720 to pin 1 of the hybrid chopper control chip HB1. Here it feeds an integrated regulator circuit that produces an 8·5V supply which is used within the chip and is present at pin 3. It's not common, but we have on a couple of occasions come across a faulty integrated regulator circuit.

The 8·5V start-up supply at pin 3 of HB1 is used by the integrated chopper driver transistor, the line pulse lengthening circuit (TB508/9 etc.), the line driver transistor TB501, the EW modulator circuit (22 and 26in. models only) and the TDA2594 sync/line generator chip ICB501. When the line oscillator starts up it produces positive-going 20kHz pulses of 8μsec width and approximately 7V amplitude at its output pin 3. These are fed to the lengthening circuit and also to HB1, where they enter at pin 4, going to the bistable circuit which thus changes state. When this occurs the chopper driver transistor is cut off and the driver transformer MB700 produces output pulses to switch on the chopper transistors TB700/1. The Ipsalo circuit is then operating in what is called the minimum current angle mode, i.e. the lowest level of energy transfer from the primary to the secondary side of MB500. This limits the current flow at start-up, protecting the circuitry from high peak currents.

The secondary supplies derived from MB500 now start to increase. The most important of these is the 142V supply (125V with 20in. models) produced across CB513 by the action of the line output stage. This voltage is fed back to pin 20 of the hybrid chip HB1, where it's used to provide regulation. The internal circuit between pins 20 and 17 of HB1 controls, in conjunction with RB718/722, the voltage across CB719. This voltage is fed via pin 7 of HB1 to an integrated *RC* charging circuit which controls the switching of the bistable pulse-width modulator within the chip and thus, in turn, the mark-space ratio of the drive pulses applied to the chopper transistors. Thus the secondary supplies derived from MB500 will remain constant despite varying loads. RTB700 sets the h.t. and thus all the other supplies.

When the 12·5V supply has been established, DB513 is reverse biased, RB539 is effectively removed and the line oscillator frequency shifts down to the normal running 15·625kHz.

When the current drawn by a secondary supply increases, the 125/142V line will drop and, due to the action of the regulatory circuit within HB1, the voltage across CB719 will increase. As a result the conduction time of the chopper transistors will be increased to compensate. If there's an overload, the voltage across CB719 will rise above 15V and zener diode DB720 will conduct. This reduces the internal charging supply and as a result the conduction time of the chopper transistors is reduced. Once this has happened the set must be switched off for a few seconds to clear the condition. An important point to note is that it takes only a short peak of excessive current to trigger the overload condition, and that when this occurs the 125/142V supply falls to about 50V rather than 0V. The result is a very small raster and a dim channel number display. If there's a complete short-circuit across any of the secondary supplies, e.g. the line output transistor is short-circuit, the 125/142V supply will fall to zero and so will the voltage across CB719. The drive to the chopper transistors is now reduced to the minimum level, protecting the power supply.

If you suspect excessive loading due to a fault in the line output stage, a useful check is to unplug the scan coil plug (B3) and connect two suitable diodes (e.g. two BY223s) in series with the anode end to pin 7 of MB500 and the cathode end to pin 13. When the set is switched on the 125/142V supply should be correct. Don't leave the set switched on for long in this condition as the other supplies will also be present and you'll end up burning a

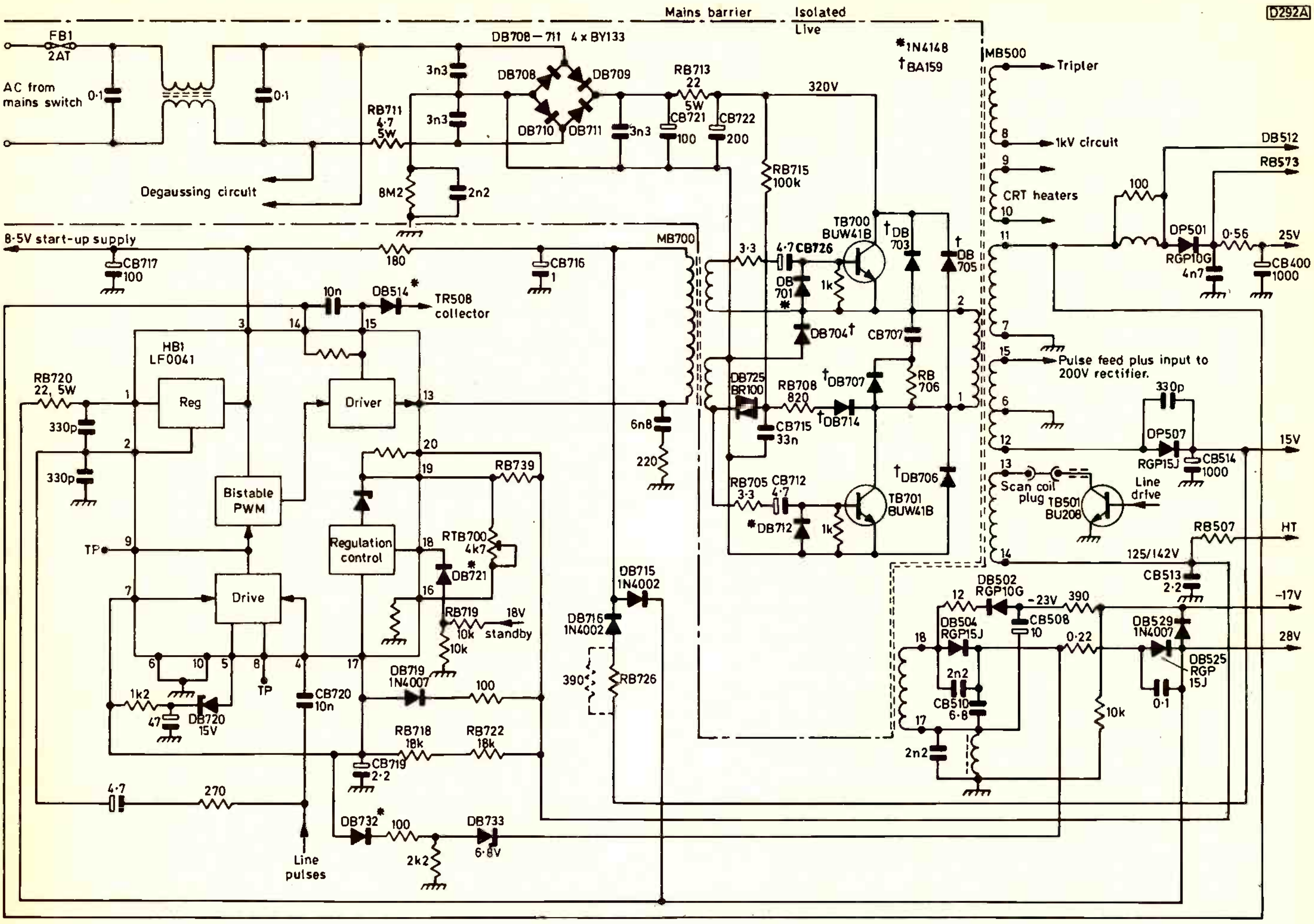

Fig. 1: The Ipsalo circuit used in the Salora J chassis. RB507 is 3·9kΩ in 22/26in. sets, 2·2kΩ in 20in. sets; RB726 is 56Ω in 22/26in. sets, 82Ω in 20in. sets; RB739, 560kΩ, is fitted in 20in. sets only; RB706 is 2·7kΩ in 22/26in. sets, 15kΩ in 20in. sets (4W in both cases); CB707 is 1nF in 22/26in. sets, 270pF in 20in. sets (1kV in both cases).

spot in the centre of the screen.

When the standby command is received by the SAA1251 remote control decoder chip ICC9, its output at pin 19 drops and 18V is switched via transistor TC19 to the power supply and the line drive circuitry. This voltage is fed via RB719 and DB721 to pin 18 of HB1. As a result the voltage across CB719 will fall to zero and the chopper switch-on time will be at minimum. In the line drive circuit the standby voltage brings the inverter transistor TB507 into circuit to invert the line drive pulses. The normal phase relationship between the on/off times of the line output and chopper transistors is thus altered. This action removes all energy from the secondary supplies, leaving only the supply obtained from the close-coupled winding 17-18 (this is required to power the Ipsalo and remote control circuits).

The Colour Circuits

The Salora J chassis uses the TDA3562A colour decoder chip (ICB200) to produce the RGB drive waveforms for the output stages. The operation of this chip was described in some detail in the October 1987 issue of *Television:* we'll simply mention the areas that have caused us problems.

When fault-finding around ICB200 the most important signal is the composite blanking waveform (sandcastle) which is fed to pin 7. It includes both line and field blanking, see Fig. 2. We've never had any problems with the line blanking part of the signal, which is taken from the TDA2594 sync/line generator chip via RB515. The majority of the problems have been with the field blanking signal which is taken from pin 2 of the TDA2653A field timebase chip ICB400 (note that this pin is also the field sync input). The positive-going field blanking pulses, at about 20V peak-to-peak, pass via DB404 and RB402 to TB400 and its associated components DB401, RB424/5 and TB209. It's this circuit that has been responsible for the majority of no-raster faults.

What happens is that loss of the field blanking part of the waveform blanks the RGB outputs from the TDA3562A chip. Typical causes are TB400 (BC237B) going open-circuit base-to-emitter or TB209 (BC307B) going short-circuit collector-to-emitter. Less common is a faulty field timebase chip (you can't see field collapse because it's blanked).

The same circuitry can cause the opposite effect. On

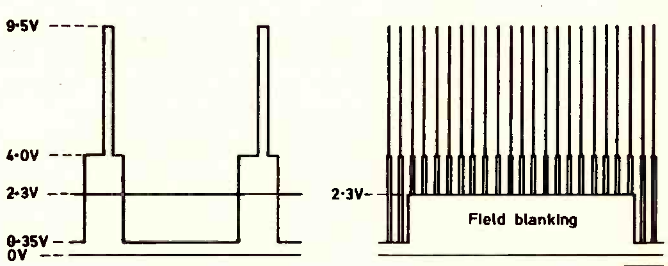

Fig. 2: The sandcastle pulse waveform at pin 7 of ICB200. (a) At line rate, (b) at field rate.

one occasion for example DB401 had gone short-circuit. As a result TB400 received a steady base current and produced a steady 2V d.c. level instead of the blanking pulses in the sandcastle waveform. If the contrast was set fairly high the set went into the overload condition.

The most common problem in the RGB output stages is failure of TB250, TB260 or TB270 (BF788 or BF871) causing loss of one colour. On one occasion the customer complained about red outlines on the picture. The fault showed up particularly well with a crosshatch display, where all the vertical white lines had a red haze, mainly on the right-hand side, giving the appearance of a poorly focused red beam. The cause was a break in the print feeding the collector of TB252 (BF788/BF871), the red output emitter-follower.

The Enable Word

This facility is not available with J20 models: it's only on the J40, J70 and J90 types which use an MAA4002 control chip. It allows you to alter some of the set's operations, for example which channel is used for direct video and audio input. The enable word will need to be reset if the MDA2060 memory chips ICC100 and ICC101 are replaced. It has been known for these to cause enabling problems, for example one channel number to be switched to direct video and audio intermittently.

To check or alter the enable word, the password must first be entered, either via the remote control unit or on the set. To do this, press the following keys: P * 0 £ then, within 1·5 seconds, M.

When on a normal TV channel, the right-hand channel number LED should display the darkened segments shown in Fig. 3.

Details of the bits/segments are as follows:

Bit 0 (the full stop): This should always be off.

Bit 1: This controls the operation of additional control bit A. It's one of the two output lines (pin 25) from the MAA4002 control chip and switches the set to direct video and audio input via DIN pin 6 or the scart socket when this segment is off.

Bit 2: This is the second output line (pin 26) from the MAA4002 control chip, called B. It can be used to switch in another input, i.e. link a satellite TV decoder or an f.m. radio decoder, when the segment is off.

Bits 3 and 7: These work together to alter the way in which the available memory is used, giving the following four options:

Bits 3 and 7 off – 59 channel storage selections without AES.

Bit 3 off, bit 7 on – 27 channel storage locations without AES.

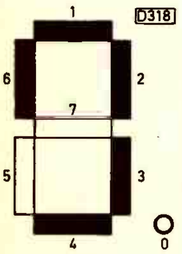

Fig. 3: The enable word display. On a normal TV channel the right-hand channel number LED should display the segments shown darkened. This feature is available on the J40, J70 and J90 versions of the chassis, using the MAA4002 control chip.

Bit 3 on, bit 7 off – 27 channel storage locations with AES (this is the usual setting).

Bits 3 and 7 on – 20 channel storage locations with AES.

Bits 4 and 5: These also work together, altering the vision i.f. The four options are as follows:

Bits 4 and 5 off – 38·9MHz.
Bit 4 off, bit 5 on – 38MHz.
Bit 4 on, bit 5 off – 39·5MHz (correct for the UK).
Bits 4 and 5 on – 38·6MHz.

Bit 6: When this segment is off, r.f. tracking of a VCR's output on location 0 is enabled.

The enable word can be altered by pressing the relevant number on the remote control unit or on the set's own keypad. This will toggle the selected bit on and off. To store the enable word again, press the M key and the display will return to the channel number.

The AES facility allows presetting of adjustments to give the "normal" volume, brightness, colour and contrast levels set for channel number one. When this facility is enabled, as it normally was from the factory, it's simply a case of setting the correct levels on channel one then storing them by pressing M and within 1·5 seconds N. The same procedure is then followed on all the channels required. Note that the adjustments stored on any channel other than one have a maximum range of approximately ±12 per cent from those set set on channel one.

Faults List

We will conclude this instalment in the series with a list of faults other than those mentioned so far.

(1) No picture, sandcastle waveform incorrect, no field output. Supply to the field timebase chip down at about 12V. Could be the TDA2653A chip but try disconnecting its output first to see if the supply rises to the normal level. If so and the load reads about 560Ω to chassis, suspect that CB400 (1,000μF) is leaky.

(2) Distorted field scan. Suspect CB400 (1,000μF) or CB412 (100nF).

(3) Set takes a long time to come on and/or a hum bar on the picture. As with previous chassis that use the Ipsalo-2 circuit, suspect the two 4·7μF capacitors CB712 and CB726 in the base circuits of the chopper transistors. Use standard, not sub-miniature, capacitors (63V). We recommend that these capacitors, if they are the originals, are replaced whenever a set is serviced – especially when they are the yellow or orange versions. Other symptoms are flaring due to the hum on vision and possibly width fluctuation at high contrast levels.

(4) Grey-scale drift. Suspect the 56kΩ, 0·5W d.c. feedback resistors RB251, RB261 and RB271 in the RGB output stages.

(5) Teletext o.k. for the first minute or so then becomes completely garbled. Thermal fault in the SAA5040 chip in the teletext decoder.

(6) Rattle/buzz from the scan coils. Caused by the yellow tape that secures the metal strips where the windings fold forward being broken. Resecure strips with glue or silicone rubber. The coils will have to be removed to do this.

(7) Set won't start, start circuit cannot be heard. Short-

circuit turns on the primary winding of the Ipsalo transformer. Can often be seen by burn marks.
(8) No go, set trips. 15V rail low as DB507 is open-circuit or high-resistance. When working on these sets, check for dry-joints on this diode. Use only type RGP15 as a replacement.
(9) Set goes to standby when switched on. Disconnect the IR amplifier module to eliminate this as it can produce random noise, causing all manner of faults. If the set has teletext, unplug the decoder panel to eliminate this. If the fault persists, suspect the SAA1251 remote control decoder chip on the STC panel.

If the IR amplifier is faulty the cause is usually the TEA1009 chip, but replacement modules are very reasonably priced so you have to consider time against profitability.
(10) Set won't go to standby. Switch at back of set, above the aerial socket, faulty or in wrong position. Should be in position 2, or open-circuit for remote control.
(11) Chroma errors, i.e. horizontal lines of alternating colour. Field hold control RTB400 incorrectly set.
(12) No raster, with no 25V supply at pin 9 of the TDA2653A field timebase chip. Dry-joint on pin 11 of the Ipsalo transformer.
(13) Crackling and shriek on sound. Faulty TDA1236 (ICD2) intercarrier sound or TDA2030 (ICB100) audio chip.
(14) Set goes dead intermittently: DB712 (1N4148) in chopper circuit leaky.
(15) Set dead or intermittent bright raster with loss of sound. DB507 faulty or dry-jointed – see (8).

We shall be following up next with the K and L chassis.

Letters

CDs AND THE AMSTRAD PCW8256

I was a little puzzled (and annoyed) by Les Sage's letter on compact discs in the November issue, particularly with regard to signal-to-noise ratios. Personally I don't find a bit of tape hiss or a slight background hum irritating in the least. They seem to add to the enjoyment value of a "live" recording, where noises like these are inevitable. By the way, I'd like to know how the signal-to-noise figures quoted were actually measured.

With regard to recording studios "refurbishing" their equipment, a signal-to-noise ratio of −60dB seems to be more than adequate. And anyway it would mean that the studios would have to throw out all their good analogue equipment and replace it with digital equipment. It must be remembered that many recording artists don't like digital studios – surely they must be given the right to choose? And don't forget that analogue electronic instruments, e.g. organs, guitar pedals, good old valve guitar amplifiers etc., also throw out a lot of noise. I could go on for ever about things like this!

I've been collecting compact discs for nearly five years. In my experience they do have their faults, but they are not the ones that Les Sage writes about. One problem is that recording companies will insist on using a noise gate to suppress tape hiss between songs – it often clips the beginning of the next song as well. Not all discs are like this: I've a few in my collection where the hiss has been left in. Other faults I've noticed are "pings", presumably caused by dropouts in the digital master tape, and varying tolerances between manufacturers. I have one pair of CDs that are distinctly off-centre – to the point where the sled motor in my Yamaha CD-X1 can, with the lid removed, be seen whizzing back and forth to keep up: obviously the tracking solenoid doesn't have enough range. I've resorted to sticking small pieces of vinyl tape in the centre hole to force the disc on-centre, as the whole batch is probably affected in this way. Another problem with off-centre discs is that the fast search, on my player anyway, dithers back and forth instead of going in the intended direction.

After that, a couple of small points on other subjects. I've recently bought an Amstrad PCW8256 and have upgraded it to 512K and LocoScript 2 with Spell. This has proved to be very worthwhile. A point to note is that the printer doesn't take kindly to being dropped. One printer, not mine fortunately, had suffered in this way, with the result that the print head misfired on a couple of pins. The problem is that the black ribbon cables from the print head plug into plastic connectors on the PCB: it's these that seem to suffer. This source of trouble can be eliminated by chopping the connectors out and soldering the cables to the PCB directly. By the way, on a topical point: these computers tend to have a small burn on the side where the mains cable is wrapped round its tidy when packed.

S. Pearson,
Chipping Norton, Oxon.

MORE ON COMPACT DISCS

I read Les Sage's comments on the quality of compact discs with interest. My own views are as follows:
(1) The main advantage of CDs over vinyl discs is that they don't deteriorate through regular playing.
(2) One 5in. CD can hold nearly eighty minutes of music. While many record companies have not taken advantage of this others, notably the specialist companies, have added a single or previously unreleased material on the CD versions of their older albums.
(3) One cannot expect older recordings to match up to today's specification levels. If a CD sounds as good as a perfect LP pressing, I'm quite happy with that!
(4) The major disadvantage of some CDs is that they expose excessive tape hiss and even master tape deterioration with some older recordings.
(5) Finally, perhaps master tape cannot match the impressive specifications of today's CD players? Maybe others would like to comment on this?

I believe that the compact disc will eventually supersede the vinyl record, as vinyl did the shellac disc nearly thirty years ago. It's comforting to know that those of us, such as myself, with vinyl disc collections won't find the plastic deteriorating with old age as other plastics do – read about the mains lead problem (September and October) for example!

Brian Renforth,
Newcastle-upon-Tyne.

TV TIMERS

Here's a point I've not seen mentioned in your pages. Could be worth an argument or three! Why does my TV set (a JVC model, but I've seen it on many other makes) have a timer? I can see no reason whatsoever why anyone should want the TV set to switch on without

next month in TELEVISION

● **SERVICING THE PANASONIC NV2000/2010/3000**
These machines are now quite old and were not over-endowed with features. They still sell in large numbers on the reconditioned VCR market however as they are very easy to use and to service. They are in fact an ideal choice for budget rental or sale. As Nick Beer points out, there's no real reason to scrap them, so here's how to get the best out of them for a while longer. Advice on the mechanics and a detailed faults list are included.

● **CAMERA TUBE GUIDE**
Since data on camera tubes is not always easy to locate, those who need to replace such tubes or make use of them can encounter difficulties. P.M. Delaney has compiled data on over 300 tube types with a view to helping the service engineer or constructor to identify a particular tube and find a suitable replacement or circuit. Some general guidance on suitable substitutes is also given.

● **CD PLAYER SERVICING**
Next month's instalment will deal with the sled drive and control system, including the Philips radial tracking arm, and disc speed control.
A further collection of fault reports will appear on the CD Player Casebook page.

● **BANDWIDTH COMPRESSION**
Part 2 of this article deals with bandwidth compression schemes intended for TV broadcasting, including videoconferencing and HD-TV systems.

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anyone in the room. The safety of having a set running in this way also seems questionable. Even the maximum length of the timer period, two hours in thirty-minute steps in the case of my JVC set, doesn't make sense or seem to fit in with any convention.
D.C. West,
Tiverton, Devon.

SERVICING TIPS

There have been a couple of letters recently on cleaning old or unobtainable potentiometers. I file down the lead of a pencil and mix it with a spot of oil or Philips contact cleaner. When this is spread on the track it will give even the oldest potentiometer a new lease of life. I'm told that Redex is good for this, as it leaves a deposit even when it dries out.

Further to previous notes on the Rediffusion Mk. 3 chassis, I've had several cases recently where the two electrolytic cans (6C12/14, 220μF, 400V) on the power supply panel have been leaky or open-circuit. The result is ripple that causes tripping, sometimes only when the set has warmed up. The type used in the Rank T20 chassis fits o.k.

Finally, if anyone still needs Rank tuner cams I still have a large number left and can supply them at 16 for a £1. Send coin and SAE.
Dave Mackrill, 32 Southwater Road,
St. Leonards-on-Sea, East Sussex TN37 6JS.

HELP WANTED

Could any reader supply a circuit diagram for the Intel CTV6000 14in. colour set?
A.M. McConnochie, Television Hire Service (South London) Ltd.,
10 Clapham Park Road, London SW4 7BB.
Telephone 01-622 7762.

Does anyone know where the National Panasonic i.c. type AN239 can be obtained? We require two for use in two colour portables in for repair, Models TC361GM and TC481GR. The same chip is faulty in both and the suppliers I've checked with say it's no longer available. Failing chips, does anyone have any information on using an alternative and whatever circuit changes might be required?
P. Henson, c/o F. Walker TV, 267 Hessle Road,
Hull, North Humberside HU3 4BE.

Can anyone help with information on the Mader monochrome Videokamera 553, in particular its supply requirements and the connections to the 5-pin DIN socket?
Don Webber, 3 Shirburn Road,
Crownhill, Plymouth PL6 5PG.

FOR DISPOSAL

I have for disposal three 24in. sets fitted with the Thorn 1500 chassis. They've long been part of my hobby stock, but I no longer have room for them. They are free for collection, but a phone call or letter before doing so would be appreciated.
W.J. Knight, 532 Rochester Way,
Eltham, London SE9 1SQ.
Telephone 01-850 4147.

Servicing Compact Disc Players

Part 10: Servo Systems – 1

Joe Cieszynski

There have been quite a number of references in past parts of this series to laser focusing and tracking and the disc's rotational speed. This month we'll begin to look in detail at the servos that control these movements. The subject of electronic servo control has been covered in numerous articles in past issues of this magazine – see for example "VCR servo systems", October 1988. The basic idea is to use a feedback signal to control the drive to a motor or similar device.

CD Player Servo Arrangements

A compact disc player has three separate servos plus an additional sled system which is related to the tracking servo. By way of an introduction, we'll outline briefly what these servos are and what they control.

(1) The focus servo is used to control the focusing of the laser beam. It maintains the objective lens for the beam at the correct distance from the disc's reflective surface. For this purpose (and for tracking control) the position of the lens is controlled by a two-axis device. The focus servo controls the current through the vertical coils on this device. Feedback is based on the shape of the reflected beam, which is detected by a group of four photosensitive pickup devices.

(2) The tracking servo controls the current through the horizontal coils on the two-axis device. This action tilts the objective lens so that the beam is kept in alignment with the track. The source of feedback is either the output from the side spot detectors (in a three-beam device) or the four main photodetectors (in a single-beam device).

(3) The speed servo controls the spindle drive motor to maintain the correct rotational speed of the disc as the laser moves from the inner extremity of the music track to the outer extremity. The off-disc frame sync data provides the feedback signal.

(4) Sled or carriage control. In most players this switches a motor on the sled assembly and moves the laser progressively across the disc. As we shall see later, some Philips players use a swinging arm in place of a sled. The control for this system originates in the tracking servo.

Fig. 1 shows an overall view of the servo arrangements used in a CD player.

In most CD players the four main reflected beam detectors are arranged in a cluster as shown in Fig. 2, where they are labelled A, B, C and D. In Part 2 we looked at the different types of laser assemblies used in CD players, and in particular considered the differences between three-beam and single-beam arrangements. Just to recap, the three-beam system works on the principle of splitting a single beam into a main beam and two lower-power side beams. The reflected main beam is detected by the four pickup photodiodes as shown in Fig. 2. From their output we obtain the audio data and a feedback signal for the focus servo. The two side beams are detected by an additional pair of photodiodes, referred to as E and F, which provide a feedback signal for the tracking servo. With a single-beam device only four photodiodes are used: these must therefore provide the data plus the focus and the tracking feedback signals.

Focusing with a Three-beam System

We'll consider first the way in which a focus feedback (error) signal is generated in a three-beam system. As the illustrations of three-beam devices in Part 2 showed, a cylindrical lens is mounted just above the six photodiodes. The action of this lens is such that when the beam is correctly focused on the reflective surface of the disc the light that emerges from the lens is circular. This condition is shown in Fig. 2(a): the four main beam photodiodes shown here produce equal outputs and the net focus feedback is zero. When the laser beam is not correctly focused, the output from the cylindrical lens will suffer from astigmatic distortion – see Fig. 2(b) and (c). As a result the photodiodes generate an error voltage. The focus servo moves the two-axis device up and down, looking for 0V condition.

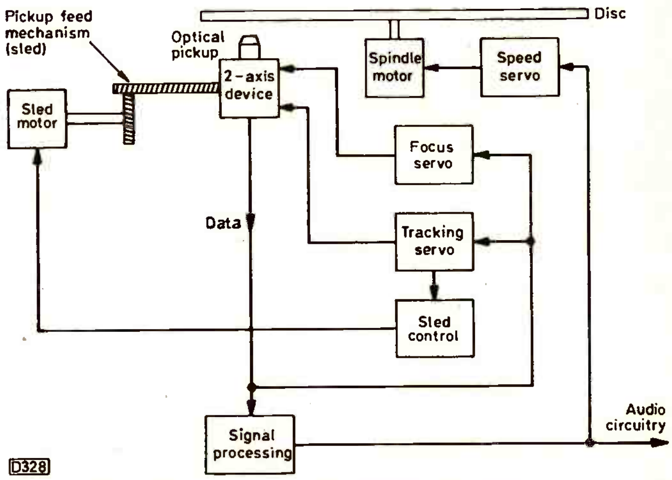


Fig. 1: Block diagram of a CD player's servos.

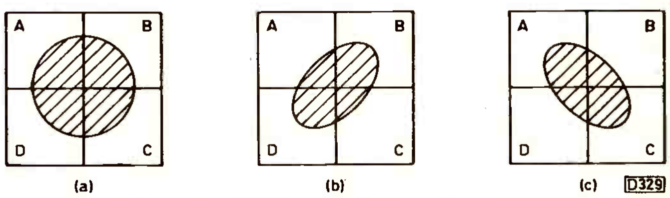


Fig. 2: Method of obtaining a focus error signal from the four main-beam photodetectors with a three-beam system. When the lens is correctly positioned with respect to the surface of the disc the reflected beam falls equally on all four photodetectors: the outputs combine to give a zero net output voltage. When focusing is incorrect the beam takes on an elliptical shape and an error output is produced to control the servo. (a) Lens in correct position, zero output. $(A + C) - (B + D) = 0$. (b) Lens too far from the disc, negative output. $(A + C) - (B + D)$ less than zero. (c) Lens too close, positive output. $(A + C) - (B + D)$ is this time greater than zero.

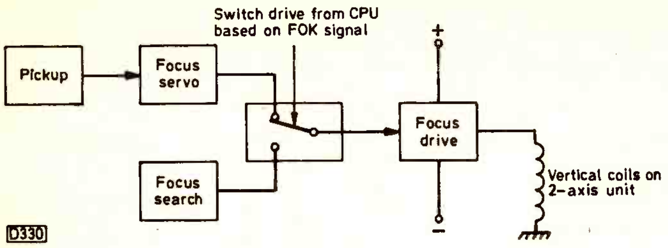


Fig. 3: Basic focus servo system.

If the beam is not correctly focused the data cannot be retrieved from the disc. This will not only result in loss of sound; the disc speed will also be incorrect, because the speed servo relies on feedback information derived from the data. In addition, the tracking servo feedback signal, which is derived from the side beams, will be lost and the main beam will move off the track. It's thus essential that correct focusing is maintained at all times.

Start-up System

Let's consider the situation with the disc speed and the tracking servos when a disc has just been inserted and play had been selected. At this point the two-axis device will be in its natural, central position and the beam will be way out of focus. So how can the other two servos begin to operate when they cannot receive any feedback information? The answer is that they can't. Because of this the central processor (CPU) in a CD player doesn't enable the tracking and speed servos until correct focus has been achieved.

With the two-axis device in its natural, resting position the beam will be so diffused that the output from the photodetectors will be zero. This of course is also the situation when the focusing is correct! Thus some sort of start-up routine is required to get the two-axis device moving. Otherwise focus will not be attained and the player will not get going.

This problem is overcome by including a focus search circuit. It's a coarse focus control arrangement which is switched on by the central processor when the disc is initially inserted. It makes the two-axis device move the lens with respect to the disc until an approximately correct focus is achieved, i.e. until the photodetectors see some form of ellipse. At this point the focus error detector circuit will produce a positive or negative output, and a monitoring circuit (a gate or op-amp) will send a logic signal to the central processor to tell it that approximately correct focus has been attained. This logic signal, a simple high or low depending on circuit design, is called the FOK (focus o.k.) signal. Likewise the monitor is called the FOK circuit.

Once the FOK signal has been received the search circuit will be overridden and the normal focus servo action will take over, bringing the beam into perfect focus. At the instant when the spot becomes circular a focus zero cross (FZC) logic signal is produced to inform the servo logic control, which is normally separate from the central processor, that focus is correct.

Should the player fail to achieve approximate focusing at the first search attempt, for example because the disc is a poor one, the search will be repeated another once or twice, depending on player design. If an FOK signal has not been received by the last attempt the central processor will stop all operations: an error message will appear on the front display and in some designs the disc may be ejected. When the central processor receives the FOK signal it will enable the tracking and speed servos so that they can begin their start-up routines. We'll be looking at these later on.

Focus Servo Operation

Fig. 3 shows the basic focusing system in block diagram form. The focus search circuit generates a ramp, beginning with a negative peak (lens fully in) and then passing through zero (lens at centre) to a positive peak (lens fully out). At some point during this ramp the beam should come into focus and the FOK signal will be sent to the central processor, which then switches control to the focus servo.

Fig. 4 shows a focus system in greater detail. Initially the output from the focus error (FE) amplifier is zero and the focus search amplifier drives a ramp current through the focus coils. When the photodiodes produce an output, the FOK signal is generated and the search amplifier is switched off. The FE amplifier is now in control of the focus drive transistors Q1/2 and correct focusing can be obtained. When this occurs the output from the FE amplifier is zero and the FZC signal is generated. Note that the FZC signal will also be present when the focusing is way off (beam diffused) and the output from the photodiodes is zero: this is why we need the FOK signal.

The focus offset control is incorporated to compensate for any d.c. offset in the FE amplifier. If this control is incorrectly set the FE amplifier will produce an output when the beam is circular at the photodiodes. As a result the servo will move the two-axis device until the FE

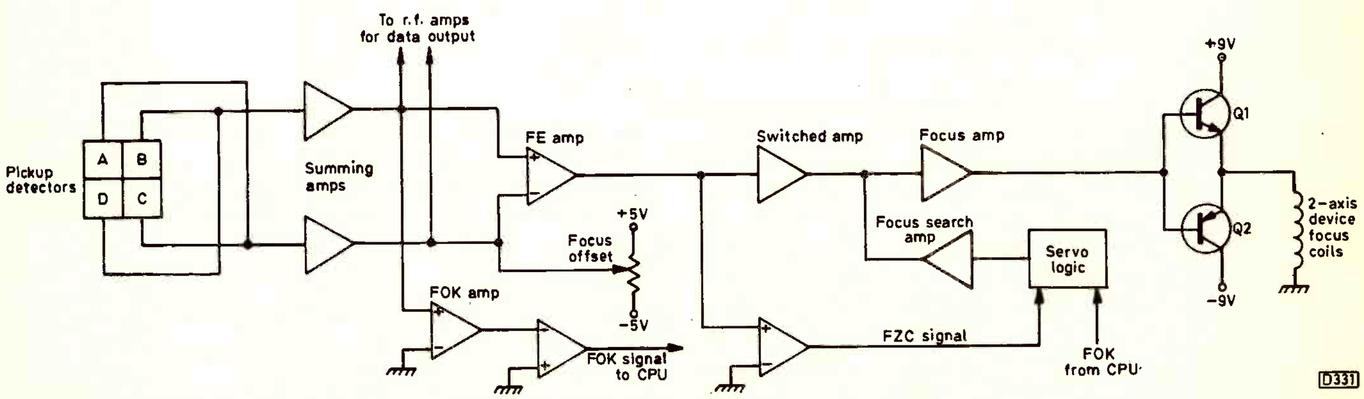


Fig. 4: Typical focus servo system. In most players the FOK signal is available at the pin of an i.c. and is a useful check to show that the beam is correctly focused.

amplifier's output is zero, which will of course correspond with an elliptically shaped beam at the pickup and incorrect focus. The setting of this control is thus critical: it should be adjusted only by following the procedure laid down by the manufacturer.

In the event of failure of the disc to rotate, the state of the FOK logic signal is an important clue for the service engineer. The central processor won't permit disc run-up until it receives the FOK signal, so a check on the logic state of this signal can be made to find out whether or not focus has been achieved. If it hasn't, the problem is likely to be caused by a defective laser (see Part 2). If it has, check that the disc is able to spin freely in the tray. If it can, go on to check the speed servo and the associated power supply lines.

Focusing with a Single-beam System

Although the circuit arrangements used with three-beam and single-beam laser assemblies are similar, the method of obtaining the focus error signal in a single-beam assembly differs from that used in a three-beam assembly. The technique used to derive an FE signal with a single-beam assembly was discussed in Part 2 (April), when we looked at the different types of laser assemblies. I'll recap only briefly therefore.

The principle used by Sony is shown in Fig. 5. It uses a critical-angle prism which gives maximum reflected light only when the beam enters at a certain precise angle, in this case 42°. This occurs only when the beam is correctly focused at the disc. When the focusing is incorrect, part of the beam passes straight through the prism and is lost, resulting in an uneven light distribution at the photodiodes. An FE signal is obtained by combining the outputs from the photodiodes in the manner (A + B) − (C + D).

Philips single-beam devices work on a slightly different principle, see Fig. 6. Instead of a critical-angle prism, a prism with a V-shaped cut on the side where the light leaves is used. This splits the beam in two, one half of which falls on one pair of photodetectors and the other half on a second pair. When the focusing is correct, all four detectors receive equal light. With incorrect focusing the two beams will move to one side, resulting in a greater output from two of the pickup detectors. The four outputs are added in the manner (1 + 4) − (2 + 3).

Three-beam Tracking Servo

The task of the tracking servo is to keep the main beam aligned with the data track. Coarse and fine control are used for this purpose. As the disc rotates, the beam is kept on the spiral track by feeding a ramp current waveform through the horizontal coils on the two-axis device. This tilts the objective lens so that it follows the track, and is the fine control action. It's able to maintain tracking up to a point where the objective lens has moved 70μm (approximately 44 sections of the track) across the disc. At this point the two-axis device is at one extremity and the beam would begin to lose alignment with the track. Before this happens the sled motor is energised, moving the optical assembly along by about 70μm, as a result of which the lens returns to its central position. These movements are controlled by the radial tracking servo – Fig. 7 shows the basic arrangements.

As previously mentioned, with a three-beam system the tracking servo feedback signal is provided by two

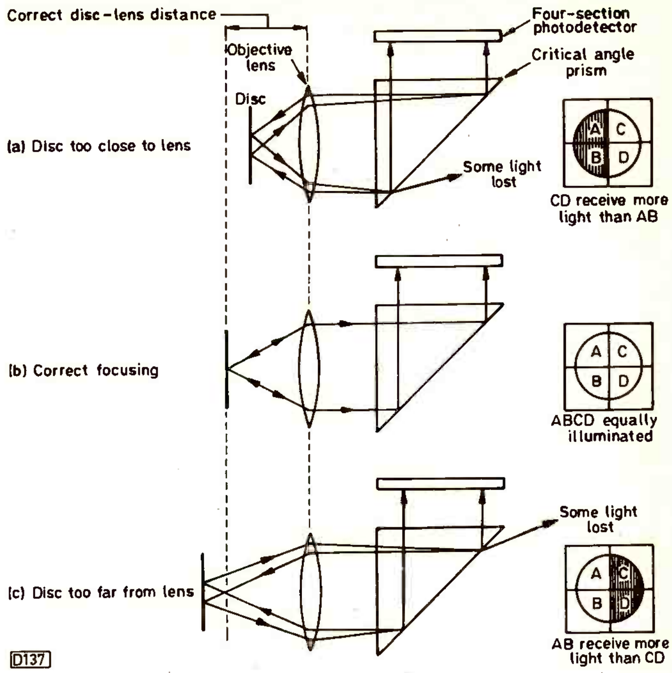


Fig. 5: Sony method of obtaining a focus error signal with a single-beam laser assembly.

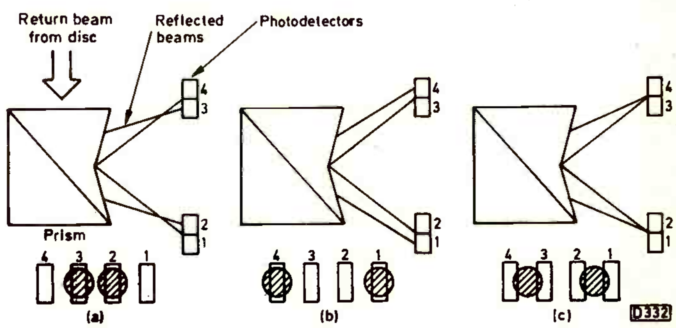


Fig. 6: Philips method of obtaining a focus error signal with a single-beam laser assembly. (a) Lens too far from the disc, (b) lens too close, (c) correct focus.

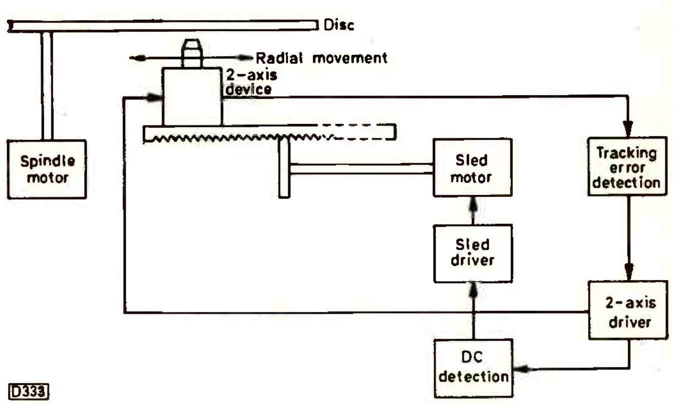


Fig. 7: The joint action of the two-axis device and the sled maintains correct tracking. The tracking arrangements must be able to operate in the forward and reverse directions so that tracking is also maintained in the reverse search mode.

side-beam detectors which are referred to as E and F. The output voltages obtained from these detectors are added in antiphase so that, when the tracking is correct, the net output voltage is zero. Fig. 8 shows the action. When the tracking is correct, the two side beams fall primarily on the non-track (mirror) surface of the disc and the E and F detectors provide high outputs. When

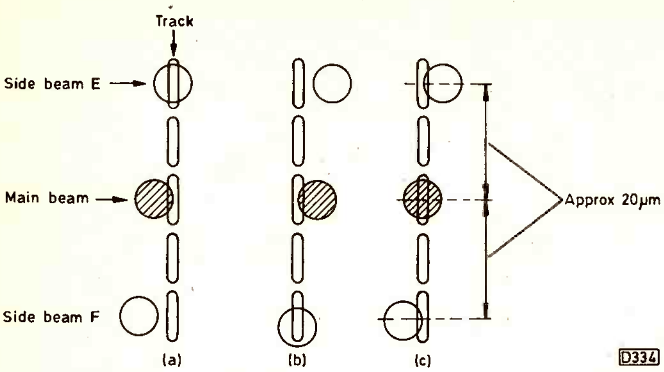


Fig. 8: Obtaining a tracking feedback signal with a three-beam assembly. (a) Mistracking to left: E – F is less than zero. (b) Mistracking to right: E – F is greater than zero. (c) Correct tracking. E – F = 0V.

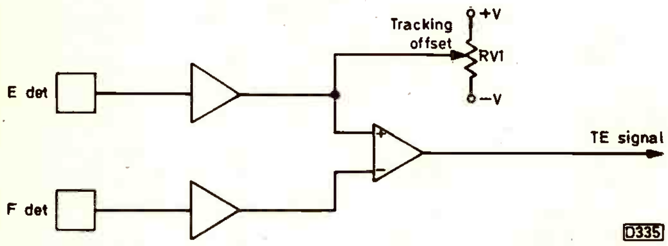


Fig. 9: Amplification and addition of the E and F signals.

the main beam is off-track, one side beam will fall entirely on the mirror surface (maximum reflection) while the other will pass over the pits (minimum reflection). The difference between the E and F output voltages is fed back to the servo.

Fig. 9 shows how the E and F outputs are amplified and added – this addition takes place at the r.f. amplifier stage. When the F output is high, condition (a) in Fig. 8,

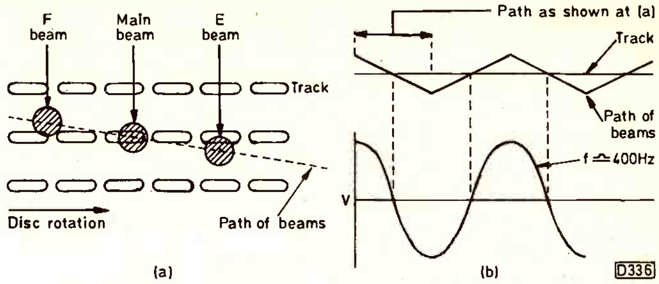


Fig. 10: Because the track spirals outwards, there is a continuous tendency towards incorrect tracking. This is shown at (a). As a result, the tracking error signal is cyclical with a frequency of about 400Hz, as shown at (b).

the result is a negative output. This signal is used to move the objective lens to the right (as viewed in Fig. 8). Conversely when the E output is high a positive output is obtained to move the lens to the left. Condition (c), correct tracking, gives a zero tracking error (TE) signal.

These remarks may give the impression that the output from the TE amplifier is always 0V when the disc is being played normally. In practice however the beam has a tendency to move off track because the track is constantly spiralling outwards. With correct tracking adjustment for zero output the lens will be in a fixed position. As the track spirals outwards, the beam starts to deviate from the track. This is shown in Fig. 10(a). As a result a TE voltage is generated. The TE output provided by the circuit shown in Fig. 9 is thus a cyclic voltage, because of the need for continuous beam alignment correction – see Fig. 10(b). The frequency of the TE signal is around 400Hz.

RV1 in Fig. 9 is usually called the tracking offset control. It's used to compensate for the different gains of the pickup detectors and amplifiers. If it's misadjusted, the player will either fail to work at all – it won't even

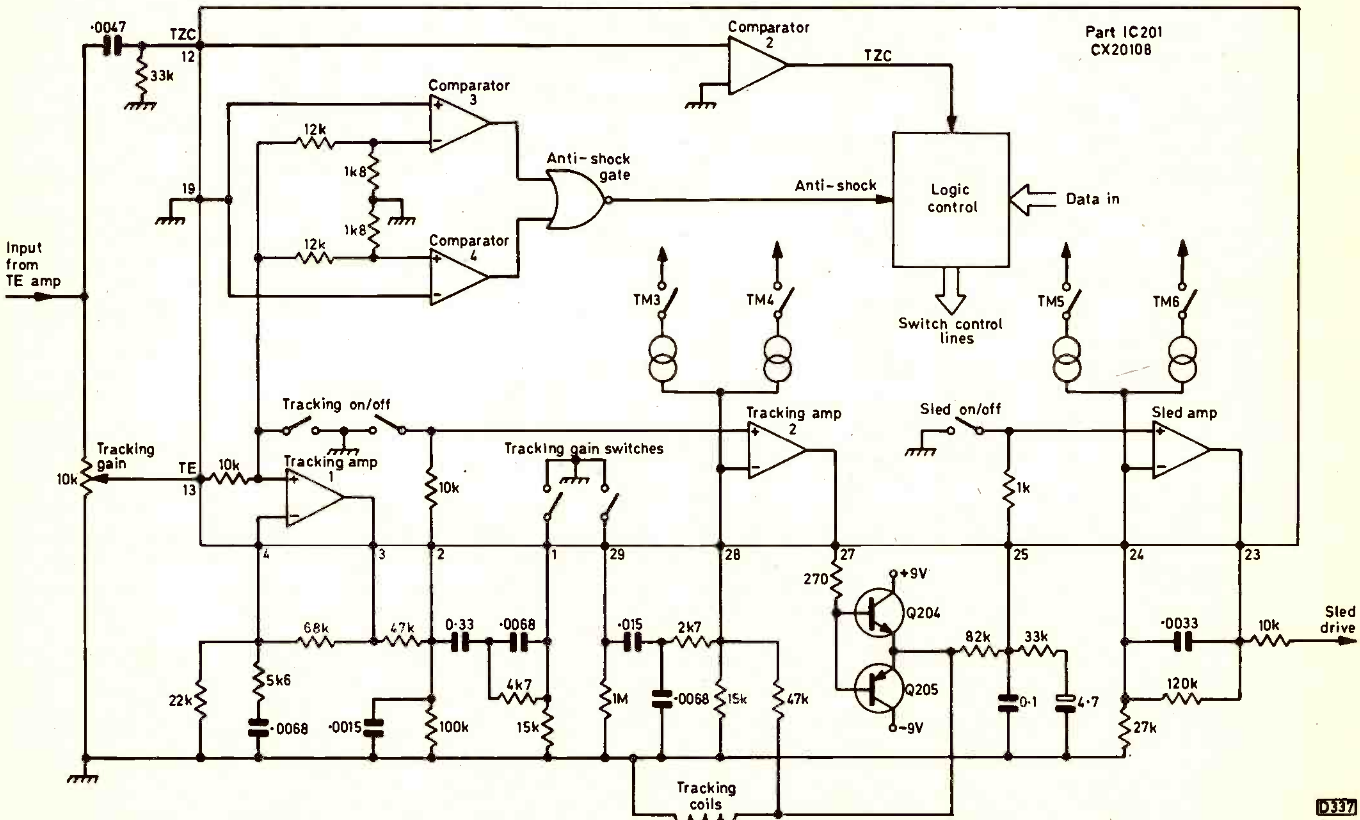


Fig. 11: The tracking servo circuit used in the Sanyo CP-08 CD player.

locate the table of contents for the front display information – or will play only certain discs whose track eccentricity is not too extreme. As with the focus offset adjustment, the setting is critical and should be carried out following the manufacturer's instructions. In addition, it's good practice to check the tracking adjustment by using the skip function to move the laser to the outer edge of the disc, where the track eccentricity is greatest. A disc with a playing time of at least an hour should be used for this test. In later players the d.c. offset correction is carried out within an i.c. and RV1 is not required.

Typical Tracking Servo Circuit

Fig. 11 shows a typical tracking servo circuit. It's used in the Sanyo Model CP-08 and is based on the Sony CX20108 servo chip. The TE signal, derived as shown in Fig. 9, is applied to pin 13 of IC201 for further amplification. The tracking on/off switching is activated by the chip's internal logic control system: it sets the two-axis device in its horizontally central position when the player is in the stop mode. Drive for the two-axis device's horizontal coil driver transistors Q204/5 is provided at pin 27 of the chip. The input to the sled amplifier is such that no output is obtained at pin 23 until the two-axis device approaches its 70μm extremity. At this point the current flowing through Q204 will be large enough to provide an output at pin 23, as a result of which the sled motor will be energised,

A point to note is the operation of the two comparators 3 and 4 which drive the anti-shock gate. The gain of tracking amplifier 2 is normally low. In the event of vibration due to the machine being nudged however the servo's gain must be increased in order to correct the tracking quickly before an audible skip is heard. For this purpose the comparators monitor the TE signal input via 12kΩ resistors. If the player is subjected to a shock, the amplitude of the 400Hz TE voltage will increase and the comparators will make the logic control system open the switch at pin 29 and close the switch at pin 1. As a result, the changed bias applied to amplifier 2 increases its gain. This circuit is also used when the player is carrying out the track skip or jump operations.

The amplifier's gain is kept low during normal play so that the servo is less affected by small scratches or dirt particles. If the gain was permanently high the servo would be more likely to start hunting when scratches or dirt are encountered. In practice a scratched disc may produce a large enough TE signal to activate the anti-shock circuit, making the servo hunt. This results in sticking or jumping as the disc is played. To prevent this, some players have a customer-operated switch to override the anti-shock circuit, thus improving the chances of being able to play a poor-quality disc.

Switches TM3/4 alter the d.c. output from tracking amplifier 2 when the player is carrying out a track skip.

The TE signal is fed to pin 12 to obtain the tracking zero cross (TZC) signal which is used for a similar purpose to the previously mentioned FZC signal.

Single-beam Tracking Systems

With a single-beam laser assembly there are only four pickup detectors from which to derive the data, focus error and tracking error signals. The main problem is in separating the FE and TE signals: this is done by using different ways of summing the four pickup outputs in the tracking and focus servo circuits.

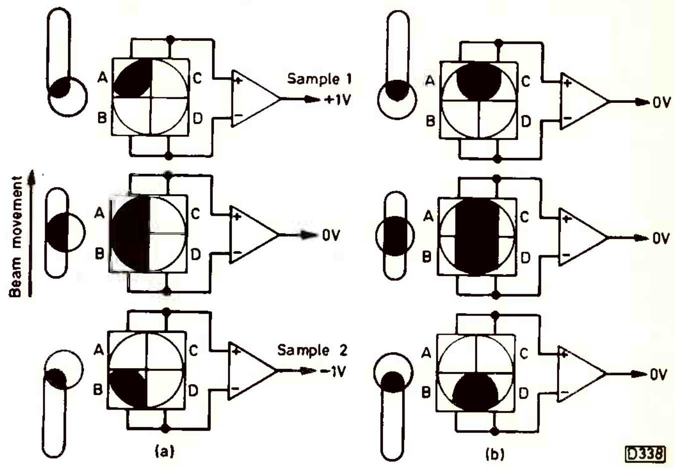


Fig. 12: Sony method of obtaining a tracking error signal with a single-beam laser assembly.

We've seen that with the Sony single-beam device (Fig. 5) the photodetector outputs for the focus servo are summed in the manner (A + B) – (C + D). For the tracking servo the outputs are summed as (A + C) – (B + D). From here on the story gets a bit mathematical.

As the beam moves over a pit, its position relative to the pit is monitored by the photodetectors. To obtain an accurate TE signal the position is measured twice: once as the beam approaches a pit, i.e. when it's half over the pit, and again when it leaves a pit, i.e. when it's half off the pit. These two measurements are subtracted to produce the resultant TE signal. A squarewave signal derived from the off-disc r.f. component is used to detect the instants when the beam starts to scan then leaves a pit.

Fig. 12 shows the basic idea. The operational amplifier receives A + C at one input and B + D at the other. In this diagram the darkened areas represent the reduced light detected when a pit is scanned, resulting in a low output from the relevant photodetector(s). In (a) the beam is out of alignment with the track. When sample 1 is taken a positive output is produced whereas sample 2 produces a negative output. The two outputs produce a positive TE signal when summed. Had the beam moved to the left of the track a negative output would have been produced. Correct tracking is shown at (b), where a constant 0V TE signal is produced. Note that the signal level may in practice vary from this idealised state, i.e. a predetermined d.c. voltage may be present at the summing amplifier's output when the tracking is correct.

With the Philips single-beam device the tracking error signal is obtained by summing the detector outputs as (3 + 4) – (1 + 2) – see Fig. 6. When the beam moves off the track the reflected beam still falls centrally on the two pairs of pickup detectors. What happens however is that one half of the reflected beam is brighter than the other, because it's no longer crossing any pits. When this beam is split into two halves the bright side will fall centrally on one pair of pickups, say 3 and 4, while the darker side will fall on the other, 1 and 2 in this case. Applying these signals to a summing operational amplifier generates a TE signal.

A further dimension had to be added to the Philips system to compensate for dirt, disc impurities, mechanical tolerances etc. that could make one side of the beam darker than the other, giving rise to a TE signal when the

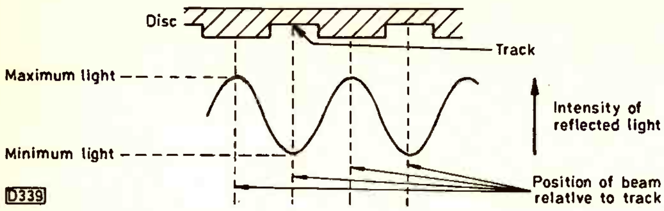


Fig. 13: How the intensity of the reflected light changes as the position of the beam relative to the track varies.

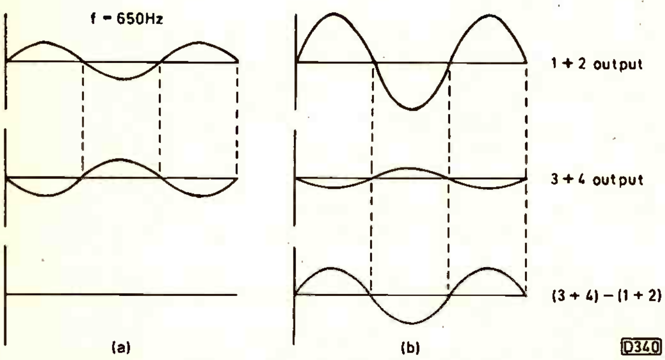


Fig. 14: Principle of the additional fine tracking system in the Philips single-beam arrangement: (a) shows correct tracking, (b) incorrect tracking.

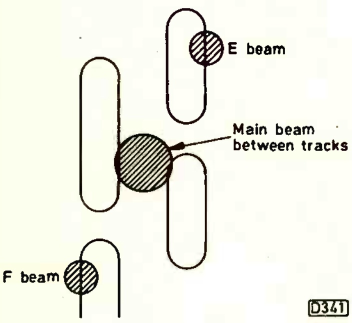


Fig. 15: One drawback with a three-beam laser assembly is that with the main beam between two tracks the summation of the output from the two side-beam photodetectors E and F is zero. The output from the mirror detector reveals this condition.

tracking is correct. A sinusoidal 650Hz signal is passed through the tracking coils to make the beam oscillate from side to side by about 0·1μm (remember that the pits are 0·6μm wide). The result of this is a small 650Hz sinusoidal output from both pairs of pickup detectors, with the output from one pair 180° apart in phase from that provided by the other pair, due to inversion in one of the summing amplifiers. Fig. 13 shows that when the tracking is correct the average reflected light is minimum and that when the beam is off the track the reflected light increases to a maximum. Thus when the tracking is correct the amplitude of the 650Hz signal will be small. Furthermore, when the two 650Hz signals are added they will, being equal and opposite, cancel out – see Fig. 14(a). When a tracking error occurs, the amplitude of the 650Hz signal will increase – but only at one pair of detectors. It will be reduced at the other pair. When these sets of outputs are added – see Fig. 14(b) – a resultant that can be used as a fine tracking control, in addition to the TE signal derived from the main beam, is obtained.

In practice the 650Hz signals are not simply added. They pass through a synchronous detector to ascertain the phase of the resultant. From this the servo knows in which direction to deviate the beam.

It's worth noting that with the Sony and Philips single-beam arrangements a focus error doesn't produce any d.c. change in the tracking error circuit and vice versa. Careful consideration of the principles shown in Figs. 5 and 12 will make this clear. This being the case, we can safely assert that the two signals have been separated.

Mirror Signal

The mirror signal generated in the r.f. processing stages is used for a number of important purposes. The detector operates by monitoring the r.f. level. If the beam is for any reason permanently on the mirror surface of the disc the r.f. will fall to zero. This loss of r.f. signal changes the logic condition at the output of the mirror detector.

In a machine that employs a three-beam laser assembly the most important function of the mirror signal is to combat the situation shown in Fig. 15, where the main beam is directly between two tracks and the TE signal is zero, suggesting correct tracking. As the main beam is focused on the disc's mirror surface the r.f. output is also zero. Under these conditions the mirror detector's output will indicate loss of r.f.: if this signal is passed to the servo logic control, the tracking can be readjusted to bring the beam back into alignment with the track.

Another function of the mirror signal is to alter the gain of the tracking servo when a dropout occurs due to a bubble in the disc's transparent coating. When such bubbles are encountered they can distort the beam path and make the track appear to be crooked. By detecting these bubbles the servo gain can be reduced so that it's less likely to hunt and will thus be better able to follow the track.

When the beam passes a bubble, the r.f. output will fall. This will in turn cause a momentary change in the mirror logic. Clearly the bubble will return with the next disc rotation. The first mirror signal fluctuation starts a timer in the servo control logic. Each time the bubble passes, the mirror signal resets the timer. During the period when the bubble is present the timer reduces the tracking gain.

Not all players have this facility, which is just one reason why a particular disc may play on some players while with others there may be jumping or disc ejection when a certain music passage is reached.

We will see yet another vital role of the mirror signal when we come to look at track search techniques.

Having taken a detailed look at the focus and tracking servos, next month we'll concentrate on sled control and the disc speed servo.

This prototype video telephone exhibited by Siemens at Cebit 89 uses some of the techniques discussed in the following article. West Germany plans to start a video telephone service in the early Nineties.

Bandwidth Compression Techniques

Part 1

Tom Ivall

Recent developments in high-definition television in Europe, Japan and the USA have once more focused attention on the problem of the bandwidth required for a television system. Existing TV broadcasting services call for a vision bandwidth of 5-6MHz. HD-TV would need a lot more, depending on the system, because more visual information has to be transmitted in a given time to produce the higher resolution pictures.

Generating wideband vision information is no problem for broadcasters and other programme originators. Difficulties arise because of the bandwidth limitations of existing channels. For broadcasting and signal distribution over telecoms links the channel bandwidths are laid down by international agreement, through the International Telecommunications Union (ITU). They have been designed for existing broadcast and telecoms video signals, not for HD-TV.

The way to get round the problem is to use bandwidth compression. In a recent HD-TV project, the European collaborative Eureka 95 system, 4:1 bandwidth compression is used. This has been done in an attempt to make the system compatible with the DBS channel bandwidths laid down by the ITU's WARC 1977 conference on satellite broadcasting. The current state of development of the Eureka 95 (EU95) system was demonstrated at the International Broadcasting Convention, Brighton, in September 1988.

A parallel situation arises with television's non-broadcasting and non-entertainment applications. These consist mainly of closed circuit systems for videoconferencing, visual monitoring, industrial inspection, educational applications, surveillance and so on. Sometimes these have to make use of telecoms circuits to transmit the video signals. This means channels originally intended for voice and data, using coaxial cables, microwave links, optical fibres, right down to the standard twin-wire telephone line that comes into the home.

The bandwidth of the ordinary telephone line is about 4kHz, which is adequate for speech communication. In the past this has been one of the major problems in developing successful domestic video telephones – for example the experimental Picturephone in the USA and Viewphone in the UK. Advanced coding techniques have now overcome this bandwidth problem, the remaining obstacle to the start of videophone services being the question of marketing, i.e. price and demand. In video telecommunications generally, bandwidth compression factors of up to 2,000:1 are now possible.

From Analogue to Digital Technology

A bandwidth compression system has to provide adequate picture quality for the application concerned while using a channel bandwidth substantially narrower than that normally required for the output from a camera or other signal source. As far as I can discover, technology to improve bandwidth efficiency has been under development for about sixty years. My earliest record of such work is a 1929 British Patent (No. 341,811) for a bandwidth compression system intended for use with mechanical scanning using a Nipkow disc (see Fig. 1), but some readers interested in TV history may be able to beat this.

Early techniques all used analogue circuitry, with thermionic valves as the active devices. But since the digital revolution of the early Sixties, accelerated as it was by developments in semiconductor technology, the trend has been almost exclusively to the use of digital signal processing. Computer technology has had a big influence here, especially in the use of algorithms and programs for specifying the detailed logical steps to be followed in the digital processing.

Some readers will already be familiar with the use of digital techniques in domestic equipment – see for example the "Storing pictures in chips" series that began in the June 1988 issue and Part 5 (July) of the current series on "Servicing compact disc players". Central to this is the digitisation of analogue waveforms by sampling, quantisation and binary encoding. These processes are carried out by an analogue-to-digital (AD) converter. Once a picture has been converted into a stream of digital data, many sophisticated processes can be carried out on it, including reduction of the data rate for transmission.

Information Redundancy

The basic principle involved in bandwidth compression for television is to reduce the transmitted information rate by eliminating redundant information, i.e. visual information that's not essential for reconstructing a satisfactory picture at the receiver. What constitutes a "satisfactory picture" obviously depends on the purpose of the TV system – whether high-definition, standard broadcast, electronic cinematography, teleconferencing or slow-scan surveillance – and the associated viewing conditions.

Before getting involved with the technology, let's first

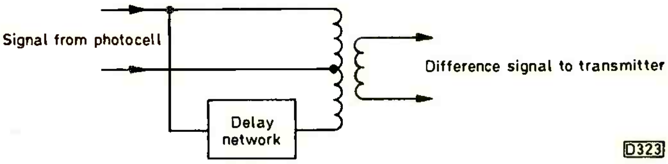


Fig. 1: This early bandwidth compression scheme, intended for use with mechanical (Nipkow disc) scanning, illustrates a basic principle used in many later systems. It reduces the transmitted information rate and thus the bandwidth required by transmitting only the differences between successive pictures (successive complete cycles of the Nipkow disc). The signal from the photocell is applied to the top half of the transformer's primary winding directly and to the bottom half via a delay network whose delay time is equal to one complete scan cycle of the Nipkow disc. Thus during any scan a delayed version of the previous scan is present in the bottom half of the primary winding, in phase opposition. If the two scans are identical they cancel out due to the phase opposition and no signal is induced in the secondary winding. If the scans are slightly different a corresponding difference signal is induced in the secondary winding and this is transmitted. At the receiver the incoming difference signals are integrated by a mechanical storage technique so that the original succession of complete pictures is built up again.

clarify what we mean by "information" and "information rate". This is particularly important with the latest digital techniques, where the signals are encoded into streams of digital data.

Information in an Electrical System

In digital data processing and communications it's normal to measure the amount of information in bits (binary digits) and to specify information rates in terms of bit/s (binary digits per second). Basically, information is created in an electrical system when a change takes place: no change means no information, while a completely random sequence of changes means noise. The simplest change that can be made is between two states, e.g. on/off, left/right, dot/dash (Morse code), black/white (television) and so on. This basic fact has provided many practical methods of signalling and of recording and storing information, and from the late Twenties onwards has provided a universally accepted method of defining and measuring information in precise terms.

Communication of information is basically a process of selecting signs from a given set of signs. This is so whether we are selecting sounds from a vocabulary, letters from an alphabet, words from a dictionary, voltage levels from a quantised set or brightness values from a set of grey levels. Writing in English involves successive selection of letters from a set of 26. In another language the total number of letters in the set may differ.

The smallest possible set is just two signs: below this there's no choice. Thus selection from just two possible signs – the binary choice – is the elemental choice. In binary notation and arithmetic the two signs are conventionally written as 1 and 0, though the actual characters used are unimportant. Since the binary choice is the basic element in selection it's also the basic item of information – on the principle of selecting from a set of signs, as discussed above. When one sign in a binary system is chosen we are saying "this one out of two possibilities". It has become the convention to describe the binary choice as being of either one of two digits, 1 or 0, hence the binary digit or bit. A semiconductor memory chip for holding binary information, e.g. a RAM, consists of a group of two-state circuits each of which can store one binary digit.

By making an ordered sequence of binary choices, on the "tree" or "branching" principle, we can select from much larger sets than just two states such as black and white – as large as we want in fact. For example, by carrying out a branching sequence of two binary choices we can select from say a set of four grey levels, quantised from a video waveform – black, dark grey, light grey and white. A sequence of three binary choices gives selection from a set of eight grey levels, a sequence of four gives selection from sixteen levels and so on. The general formula for this is

$$\text{number of bits} = \log_2 N$$

where N is the total number of signs (e.g. grey levels) in the set. For example, $\log_2$ of 16 = 4.

Information Rate

If a selection of one level out of 16 is made every millisecond, the information rate is 4,000 bits per second (4kbit/s). A broadcast video signal transmitted to a receiver has a maximum information rate of about 11 million bits per second (11Mbit/s). If this is encoded into 8-bit pulse code modulation (PCM) by an AD converter the resulting data stream will have a maximum information rate of 88Mbit/s.

Bandwidth and Information Rate

The relationship between information rate and bandwidth in television can be understood by considering video waveforms. In a luminance signal waveform, any transition between different grey levels can be analysed in terms of a set of sinusoidal components (Fourier analysis). A very sudden transition between black and white, representing a sharp edge in the picture, contains many high-frequency components.

This sudden black-to-white transition means that the waveform has passed through many intermediate grey levels in a very short time. If these successive grey levels are considered as signs that are selected from a set by binary choice, as discussed above, this brief section of waveform represents a large number of binary choices – bits – made in a very short time. In other words it represents a high information rate in bit/s.

Thus high-frequency sinusoidal components occurring at waveform transitions mean high information rates. Since a video signal's bandwidth includes all frequencies from zero up to the highest frequency sinusoidal components occurring in the waveform, a wide video bandwidth means a high information rate.

The precise quantitative relationship between bandwidth and information rate was defined by scientists such as Hartley, Nyquist and Shannon over the years from about 1928 to 1950. This relationship involves time, because of the frequencies and rates. It also brings in signal-to-noise ratio, since the presence of noise in a signal changes its waveform and thus reduces the accuracy with which true quantised waveform levels, e.g. grey levels, are selected from the whole set.

The relationship can be shown graphically, see Fig. 2. The volume of the boxes in (a) and (b) is proportional to a certain quantity of information in bits. A particular volume can clearly be obtained using boxes of different relative dimensions, which in this case represents bandwidth (Hz), time (s) and signal-to-noise ratio (dB). Thus the three box dimensions can be exchanged, or traded with each other, to give us the characteristics we require of say a TV transmission system.

In box (a) a given amount of information, say one line of a picture, is transmitted in a certain time, which determines the information rate (bit/s). If, as at (b), we allow more time to send the same amount of information, thus reducing the information rate, the bandwidth required is reduced (assuming a constant signal-to-noise

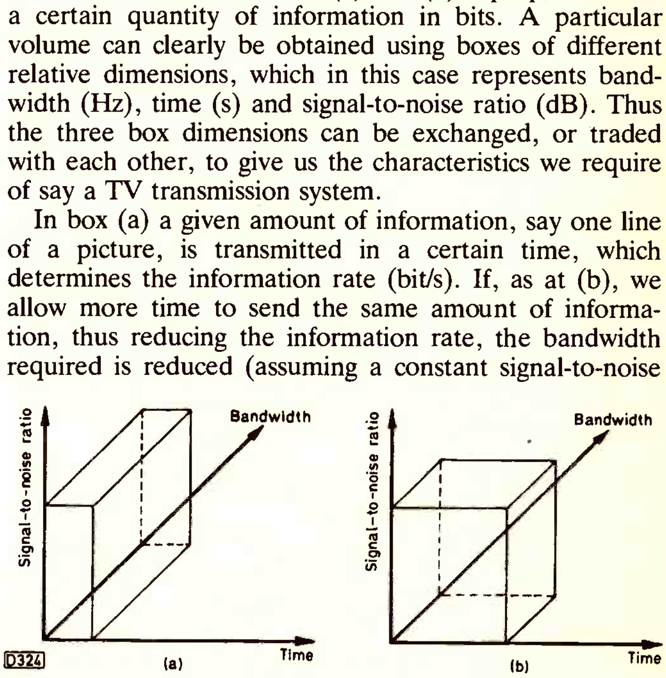


Fig. 2: Three-dimensional diagram illustrating the relationship between bandwidth, time and signal-to-noise ratio. In (b) the time taken to transmit the vision information is longer than in (a) so the bandwidth can be less.

ratio). This is of course what happens with slow-scan TV, where the required bandwidth is reduced by transmitting the pictures at a slower scanning rate – or a lower sampling rate in digital systems. Similarly, high-definition still pictures are transmitted from spacecraft at low digital data rates by allowing several hours for their transmission.

Some Existing Techniques

Before discussing the latest bandwidth compression techniques, let's put the subject into perspective by glancing briefly at some of the methods already in common use.

Vestigial sideband transmission, which is the accepted practice with a.m. broadcast TV, relies on the principle that all the modulation frequencies required for reproduction of the picture are contained in one sideband. Thus the channel bandwidth that would be required using double-sideband transmission (as in the early days of Alexandra Palace!) can, by suppressing one of the sidebands, be almost halved. A vestige of the suppressed sideband (the vestigial sideband, usually 0·75MHz or 1·25MHz wide) is retained to avoid the problem of having to reinsert the carrier at the receiver, as is necessary with strict single-sideband transmission.

A second bandwidth saving technique that has long been used for TV transmission is interlaced scanning. To avoid large-area flicker, the receiver's display screen must be refreshed at a rate of at least 50Hz (or 60Hz in the USA and other countries that use the same standards). If sequential scanning was used for this purpose the line-scan frequency, in comparison to interlaced scanning, would have to be doubled, calling for twice the bandwidth to achieve the same horizontal resolution. The use of 2:1 interlacing enables the picture rate to be reduced to 25Hz (30Hz) while still achieving complete screen refreshment at a 50Hz (60Hz) field frequency. In effect, the use of interlacing halves the bandwidth compared to what would be required for the equivalent horizontal resolution with sequential scanning.

Finally, compatible colour systems such as PAL make use of frequency interleaving to enable the extra colour information to be contained in the basic luminance channel bandwidth. This is possible because the frequency spectrum of the monochrome picture consists of regularly spaced peaks and troughs of energy, resulting from the fact that the picture is scanned at the line and field rates. The chrominance signal, which has a similar energy distribution pattern, is interleaved with the luminance peaks and troughs. Filtering enables the two sets of signals to be separated for processing in the receiver. In addition, because the human eye is relatively insensitive to fine colour detail (see later) the chrominance signal bandwidth can be made much less than that of the luminance signal.

Bandwidth Compression Principles

There are two main ways in which the information rate in a TV system, and thus the bandwidth, can be reduced.
(1) We can take advantage of the limitations of human vision and its tolerance to certain image impairments to avoid transmitting and displaying more information than the human eye-brain system can perceive. We can also exploit the fact that in some applications the user doesn't require broadcast-quality pictures.
(2) We can also take advantage of the inherent information redundancy in TV pictures in three dimensions, horizontal (line scan), vertical (field scan) and time (picture repetition). Unless the scene is changing rapidly, a lot of the information transmitted is the same from line to line, field to field and picture to picture. Coding techniques can be used to reduce the amount of repetition in the transmitted information.

We'll consider these in turn.

The Eye's Limitations

The acuity of the human eye – its ability to distinguish between closely spaced points or lines – is limited to about one minute of arc, or a resolution of 60 cycles per degree. This determines the fineness of the detail that can be seen at a given viewing distance. To transmit and display greater detail would be pointless. In addition, the eye is less sensitive to the loss of fine detail where movement occurs in the scene.

Another limitation of human vision is in its ability to distinguish between small differences in area brightness. The eye can distinguish between about one hundred intermediate grey levels between black and white, i.e. differences of one per cent of peak brightness. Again there's no point in transmitting and displaying more detail. For some applications, e.g. surveillance and inspection, the number of grey levels can be reduced to well below 100 by appropriate quantisation.

The eye also has well-known minimum requirements for picture repetition frequency to give the illusion of movement, and in screen refresh rate (e.g. the interlaced field frequency) to avoid large-area flicker at a given brightness level.

When it comes to colour, the acuity of the eye depends on hue, i.e. the eye is more sensitive to some colours than to others. In addition, as patches of different colours are reduced in area the eye begins to lose its ability to distinguish between their hues.

All video waveforms are subject to amplitude distortion and noise. The eye is more tolerant of impairments of this kind at sharp edges and regions of fine detail because these high-information regions have the effect of masking the noise and distortion.

Many of these characteristics are already exploited to the full in TV broadcasting systems in order to keep the bandwidth to an acceptable spectrum. Indeed from the HD-TV viewpoint they are exploited too far. HD-TV is all about revising the thresholds to achieve better picture quality. At the other end of the scale, for applications such as videoconferencing and surveillance, the broadcast picture quality is needlessly high. Thus there are opportunities here to save bandwidth by reducing the picture size, the spatial resolution, the temporal resolution (through a lower scanning rate) or, by quantisation, the number of separate grey levels.

A further limitation of the eye is its relative insensitivity to fine detail (high spatial frequencies) lying in diagonal directions across the field of view in comparison with fine detail in the horizontal and vertical directions. This so-called "oblique effect" is now being exploited for bandwidth compression in HD-TV by a technique known as diagonal filtering (see later).

Redundant Information

When it comes to redundant information, we are concerned with information that doesn't bring anything new to the eye during the repetitive scanning process. As an extreme case, consider a TV system that's transmitting a completely stationary scene. After the first complete picture has been scanned the information that follows provides nothing new because each scanned picture is the same.

A more typical example is the kind of camera shot where a person or object moves across a static background. Fig. 3 shows at (a) and (b) two consecutive pictures from such a shot. The two-dimensional pattern shown in (c) indicates in black the difference between (a) and (b), i.e. the new information supplied to the eye as the moving figure covers and uncovers part of the background. In principle it's necessary to transmit only

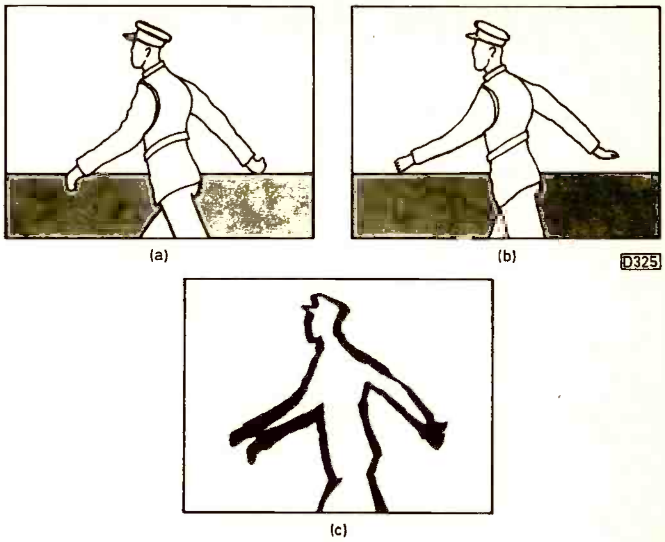


Fig. 3: Sketches – (a) and (b) – of two consecutive pictures from a camera shot. The black areas in (c) show roughly the difference between (a) and (b). Note that the background remains the same from (a) to (b).

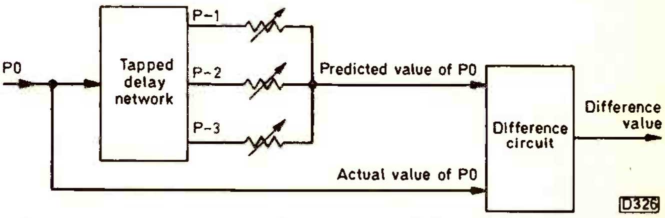


Fig. 4: Videophone analogue signal bandwidth compression system based on pixel-to-pixel linear predictive coding. The difference circuit compares the actual value of each pixel with an analogue-computed predicted value based on the value of several previous pixels.

the successive differences between pictures in order to be able to build up a normal, moving television image. This of course is the process that formed the basis of the early proposal shown in Fig. 1. The result is a reduction in the information transmission rate and hence the bandwidth required.

Fig. 3 illustrates the inherent redundancy of the TV image in the time dimension when there's a strong similarity between successive pictures. In addition to this redundancy between pictures, there's a high degree of correlation between adjacent pixels along each scanning line (redundancy in the horizontal dimension) and between adjacent pixels in successive displayed lines (redundancy in the vertical dimension). A typical case would be a temporarily motionless area of uniform brightness and colour, such as a background of clear blue sky.

Thus in principle it's necessary to transmit only the differences between adjacent pixels in the horizontal and vertical directions of each picture in order to be able to build up a normal, moving image. Where these differences are zero or small, e.g. with a clear blue sky, this enables the transmitted information rate and hence the bandwidth to be reduced. Measurements of pixel-to-pixel redundancy have been done on typical TV pictures. They were compared with an artificially generated reference pattern with theoretically zero redunancy (a very fine check pattern). The results indicate that in general pictures have up to 90 per cent redundancy to be exploited.

The TV system must still however be able to handle

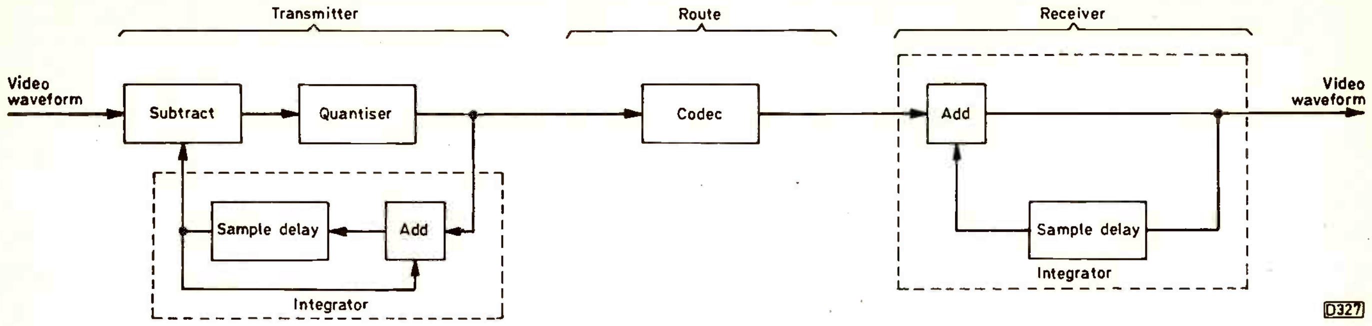


Fig. 5: An early digital compression system for videophone use, based on differential pulse code modulation.

the high image frequencies, i.e. high information rates, that occur when abrupt changes of brightness or colour are present in the scene. These typically occur with sharp edges and complex patterns, both spatially and temporally. This suggests that the full bandwidth is necessary anyway, and that no reduction is possible without impairment of the image under such critical conditions. In practice this problem can be solved by encoding the information stream in the video baseband signal. The idea is to "smooth out" the information rate so that it's always less than the peak rate that would otherwise be necessary to cater for such critical parts of the display.

Linear Predictive Coding

One of the coding principles that's proved to be particularly useful in exploiting pixel-to-pixel redundancy is linear predictive coding. Basically this predicts that each current pixel resulting from the scanning process will have a similar value to the previous pixel or pixels. If indeed successive pixels have exactly the same value there is redundancy and no signal information is transmitted. If the current pixel differs from the previous one(s), the difference value is transmitted.

This technique is nowadays applied to the binary data in digitised video waveforms. Early attempts to do it were applied directly to analogue waveforms as fast AD converters were not available. Fig. 4 shows the essentials of an experimental analogue system that was devised by Bell Telephone Laboratories in the early Fifties for the monochrome Picturephone project. Called a decorrelator, it uses a delay network to enable previous pixels (voltage levels in the analogue waveform) to be compared with the current pixel being generated. The delay network is tapped to obtain a predicted value of the current pixel P0, analogue computed from the statistical trend of the three previous pixels P – 1, P – 2 and P – 3. This is more realistic, in terms of the statistics of TV signals, than taking just the immediately previous pixel. It thus gives better prediction. The three attenuators adjust the relative weightings of the three contributions to the predicted value. The difference circuit – a cathode-coupled differential amplifer was used – measures the difference between the current and predicted value of each pixel and passes this on for transmission.

By making the delays in the network equal to the intervals between adjacent pixels along a scan line, the decorrelator can be arranged to reduce horizontal redundancy in the picture. In addition by making the delays correspond with the intervals between adjacent lines (in a sequential scan) the system can be set up to reduce vertical redundancy. Two such correlators working together will reduce both the horizontal and vertical redundancy. For further details, see "Experiments with linear prediction in television", *Bell System Technical Journal,* July 1952.

Differential Pulse Code Modulation

When AD converters fast enough to handle video waveforms became available the processes of sampling and quantisation were brought into the prediction operation. The result was a system called differential pulse code modulation (DPCM), a version of standard pulse code modulation. With DPCM, which is now well established in the telecoms field, only the difference between successive waveform samples is transmitted, not the value of each sample individually as with standard PCM. These differences are quantised and encoded into a digital signal for transmission.

Fig. 5 shows the basic arrangement used in an early DPCM bandwidth-compression system that was developed by the UK Post Office (now BT) in 1972 for an experimental 319-line Viewphone scheme. The line scanning frequency was 8kHz and the field rate (interlaced pictures) was 50Hz.

The system employs differential sampling and quantisation at the transmitter (the quantised samples correspond with the instantaneous slope of the video waveform), with integration at the receiver to reverse the differentation process. To avoid an accumulation of quantising errors by the receiver's integrator, differentiation at the transmitter is performed by a feedback loop. The quantised difference transmitted is not the difference between two picture samples but the difference between a new picture sample and a series of previously quantised differences.

By its nature quantisation introduces amplitude distortion. The DPCM system takes advantage of the eye's tolerance of amplitude distortion at edges and areas with high detail – this has a masking effect on the distortion (see previous comments). The system uses "tapered" quantisation. This quantises the difference signal accurately in areas where the distortion would be easily perceived while applying coarse quantisation where the masking effect can be relied upon. In this way the best possible use is made of a small number of quantising levels.

Adequate picture quality with the Viewphone system was obtained with a maximum sampling rate of 2·5MHz and digital encoding of four bits per sample. This resulted in a maximum information transmission rate of 10Mbit/s. Nowadays in similar but more advanced telecoms systems the information rate is reduced to 2Mbit/s.

Next month we'll consider bandwidth compression schemes for TV broadcasting.

TV Fault Finding

Reports from Philip Blundell, Eng. Tech., D.G. Horwood, Ian Bowden, Mick Dutton and Hugh MacMullen

Philips 24CE3578 (CP110 Chassis)

This set had no sound or vision, just a blank raster with the channel display showing E. This display indicates that the microcomputer thinks an external input is present at the scart socket, though there wasn't. An external input is sensed on the scart status line, which is normally at 4V in the TV mode but in this case was at 0V because the microcomputer chip was short-circuit to chassis internally. Some versions use the TMP47C432AP-8188, part no. 209 72038, while others use the version suffixed -8189, part no. 209 87305 (the manual lists only one of these). If you fit an -8188 type in place of an -8189 no teletext functions will be available. Guess how I found out! **P.B.**

Fidelity F14

If you cannot store the tuning voltage setting, check that the TAA550 33V regulator is producing the correct voltage – this device often goes leaky. **P.B.**

Philips NC3CR Chassis

The sound and raster would go after half an hour as the crowbar thyristor would then fire. I disabled the line output transistor and connected a dummy load across the output from the power supply. When the fault next occurred I found that the 100V line had gone high. The cause of the problem was an intermittent CNX62 optocoupler. **P.B.**

Philips G90 Chassis

For tuning drift, or no signals but the green bar moves, check the ZTK33B 33V stabiliser. **P.B.**

Vega 542

This small Russian-made monochrome portable came in with the complaint no sound. Its owner was prepared to spend "only a fiver" so I wasn't prepared to spend much time on fault finding. As I'd no circuit diagram, I traced the leads back from the loudspeaker. These took me to the top panel which could be hinged up by removing three screws. The two TO220-type audio output transistors were soon checked and found to be all right. I then traced the audio back to a strangely marked (Russian lettering) chip on the same panel. It appeared to be an intercarrier sound i.c., and when one of its pins was touched a buzz could be heard from the speaker. I concluded that the chip was probably faulty and was about to parcel up the set when I noticed that the strange chip had the same number of legs as the popular TBA120S. Out of curiosity I decided to try a TBA120S, and to my amazement the sound boomed out loud and clear. **D.G.H.**

Ferguson TX100 Chassis

Here's a point worth noting when servicing this chassis. Failure of the line output transistor/transformer is quite a common problem, replacement of one or both of these items restoring normal operation. Something that's often overlooked however is the BC372 line driver transistor TR8. If you have to replace the line output transistor/transformer in one of these sets the drill is to connect your meter to the base of TR8. The reading should be 0·8V. Any steady or significant increase with the meter left on for ten minutes or so means that TR8, which is a Darlington device, should also be replaced. Incidentally Ferguson now supply an improved device. **D.G.H.**

Ferguson ICC5 Chassis

This set failed at switch on when delivered to the customer's house. A bit embarrassing to say the least. You could hear the power supply pulse three times before shutting down. The power supply's h.t. output would pulse up to around 130V followed by a second pulse up to about 80V and a third up to only 40V. A voltmeter connected to pin 28 (safety sensing input) of the power processor chip IL14 revealed nothing, i.e. no high input was apparent.

We checked for shorts across all the outputs from the chopper power supply then all the rectifier diodes without finding anything amiss. So we disconnected the supply to the diode-split line output transformer LL53 and switched on again. This time the h.t. came up – in fact it rose to some 170V, but the power supply didn't shut down, pointing to a fault somewhere in the line output stage. All the secondary supplies from LL53 were checked for shorts, then the rectifiers were checked. This revealed the culprit. DL55 (BA157) which is used to provide the 200V supply was short-circuit. **I.B.**

Sony KV2096 (XE4 Chassis)

There was intermittent loss of sound and vision, due it seemed to a mechanical problem – if the main panel was touched almost anywhere the fault would occur. After some careful flexing and tapping around the cause of the fault was found. There was a dry-joint at one end of coil L852 which couples the 12V supply to much of the set. **I.B.**

Salora K70 Chassis

This set had a very intermittent fault that had never been seen during several calls to the house. Apparently the picture would go bright red. A field engineer had replaced all the transistors in the red output stage on spec. during the last call, but after a couple of months the fault reappeared and the set was brought into the workshop. We ran it for several days until, much to our surprise, the fault occurred. A check revealed that the red output at pin 13 of the TDA3562A colour decoder chip ICB200 was at some 8V instead of the normal level of approximately 3V. Our past experience with this chip has been that faults are more likely to be caused by a peripheral component than the chip itself, so we looked around for something that might cause this increase. Voltage checks on the three cut-off level clamp capacitors CB226, CB221 and CB217 then revealed the reason for the increased drive. The voltage at pins 10, 20 and 21 should normally be about 7·2V. While the voltages at pins 20 and 21 were correct, the red reference voltage at pin 10 had increased to 11·5V. The black-level clamp action relies on feedback from the RGB output stages, so the cause of the fault had to be low feedback voltage during the time when the red beam current measurement was being made. What we found was that RH16 (33kΩ) was going open-circuit with increase in temperature so that there was no feedback voltage from the red output stage. **I.B.**

Panasonic TX5500 (U5 Chassis)

The complaint with this set was of intermittent loss of sound on ITV after an hour or so. When we'd run the set in the workshop for several hours a similar fault occurred: on changing channel from another station to ITV, no matter which channel number was used to store it, the field would take much longer to lock in. Sometimes the field would lock in then the tuning would appear to shift, turning the picture to black-and-white, after which the fault would correct itself. On a couple of occasions the field locked with the on-screen display too high so that only its lower half was visible. When this happened the sound was muted and could be brought back only by changing channels.

As the problem seemed to be connected with the field sync and there's no field hold control in these sets the TDA2579 sync/line generator chip IC501 was given a quick squirt of freezer. This restored normal operation straight away. So a new chip was fitted and the set was left on soak test. About five hours later the fault started again, exactly as before, and once more a squirt of freezer corrected it. Heating the area around the chip with a hairdryer then carefully cooling the individual components associated with the chip failed to bring anything to light. I then remembered the resistor on the underside of the panel, added as a production modification, from pin 18 of IC501 to chassis. It's value is 1MΩ and it isn't shown on the circuit diagram. We found that a 180kΩ resistor had been fitted. The area was heated again until the fault returned, then one leg of the resistor was cut free. This cleared the fault. Fitting a 1MΩ resistor in its place produced correct operation. **I.B.**

Philips CF1 Chassis

This colour portable came in dead – the power supply refused to start. We set about measuring all the usual things but couldn't find anything amiss. A short across one of the supply lines was suspected, but there was nothing that was measurable. As a last resort we unhooked the secondary side of the chopper transformer and connected a dummy load in the form of a diode and bulb. The power supply then came to life. When the 185V supply rectifier D6310 was reconnected the power supply shut down, but replacing it didn't alter the situation. What was happening was that the protection capacitor C2310 (1·5nF) in parallel with D6310 was going short-circuit under load. **M.D.**

GEC PIL Chassis

The customer complained about a rolling picture. We arrived at the house expecting a two-minute job – replacing the 4μF electrolytic that decouples the emitter of the sync pulse inverter transistor TR351. This was not to be. The electrolytic and the transistor were both changed, also the TDA1170 field timebase chip. We then took the set back to the workshop to investigate the problem with the scope. This soon showed that C353 (120pF) which couples the inverted sync pulses to the TDA1170 had gone open-circuit. **M.D.**

Amstrad TVR2

The TV section of this unit wouldn't switch on. The bridge rectifier produced a d.c. output which was present up to the power supply chip. Replacing this item didn't provide a cure and as we'd no manual we resorted to component checking on spec. When C1507 (1μF) was replaced we were rewarded with a healthy line whistle and the rustle of e.h.t. We also replaced the other two electrolytics in the power supply as they appeared to be in a distressed state. **M.D.**

Samsung BT309K

The problem with this set was a blank white raster. It didn't take us long to pin the fault down to the detector can in the i.f. strip, but when it was removed we couldn't find anything wrong with it. A replacement was ordered and fitted, providing a complete cure. **M.D.**

Panasonic TX1752

This was an unusual one: there was no sound with teletext. It's better not to ask how long it took us to find that the cause of the problem was IC171 (SAB3035). **M.D.**

Sharp C1891

When one of these sets came in with the complaint of intermittent brightness variation we looked at the transistors in the clamping circuit. They are notorious for causing this fault. Not this time however – the high-value resistors in series with the first anode control were arcing intermittently. **M.D.**

Hinari CT16

The complaint with this new portable was no sound. We found that Q802 went open-circuit intermittently when warm. **M.D.**

Ferguson TX90 Chassis

The problem with this 20in. model was that the field scan shrank after a couple of hours. We eventually found that R187 (6·2kΩ) in the chain of resistors that form the load for the field driver was going high in value when warm. It read correctly with no voltage applied. **H.MacM.**

Grundig A3106

Very occasionally there was no luminance. The cause turned out to be a dirty contact at pin 11 of IC2594. The solder looked all right but there was a small positive voltage instead of −3V. **H.MacM.**

Philips K35 Chassis

On the odd occasion there was no remote control operation. We found, only by accident, that the socket for IC1 was dirty at pin 13. Under the fault condition there was no control waveform at the pin of the chip though the waveform was present at the socket. **H.MacM.**

Teletopics

SATELLITE TV LATEST

Alan Bond, whose Australian companies have run up substantial losses during the past year, has paid his final agreed contribution to BSB. The £27·5m payment brings his investment to £154m, giving him a 35 per cent stake in BSB. Meanwhile BSB's communications subsidiary DataVision has announced its first customer, the Press Association. DataVision is a licensed specialist satellite service operator – under the terms of the SSSO licence it's able to transmit information (video, audio or data) from any point in the UK via satellite to groups of users within the UK. The PA plans trial transmission of news and pictures to six regional newspaper groups. ITT Intermetall, which has been developing the decoding/descrambling chips for BSB receivers, has announced that the 21st version of the chip set operates 99·5 per cent correctly. It's understood that only small changes will be required to make the 22nd set 100 per cent operational. Bulk production of the chips can then start – problems with the development of the complex VLSI two-chip set led to BSB's start of service being postponed. BSB hopes that some 80,000 receivers will be available in the shops by March, when the services are due to begin. An order for 70,000 Squarials has been placed with Matsushita.

Asked about the long-term prospects for Sky Television, which is at present loosing over £2m a week, Rupert Murdoch said in a recent TV interview that he would keep it going for a minimum of five years. If profitability had not been established by then the operation would be sold or closed down. The number of Sky Television installations rose to some 230,000 during September, the best month to date. Many other households receive the channels via cable of course.

The government plans to rationalise the rules on satellite dish installations. A green paper on the subject is to be issued shortly by the Environment Department. New restrictions could be imposed on those living in conservation areas.

Ferguson's Astra satellite TV receiver, which was described on pages 46-7 last month, is being upgraded to include stereo sound capability. An S suffix on the model number indicates that stereo sound circuitry is incorporated. Panasonic has entered the Astra TV market with a dish/LNB/tuner package, type TUS100, which is expected to sell for £450 or £480 depending on dish size. The LNB has a noise figure of 1·3dB.

According to Grundig not a single STR20/22 LNB that has been returned as faulty has in fact been defective. A 100 per cent calibration check has been carried out on all returned LNBs and none have failed this check. A test LNB unit is to be made available to dealers at £45 (one per dealer) to provide an aid for technicials and installation engineers.

BUSINESS NEWS

Amstrad's profits for the year to June 30th fell from £160m last time to £76m. Turnover was much the same however. The company has suffered from problems with its latest computer range, the squeeze in the consumer electronics field, failure of the satellite TV market to take off as expected and problems with its Spanish subsidiary. It is to pull out of the audio market and will be closing down its manufacturing operations in Hong Kong and Essex.

Just after we went to press last month news came through that Hinari has called in administrators from insolvency practitioners Cork Gulley. The aim of this move is to try to maintain trading while looking for a purchaser.

The Granada Group has sold Laskys to Comet, a subsidiary of Kingfisher (the Woolworths group). Granada had bought Laskys from hotels and leisure group Ladbroke just three years previously and will show a small book loss on the transactions. Most of the 58 Laskys stores are being converted to Comet outlets though the Tottenham Court Road store will keep its original name.

Alba's profits for the year to June 30th fell only slightly, from £4·61m in 1988 to £4·08m. Turnover rose 79 per cent however, helped by two acquisitions including Bush Radio which was bought in May 1988. The fall in profitability is put down to the increasingly difficult trading conditions in the consumer electronics field.

Murata, famed for its integrated filter packages, is to start manufacturing at Plymouth, Devon. It's taking over a factory that had been used by Texas Instruments for chip packaging. Murata will invest £45m over five years, creating 950 jobs.

VIDEO NEWS

The five-hour BASF E300 video tape mentioned by George Cole in his Berlin Radio Show report last month has been launched in the UK but will be available in only limited quantities initially. The suggested retail price is around £6·99.

Pioneer in conjunction with the Japanese international telephone company KDD has developed a re-recordable laser disc system capable of storing half an hour of sound and vision. The disc is an optomagnetic type. Production is expected to start within two years, initially for professional use as the discs are made of glass and are fragile. A plastic version for domestic use is being worked on.

Canon is about to launch in the UK a PAL version of its video stills camera. A two inch square magnetic floppy disc is used to store up to 50 full colour pictures. The camera can erase and playback directly to a VCR or TV set, making a separate playback unit unnecessary. In good light it can record up to three frames per second. The suggested retail price will be £499.

NEWS FROM TANDY

Tandy has added to its range of video and audio accessories the Realistic Four-in-One universal remote control unit. Selling at £39·95, the unit is compatible with most IR systems and can be used to replace up to four different handsets.

Tandy's 1989-90 catalogue is now available free of charge at the company's stores and authorised dealers throughout the UK. The catalogue has 140 pages and features 2,452 products, 469 of which are new.

TV DEVELOPMENTS

Loewe has introduced at £3,000 a luxury set fitted with a 95cm (about 38in.) Philips Blackline tube. Features include a built-in satellite tuner, multistandard operation, S-VHS compatibility, Nicam stereo sound, Fastext, childlock, end-of-broadcast switch off and multilingual on-screen menus.

Texas Instruments is working on a high-brightness projection system for high-definition TV displays. The light for the display is modulated by what's called a DMD – deformable, mirror-based display. This consists of a chip to which an array of minute movable mirrors – each mirror forms one pixel – is attached. The mirrors are controlled by the semiconductor elements beneath. The principle can also be used for switching in fibre-optic communications systems.

Test Report: Futek FV-1 VCR Tool Kit

Eugene Trundle

A wide variety of mechanical adjustment points and fixings are encountered with VCR decks. Some of these call for the use of special tools. The FV-1 tool kit reviewed here was designed with this in mind.

The kit is housed in a zip-up mock-leather wallet measuring 15 × 24cm, with a wrist-strap. It contains fourteen specialised hand tools and a plastic wallet full of hex wrenches. There are elastic retaining sleeves to keep everything in place. This gives quick indication of whether anything is missing when the kit is put away.

You get three reversible screwdrivers with plain and crosspoint blades, small, medium and long in each type; a video head puller with adjustable fixing points on its cross-bar; a 15cm long retaining-ring remover to deal with C-shaped shaft clips between 2 and 4mm in size; a double spring hook, 21·5cm long, with ends capable of pushing and pulling tension springs to hook them into place; a "micro-screwdriver" with crosspoint tip and 2mm diameter shaft; and a set of eight millimetre hexagonal wrenches in sizes 0·71, 0·9, 1·27, 1·5, 1·6, 2, 2·4 and 3mm.

The other tools are for video deck adjustment and have large, knurled tops for good finger grip. There are two fine-adjustment drivers with pinion teeth and 2 and 3mm centre spigots, typically for adjusting back-tension straps; two fork-shaped split-screwdrivers that fit tape inlet and exit guides; an eccentric screwdriver with a 1 × 6mm paddle-type blade, as needed for lateral adjustment of the audio/control/erase head on some decks; a larger screwdriver of similar purpose with a square base and 1·5mm blade; and an inclined base driver with a slot milled in its stepped, at 3 and 5·5mm, shaft.

The large reversible screwdrivers are of Hozan make. They look strong and are positive in action. The steel blades, which are hard and resistant to chewing, are held in place by hexagonal plastic grips. The selection of sizes enables any screw found in a VCR to be dealt with.

I have only once encountered a video head drum that I couldn't remove by hand, and have no doubt that the puller provided in the kit would have shifted it. Slots on the cross-bar accommodate any fixed centre spacing, but not all video heads are amenable to this tool – it depends on the presence of threaded holes in the head drum.

The spring-tensioned retaining ring remover (sometimes called circlip pliers) looks rather tinny – it's made of pressed steel. I feel that it's stronger than it looks however and that it would cope with all but the largest and toughest of retaining rings. But the ends could become worn in time, especially if it's regularly used for dealing with the likes of under-deck machinery in the Philips VR6462 and its clones and cousins.

The long, slim spring hook is very handy for retrieving and holding links and couplings as well as seizing and hooking on springs. A further use for it is angling for bits dropped into the deck. If the kit was mine to keep I'd file down the hook ends to sharp points for greater versatility.

Hex wrenches are difficult to get in very small sizes: the three smallest (0·71, 0·9 and 1·27mm) in this set are very useful. Between them the eight provided fulfilled virtually every requirement I've encountered in VCRs and camcorders.

So we come to the main feature of the kit, the special eccentric and inclined-base drivers and adjusters – some of which, in the review kit, had a tendency to rust. I tried them on many makes and models of tape deck and was disappointed to find that though there were many that they fitted there were many that they didn't – in some cases I could have reshaped them to suit with a hacksaw and file! It would be pointless to list the machines that they did or didn't fit, but in a week's work I came across several examples of tape guides, back-tension adjusting racks, ACE head mountings and suchlike with which the kit didn't help at all.

This is my main criticism of the outfit. I believe that with more research and an eye to a wider range of VCR deck designs much greater versatility and usefulness could have been achieved. With a wider choice of ends, perhaps on a snap-into-handle basis, virtually all VCR deck adjustments could have been catered for in a kit of this size and price. I would cheerfully have done without one or all of the reversible screwdrivers, excellent though they are, for extra sizes and sorts of slotted guide drivers, a square key to fit certain Philips-style tape guides and so on.

Conclusion

Like the curate's egg, this kit is good in parts. Rusting steel apart, it's quite well made and wear resistant. Twenty two tools plus a tailor-made, pocketed wallet to retain, display and protect them is perhaps reasonable value for money at £59·95 plus VAT. I would not however put it at the top of my tool shopping list because the large reversible screwdrivers duplicate what I and every other engineer already have, while the specialised tools, well designed and useful though they are, do not fulfill enough of my needs to justify the price.

On the positive side, the basic kit would form a useful and convenient outfit when supplemented by the other specialist tools and jigs available from VCR manufacturers. These could, at a pinch, be accommodated in the spare space within the wallet.

Availability

The kit is listed as type VCRATK1 in the HRS catalogue. For further details apply to HRS Ltd., 11 Garrett's Green Lane, Garrett's Green, Birmingham B33 0UE (telephone 021 789 7575). Note that HRS deal only with trade customers.

CD Player Casebook

Reports from Mike Leach, Alfred Damp and J. Taylor

Technics SLP8

This machine came into the workshop with the complaint that the tray operation was intermittent. It opened all right, so we inserted a disc. When the open/close button was pressed the tray shut partially then opened again. This happened several times before the tray finally shut. The TOC was read and all functions worked normally, including open/close.

The tray switch was clearly visible when the machine's top cover was removed. We left the machine to stand for several hours then tried again. Once more the tray partially closed then opened. This time we touched the tray switch contacts as the tray closed. Doing this cleared the fault, so we removed and dismantled the switch to clean the contacts. It's not easy to do this as the switch is very small. When the switch was replaced the fault had cleared – for three months.

When the machine came back with the same fault we found that the switch was working adequately but something mechanical was obstructing the tray's movement. So we stripped down the tray assembly to inspect the two runners at each side of the tray. They are located beneath two stainless steel strips, held in by three screws. The runners themselves are plastic, with plastic ball bearings inserted in them. These ball bearings had seized, causing erratic movement of the tray. We cleaned off the old grease and freed the bearings with thin oil. The tray itself was cleaned and regreased. After reassembly the unit worked perfectly. **M.L.**

Yamaha CDX700

The fault report with this machine was "faulty left channel". When we played a disc we found that there was a certain amount of noise and distortion in the left-channel audio. The right-channel audio was o.k. The PCM56P AD converter chip IC503 was suspected and when this was replaced we had a complete cure.

I've had to change several DA converter chips in various machines. The fault symptom is often a wind-like noise in one or both channels – a sound rather like an off-tune f.m. tuner with no mute. **M.L.**

Philips CD104

The customer complained that the right-channel sound was distorted. When we played a disc we noticed a small amount of distortion on loud music passages. The left channel output was affected, but not as much as the right channel output.

Scope checks were carried out around the audio stages but these led us nowhere. After the error correction stage there are several chips that could cause such a fault. The SAA7000 interpolation and muting chip has given us problems in the past, but our main suspect was the SAA7030 digital filter chip. We keep one of these in stock, so in it went as a substitution check. This made no difference. Bells then started to ring. We had had a very similar fault not long since with a Philips CD150. The −18V supply to the DA converter chips had crept up when the player was warm. When we made d.c. checks around the DAC chips in the faulty CD104 we found that pin 11 of IC6520 (TDA1540) was high at −25V instead of −16·8V. We traced the supply back to a 79 series regulator (IC6453) on the power supply board and found that this was leaky. A new 7918 restored the supply to −18V and cured the distortion in both channels completely. **M.L.**

JVC XL-V2B

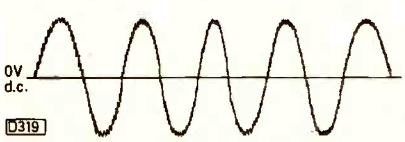
This player worked fine with some discs but not with others. We frequently encounter this fault symptom with many different types of players. There are various causes for it.

While this machine was apparently working all right the slider motor would suddenly send the laser assembly slam into its end stop then back again. It would do this sometimes at the TOC readout and sometimes when attempting to skip tracks. The first thing we had to do was to find a disc that the machine would play correctly, so that we could try the set-up procedure as laid down in the manual. We checked the laser power with a Leader LPM8000 laser power meter. It was slightly low but we were able to adjust it for the correct 0·25mW. This enabled us to maximise the amplitude of the EFM signal, using the focus offset control R209 as specified. The signal was somewhat distorted however, and the middle section of it was blurred. Next we adjusted the tracking offset control R370 for a 0V d.c. level at point TTE, with TTS and TTS connected to earth. See Fig. 1. For good, stable tracking this adjustment *must* be correct.

When we attempted to set up the focus and tracking gain adjustments, the slider motor kept throwing the laser assembly to and fro. This made it difficult, though only slight adjustment was required. The adjustment of the PLL coil L503 was next checked. We found that almost one complete turn was required to obtain the 50 per cent duty waveform shown in Fig. 2 (oscilloscope connected to pin 4 of the SAA7020 chip – MCES spindle motor waveform). This adjustment must be exact as it controls the rotation of the spindle and thus the bit rate recovered from the disc.

The EFM signal was still poor and the next step was to check the mechanical adjustments on the laser assembly. We connected a d.c. voltmeter to TF4 on the servo PCB and obtained a reading of 21mV. This showed that the turntable height was within specification. We lowered the turntable slightly to obtain a reading of 10mV. JVC states that ±50mV is within tolerance.

Adjustment of the tangential screw, underneath the laser assembly, produced a much clearer EFM signal. In fact the player produced slightly better results after this



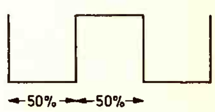


Fig. 1 (left): Tracking offset o.k. with respect to the 0V level.

Fig. 2 (right): The correct MCES spindle motor waveform at pin 4 of the SAA7020 error correction chip.

adjustment had been carried out. The fault persisted however, and it was beginning to look as though the problem was caused by a worn laser. The focus and tracking offsets were checked again, following the mechanical adjustments, but the slider motor would still slam the laser assembly against the end stop. At this point we decided that a new laser assembly would have to be ordered. After obtaining one, fitting it and going through the whole setting up procedure again the fault had cleared.

This experience shows that though the laser power is correct the unit can be faulty for various other reasons, i.e. poor photodiodes, intermittent focus and tracking coils, laser spot too wide, etc. With the new laser assembly the player produced good results, the access time from first to last track being approximately four seconds. **M.L.**

Kenwood DP840

No open/close was the fault report with this player. In fact it would do nothing at all – no functions, no display. After removing the top cover we carried out checks on the power supply rails. There were no problems here, so the front panel was removed. The player then began to function normally. As all connections on the front panel seemed to be o.k., attention was next turned to the main PCB.

Upon removal we found that plug J7 – main PCB to front control panel – was dry-jointed while Q602 (TA7354P) had one pin that was very poorly soldered and wasn't making a good connection. When we'd carried out some resoldering in this area normal results were restored. **M.L.**

Sony CDP101

A fault that's becoming common with these machines is failure of the STK6922 sled motor drive chip IC304. The usual symptom is that the tray opens by itself during play: sometimes it won't open at all when the machine is warm. The chip contains an operational amplifier that's associated with the "chucking" motor for the open/close facility. Replacing it usually cures the fault.

It's also worth checking switch S905 for poor connections. It's on the main deck behind the tray assembly. Failure of this switch sometimes results in the tray staying closed when open has been selected. **M.L.**

Sony CDP101

This player would work perfectly for about three quarters of an hour. It would then suddenly go into the stop mode and a fast rattling sound could be heard from the optical assembly. The fault was still present when the disc had been removed. This rattling sound was caused by the focus servo bouncing the lens up and down very quickly. Replacing the STK6922 focus/tracking servo chip IC204 cured the fault. **M.L.**

Philips CD160

When we tried to play a disc on this machine it would start to rotate then "Err" would come up on the display. During the TOC reading you could see that the disc was rotating too fast. The usual cause of this situation is that the laser beam is not being focused.

We put the machine in the service mode. The initial position – 0 mode – could be obtained but the 1 position was unobtainable. In this position the laser emits light and is focused. When the lens is observed without a disc being inserted you should see it move up and down searching for the focused position. Voltage checks showed that the laser's supply was correct and that there was a feedback voltage from the monitoring diode. Attention was therefore turned to the focus circuitry. A scope check showed that the focus coil drive waveform was correct, and a resistance check then suggested that the coil was open-circuit. Further investigation showed that the ribbon connector from the servo board to the laser assembly was at fault. **A.D.**

Philips CD150

There was no output from this player. Oscilloscope checks showed that the h.f. eye pattern was correct. In fact all the waveforms were correct through to the left- and right-channel DA converters. Voltage checks then showed that these two chips had no supplies. The cause was dry-joints on the supply voltage regulator. **A.D.**

Sony D50 Discman

We had two of these models that wouldn't play. They have a service mode which is entered by shorting two solder pads together. We did this with the first one then started to go through the various service mode checks. The laser emission and focusing were correct, so the disc should have been rotating but wasn't. Investigation around the turntable motor then showed that it was trying to work but was being heavily loaded by the turntable. The cause was that the turntable's lower bearing was binding on its metal support. Lubricating this support and reassembling the unit provided a complete cure.

The symptoms were exactly the same with the second machine, and again a smear of grease on the turntable got it working. When all repairs have been completed don't forget to release the service mode before reassembling the player. It's easy to overlook this. **A.D.**

Philips CD104

As a first measure for any servo fault or an oscillating output, check all the carry-through earth rivets on both the servo and the decoder panel. **A.D.**

Hitachi MX-01/Opus 1

We've had the following fault on several occasions with this unit. The disc runs fast in the CD player section, the turntable motor running continuously. Check for −10V at pin 2 of PL902. If missing, check for dry-joints on the main board around Q805, Q806, R827 and ZD811. This usually cures the fault but getting to these components on the main board involves removal of about forty screws, both cassette units, the mode selector and fluorescent display panel and finally the main panel itself. **A.D.**

Philips CD104

These players sometimes stop when hot. The usual cause is poor earth connections to the 5V regulator. A freezer check will show whether the regulators themselves are defective.

VCR Clinic

Reports from Philip Blundell, Eng. Tech., Chris Plaice, Eugene Trundle, Ian Bowden, Stephen Leatherbarrow, Colin McCormick, Jim Littler, Jeff Herbert and Nick Beer

Philips VR6180

It's rare to come across a VCR with a timer fault that's not due to pilot error. This model is an exception to the rule. If the customer complains of shutting off in the timer mode, the VCR going dead intermittently with the display going haywire, the cassette being spontaneously ejected, etc. and the error memory is empty, suspect a power supply fault.

Before starting with the hairdryer and freezer, disconnect the output plugs P1 and P2. Connect a 47Ω resistor across the 5V output (pins 7-8 of socket P1) and monitor the 5V line – the reading should be 5·2V! – while heating and cooling the power supply. Likely causes of a varying output voltage are: the BZX79/B5V1 zener diode 6012, the TCDT1101 optocoupler 7103, and transistors 7001 (BC547B) or 7004 (BC548B). **P.B.**

Grundig VS440

This machine played all right but produced just snow in the E-E and record modes. If the search button was pressed once, the correct channel number could be seen to be stored o.k. but no signals were tuned in. The +A (record) supply was missing as transistor T485 was open-circuit base-to-emitter. **P.B.**

Philips VR6362

The problem was playback dropouts, just like a worn head, but there was no improvement with a replacement deck. We found that the fault was on the luminance/chroma panel P306, where the dropout offset control (3304) was broken. This can happen if you forget to hinge up panel P306 when removing the front control panel, as the IR receiver can hits it . . . **P.B.**

Ferguson 3V44/45, JVC HRD140

For intermittent playback colour with these machines, check BPF301 for open-circuit or dry-joints.

If the on LED doesn't light but the capstan runs when the on switch is pressed, check whether the 3·9V zener diode D3 in the power supply is short-circuit. **C.P.**

Ferguson 3V65

This machine displayed all the symptoms of a defective upper drum but remained the same after a new one had been fitted. When the head pre/rec panel was pressed the fault suddenly cleared. All ten pins of connector CN2 were dry-jointed! **C.P.**

Hitachi VT130

This was almost certainly a one-off fault. I relate it here to show how careful you have to be when diagnosing VCR faults – even mechanical ones! The machine would intermittently chew the bottom edge of the tape. It was not immediately obvious that the problem stemmed from the fact that the cassette was not going down fully: the tape was fretting on the bottom edge of the plastic housing. This was because the vertical spacing pole (centre, front of the cassette) was bent, or rather the plate that it's anchored to was buckled. The backward leaning pole rubbed on the inner wall of the cassette shell and stopped it short of its correct position, though a gentle push would force it home. Each cassette inserted into the machine came out with a tell-tale scratch mark on the plastic face behind the tape. Sounds obvious, doesn't it? But it was the devil to find . . . **E.T.**

Panasonic NV-FS1

The problem with this machine was loss of audio in the E-E mode. In fact when a phono lead was inserted in one audio input socket we found that this input was permanently selected. We also found that the input select switch (S video in/tuner/line) did nothing – the tuner's picture stayed there. The reason for this was soon discovered. The input and simulcast switches on the front panel provide highs and lows to switch between modes. We found that the high levels, which are derived from the 12V line, read only 2·4V. The cause of the problem was in the power supply can: the unswitched regulator transistor Q1004 (2SD638) was open-circuit base-to-emitter and the associated zener diode D1012 connected between its base and chassis was open-circuit. **I.B.**

Grundig VS200

This machine loaded then unloaded and ejected, with an F3 fault indication. This means that there are no tacho pulses, i.e. there's a deck or electronic fault giving no reel or drum rotation. Thankfully the cause was a simple one. The capstan drive belt was very slack and sometimes slipped under load. When this was put right the machine worked o.k. on test for an hour or so. It then again failed to load. Adjustment of the deck load microswitch finally put matters right, enabling the machine to complete its full play cycle. **S.L.**

Amstrad VCR6000/6100

We've had some no chroma sillies with these machines. As in previous models an HIC101 chip is used and this is often faulty. On many occasions recently the problem has been no colour in the LP mode – the sound has also been distorted. Both faults have been due to missing items. A missing link causes the lack of LP chroma – it's just by the HIC101 chip. A lot of spaces where resistors or capacitors should have been were found on the audio panel. It's easy to spot these as next to each space there's an LP symbol.

Unstable playback with the colour dropping in and out caused some confusion. Hum on the 5V rail to the 14DN300 was responsible due to a diode in the discrete l.t. bridge going open-circuit when warm.

Intermittent or permanent shutdown with the cassette symbol flashing can be caused by several things. The carriage itself is often faulty. Usually the cassette in switch fails to make, the result being ejection and shutdown.

If a VCR6100 accepts a cassette and half loads, then unloads, ejects and shuts down, the usual cause is an intermittent half-load switch. This is situated beneath the audio/control head and is sometimes broken, or the associated gears are stripped. It's not very easy to change.

By far the most common reason for the dreaded cassette symbol flashing is grease on the mode switch contacts. Stripping and cleaning is all that's required, but do it with care, checking the deck timing at the same time. If, afterwards, the machine refuses to play/rewind/fast forward (no tape movement) you've fitted the brake actuation arm incorrectly. It should run on the *outside* of the main gear. **S.L.**

Ferguson 3V22/JVC HR3320

The problem with one of these machines was intermittent loading on play. We found that someone had mixed up the screws when refitting the cassette housing. A large screw that was too long had been put in the back right-hand corner. This put pressure on the two nylon washers (item 77, part no. 668), trapping play lever 3 (item 76, part no. 493) and producing enough friction to make its action intermittent. **J.L.**

Ferguson 3V45/JVC HRD140

You sometimes find the operate LED pulsing on and off with the video head twitching in sympathy with the LED's pulsation rate. The cause is that F2 (2A) at the centre of the power supply board is open-circuit. All rails are still present and measure correctly but the excessive hum causes constant resetting of the microcomputer control chip. **J.H.**

Akai VS55

There was horizontal patterning on the picture in all modes and tearing on the characters of the on-screen display. The cause was C10 (22μF, 50V) in the power supply – it was open-circuit. **J.H.**

Hitachi VT430

Playback was o.k. but there was no E-E sound. When we removed the plug-in tuner/i.f. module we found that the cause of the problem was a stray splash of solder on a surface-mounted resistor to the audio output line. **J.H.**

Hitachi VT120

The trouble with this machine was reduced tuning range – it wouldn't tune up to the h.f. end of the band. In the search mode the varicap tuning line reached only 15V before sweeping back to the low end. The cause of the fault was the tuner/i.f. unit – it was not a synthesiser fault as at first suspected. Excessive current was being drawn when the tuning voltage tried to rise. **J.H.**

Sanyo VRC5000 and VTC5150

It seems that the Sanyo VTC5000 and VTC5150 form a large percentage of the Betamax VCRs in use. I fix more of these than any other single VCR model. They are exceptionally robust machines that go on for ever – apart from their one weakness, reel drive.

Poor or no rewind/fast forward is very common, even though these operations are done with the tape unlaced (unlike Sony Betamax VCRs). Usually the cause is a worn idler roller: the early ones had only six turns on the springs, but replacements may have many more. Nearly always only the idler roller and springs need to be replaced. This costs about £2 instead of the £5 for the whole idler assembly.

A broken drive belt is fairly obvious and is simple to replace. The other common problem is a worn reel drive motor. This sometimes intermittently fails to run, restarting when the machine is powered down and up because of the large kick-start at switch on. I have on occasion dismantled a motor to move the brushes slightly to a less worn part of the commutator. This is not recommended, but it can work for years – and the motors are expensive.

A very important point is that there's a bug in the VCT5000's syscon. If it shuts down because it hasn't received reel pulses it proceeds to lace up! If there's no reel drive at this point to take up the tape, the result is a devastated tape. A customer who had put up with this intermittent tape chewing continued to use the tapes: it took a lot of effort to clean the heads so that the machine would work again. The VTC5150 doesn't suffer from this problem.

Sanyo don't seem to have learnt their lesson from these otherwise excellent machines. The Fisher FVHP-905 and FVHP-615 have reel drive mechanisms (they are not compatible) based on heart-shaped assemblies. These use the same principles and suffer from the same problems. **C.McC.**

B and O VHS82

A stock problem with this machine is a cassette jammed inside due to the cassette lift being blocked. The centre pin on bracket 282 blocks the rack slider 278, usually producing a small dent. Extract the jammed cassette by removing the carriage, sliding lever 281 up and down by using a screwdriver inserted through the slotted hole in bracket 282, then switching on and pressing eject. Then clean the back of the rack slider with Freon TMS. **N.B.**

B and O VHS91

A problem with these machines is incorrect positioning of the cassette in the carriage due to the spring-loaded guide pins (parts 202/3) lagging on the hexagonal shafts. The cure is simply to round off the edges of the shafts slightly. **N.B.**

Panasonic NV-G12

A very slight knocking noise was the complaint with this machine. It was slight too, but once you'd picked it up it was annoying. The cause was a dent in the tyre of the reel clutch (VXP0599). Changing this is an involved job. **N.B.**

Sony EVA300

The complaint with this machine was of intermittent flickering and what amounted to line cogging on playback of any material. Cleaning the heads improved matters a bit but not sufficiently, so a new head drum was ordered. When it arrived we fitted it with the aid of the puller supplied and set it up. I then decided to check the back tension as this is so often wrong. With Sony's Video 8 decks you do this by using a dummy reel on the supply reel, attached to a fan-type tension gauge, pulling the tape through with the machine laced up and the tape running through guides 1, 2 and 3. To facilitate this the mechanism has to be removed and connected to the Sony mode control jig which enables the mechanism to be put into any mode without being connected to the rest of the machine. The reading should have been approximately 12·5g but bordered on 30g!

The pin and slot of the tension-regulator arm had been set out of alignment and sealed, so the alignment had to be corrected and resealed. The back-tension spring had been set at its highest point. Resetting it at the second to lowest position brought the tension back to within specification. **N.B.**

Long-distance Television

Roger Bunney

There was a general reduction in long-distance propagation during September, something to be expected as autumn sets in. Despite this several enthusiasts reported Sporadic E reception and there were the first signs of the hoped-for Winter F2/TE openings now that the present solar sunspot cycle is approaching its maximum. A good tropospheric opening occurred on the 20th/21st, but was unfortunately not up to the usual standard we expect in September. Over all then conditions during September were reasonable. The collated SpE log is as follows:

5/9/89 TVE (Spain) chs. E2, 3, 4; RTP (Portugal) E2, 3.
6/9/89 NRK (Norway) E2; YLE (Finland) E3.
7/8/89 TSS (USSR) R1, 2; TVE E2, 3, 4.
8/9/89 RAI (Italy) E2; RTP E3; TVE E2, 4; CST (Czechoslovakia) R1.
9/9/89 TSS R1; RAI IA.
10/9/89 TVE E2, 3.
11/9/89 SVT (Sweden) E2; NRK E2.
14/9/89 TSS R2; TVP (Poland) R2.
15/9/89 TVE E2.
17/9/89 TVE E2, 3.
20/9/89 SVT E2, 3.
21/9/89 TVE E2; TVP R1; TSS R1, 2.
22/9/89 TVE E2, 3; NRK E2; SVT E2; YLE E3.
23/9/89 TVE E2.
27/9/89 CST R2; TVE E2, 3.
28/9/89 TSS R2.
30/9/89 RTP E2; TVE E3.

Auroral activity was noted by Iain Menzies in Aberdeen on the 15th, 18th, 26th (a good one) and the 30th.

F2 propagation showed the first signs of activity during the month. In East Sussex Tim Anderson logged Ghana, with a grey scale and digital clock (top right-hand corner), for an hour on the 17th. Nigerian 50MHz amateurs were received at the same time. Bill Cotterill reports two suspected F2 signals. On the 9th he received a play from 0817-0821 on ch. R2, with severe multipath effects. On the 23rd he received a reading from the Koran on ch. E3, from 0820-0848, with the characteristic smearing. The reading was repeated, followed by Arabic music until fade out at 0900. All times BST.

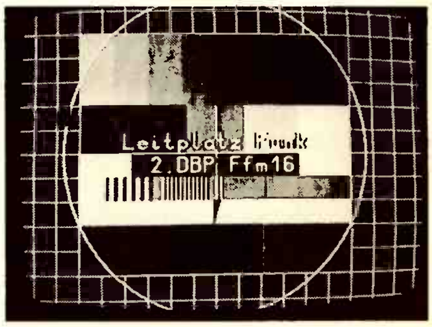
With this rising F2 activity it will pay TV-DXers to monitor chs. R1/E2 to the east over the period 0730-0900 GMT, then ch. E2 to the south and south east nearer lunch time and the south later in the afternoon. Remember that TE (transequatorial skip) is likely to occur during the late afternoon into the early evening. Ch. E2/3 signals from Africa are often present during this period. If conditions are really good, remember to check New Zealand ch. 1 and Australia ch. 0, also ch. A2 (same carrier frequency as E3) for evidence of North American 525-line signals (with reduced height and field roll).

Meteor scatter reception during the month was minimal, though Tim Anderson logged DR (Denmark) ch. E7.

Reception during the tropospheric opening on the 20th/21st seemed to be best in the Midlands and north into Scotland. Simon Hamer in Powys had quite a dramatic log. In addition to the signals you would expect during a quiet lift, i.e. from the Benelux countries and northern France, he logged many West German Band III/u.h.f. stations including several low-power BFBS (SSVC) relays at up to ch. E48, RTL+ (Luxembourg) ch. E36, East Germany chs. E6, 8, 11, 12, 27 and 34, Denmark including fourteen TV2 channels, NRK, SVT, TVP chs. R8/35 (the more distant transmitters), CST chs. R10, 36 and 38 and ORF-1 (Austria) ch. E5. An excellent log!

There was tropospheric enhancement in the south west on the 24/25th, with TVE signals, both TV1 and TV2, in Band III and at u.h.f. up to ch. E45.

Many thanks to the following for sending in logs and reception reports: Simon Hamer (Powys). Tim Anderson (St. Leonards), Peter Schubert (Rainham), Iain



Left: Regional TV identification from Tallin, Estonia, received by Ryn Muntjewerff, Holland, via SpE. Centre: BBC international control transmission logo received by Frank Lumen in Denver, USA, via the Intelsat craft at 53°W. Right: Deutches Bundespost, Frankfurt main control centre received by Frank Lumen using his 3·7m C Band dish and 50°K LNA.

Menzies (Aberdeen), Bill Cotterill (Tipton) and Roger Fussell (Torpoint).

The Belgian Canal Plus service started at 0700 (local time) on September 27th, after a period of testing. Several DXers had reported Anderlues on test for some weeks before.

The August 1989 issue of the RSGB's magazine *Radio Communication* included Part 4 of "An Introduction to Sporadic E" by Jim Bacon. This and the preceding Parts are well worth reading.

News Items

Belgium: The American Forces Network has opened a system M (525-lines/NTSC) transmitter in the Brussels area – thought to be in the south east, the area known as the Bois de la Cambre. It's producing strong signals locally on ch. E33 with horizontal polarisation and operates on a 24-hour basis.

A third Belgian Canal Plus transmitter is to be opened at Liege, using ch. E39. The Belgian Canal Plus headquarters and production centre is at Chaussee de Louvain 656, B1030. Periods of unscrambled transmissions are understood to be 1300-1330 and 1845-2000 local time.

A new regional programme is to start in early 1990 for the Genk and As areas, run by VZW Genker Televisie (VZW = Vereniging Zonder Winstoogmerk). RBF is to start a German language service over the Tele 21 network during times when Tele 21 programmes are not on air.

Finland: MTV Helsinki, the oldest Scandinavian network having been in operation for 32 years, is to form its own distribution and transmission network. At present these facilities are leased from YLE.

Spain: Canal 9 TVV has gone on air in the Valencia region, using transmitters that previously provided the Catalan TV3 service. Three private TV services, Tele-5, Antenna 3 TV and Canal Plus Espana, are due to start operations in the Madrid and Barcelona areas early next year. Canal Plus Espana will transmit for 24 hours daily.

In brief: Agreement has been reached between West Germany and France to transmit the La Sept service, at present available via the TDF-1 satellite, from terrestrial transmitters in West Germany. The other half of this dual venture will involve a German-language service for transmission in France . . . A new Dutch station TV10 intends to transmit programmes to Holland via satellite from a Milan-based production centre. It's understood that considerable advertising revenue has already been attracted . . . RTL (Luxembourg) has been seen on ch. E24 using the PM5544 test pattern with the identification "C24 TEST" at the top and "DUDELANGE" below. Is this to be another Canal Plus operation?

New EBU Transmitter Listings

West Germany: Ulm chs. E39 and E48, 5kW; Bremen ch. E46 10kW. These are private stations. Polarisation horizontal in each case.

Greece: Filia-Achaia ch. E4, 100W horizontal, EPT-1.

Spain: Madrid-2 ch. E52 117kW horizontal. Third programme produced by Tele-Madrid.

The Danish TV2 transmitter on the Isle of Bornholm is in service on ch. E56 with 800kW e.r.p. (reduced to 400kW in the direction 110-170°). The local Bornholm transmitter is now using ch. E39. TV2 Vordingborg will be next on air on ch. E58 to complete the current phase of the TV2 network. Emden is on air on chs. E50 and E60.

Multistandard Equipment

Aerial Techniques tell us that they can supply a multistandard VHS VCR with capability to receive and record SECAM L, SECAM B/G (Mesecam) and PAL B/G/I transmissions. It even has connections for a Canal Plus decoder. Mesecam is used in the Gulf areas. The multiband v.h.f./u.h.f. tuner covers chs. E2-4 plus cable S1-3, 104-174MHz (cable M1-10), 174-230MHz (chs. E5-12), 230-300MHz (cable U1-10) and 470-862MHz (chs. E21-69). The VCR has IR remote control etc. and sells at £499 including VAT plus £8·75 UK carriage.

The company also has in stock a multistandard 20in. colour receiver which is available at under £300 inclusive of VAT. The standards listed are PAL B/G/I, SECAM B/G, SECAM D/K, PAL D/K, NTSC 3·58/4·5MHz, NTSC 3·58/5·5MHz and NTSC 4·43/5·5MHz, all at 50/60Hz. Interesting that the set will cope with mains inputs over the range 90-270V a.c.

State-of-the-Art Cable TV

One of our Belgian contacts recently visited US friends who subscribe to the Media General Cable Television service at Chantilly, Fairfax County, Virginia. Media General provides a twin cable feed with each cable offering 60 channels, i.e. 120 channels in all (most US cable systems have up to 36 channels). The system cost $220m to construct and has 31,000 miles of fully addressable dual trunk cable that passes 250,000 homes.

Services offered include terrestrial/satellite TV channels, programming from local production facilities, a news channel, several "classified advertising" channels and premium channels for which extra payment has to be made. Also available are some 28 stereo f.m. stations, ten satellite TV stereo sound channels and four national TV network stereo sound channels. Each cable that enters the house requires a separate converter whose outputs, on low-band ch. 3, are fed to a standard domestic TV set. The converters are made by Zenith and are simple to use.

Media General can also provide a versatile home computer system which, via a simple A-B switching circuit, enables one programme to be recorded while another is being viewed.

Satellite TV News

Orbital activity is on the increase! The BSB satellite at 31°W is now on test while West German uplink test patterns and RTL+ programming have been seen from TDF-1 at 19°W. ECS at 7°E was busy with the Portuguese Grand Prix during the period under review. ECS at 10°E is becoming more active with various news feeds and outside broadcasts. Further to the east, at 16°, a British Aerospace satellite is carrying various media/corporate feeds.

John Standen of North East Satellite Systems reports that Gorizont at 47°E has five transponders for lease. CNN has taken one to provide a full-time English-language news feed via the global beam. Reception of this from beam centre to edge requires a 3-6m diameter dish. The uplink is via the London Teleport. An Arab consortium is negotiating to lease one transponder while US concerns are interested in the other three. The 47°E Gorizont craft has an inclined orbit, i.e. it "woobles". To overcome this problem North East Satellite Systems can provide and install an auto-tracking system. This type of installation is intended for hotel or commercial use and costs between £20,000 and £30,000 with an 8m dish. The area covered is mainly Africa and the Middle East.

John also comments that most low-Ku band LNBs can be adjusted for use in the DBS band by retuning the local oscillator. Typically a half turn of a small screw adjustment is required. Echosphere LNBs can easily be adjusted by removing the top cover to expose the DRO screw which is on a small silver plate near the F output socket. A half turn of this screw will give coverage of the complete DBS band with minimal gain fall off. Since high powers are used for the DBS transmissions a higher-noise LNB (say 1·8-2dB) can be used – these cost around £50 at present.

I'm told that if you have a colour set with rear scart input you can lock a MAC signal on the screen by paralleling the RGB inputs and feeding composite video into this combined input, also feeding composite video (with the syncs) into the sync input. I'd like to hear from anyone who tries this.

BOP (Bophuthatswana) TV is providing an English-language service that can be received throughout the Middle East and Southern Africa at 3·714GHz (circular polarisation) from 66°E. A 4m dish gives noise-free reception while a 2·5m dish will provide entertainment-quality reception. BOP radio is available on a subcarrier.

The Indian DBS/telecommunications satellite Insat ID suffered severe damage during preparations for its launch and may have to be written off. Finally, news from France that the TDF-2 DBS craft is to be launched in February 1990.

Service Bureau

Requests for advice in dealing with servicing problems must be accompanied by a £2 cheque or postal order (made out to IPC Magazines Ltd.), the query coupon and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.

GRUNDIG 8635GB

At switch on the picture appears and then goes off (no raster). Signals remain at the inputs to the RGB panel but the voltages at the collectors of the output transistors rise. R963 fell apart when touched but replacing it has made no difference. The trouble is that the fault clears after five-fifteen seconds, the set then running correctly all day.

The most common cause of this problem is failure of the zener diode that links the emitters of the output transistors to chassis. Check it by substitution.

AMSTRAD VCR4600

The following faults are present with some cassettes, both old and new. Typically, when an old recording which has been played successfully many times is replayed the picture is o.k. for the first 10-15 seconds near the start of the cassette then tracking lines appear at the bottom of the picture, extending upwards until field lock is lost and the VCR switches into the standard-play mode (I use it in the LP mode). Sometimes a noise can be heard from the cassette area, and the bottom of the tape is chaffed. After pressing stop and play the picture is o.k. for another 10-15 seconds. All cassettes play correctly after about a sixth of their length. In addition, when rewinding a tape the whine from the machine varies jerkily in pitch, presumably due to speed variation, and a single clunk is sometimes heard, especially with fast forward winding.

This problem is caused by excessive friction in the take-up clutch assembly. Considerable skill and dexterity are required to dismantle, reassemble and phase the deck mechanism mechanically.

THORN 9000 CHASSIS

Tripping was cured by attending to dry-joints around the Syclops and line output transformers and a replacement tuner cured the weak, grainy picture. The set now runs but there are flyback lines that get wider towards the bottom of the picture.

A very common cause of this problem is excessive first anode voltage. There should be about 700V at c.r.t. pin 10/R904. If the first anode voltage is correct, check the field blanking input at pin 6 of IC4. Check R172 etc. if it's missing or distorted.

SHARP VC7300

We have two of these machines with exactly the same problem. When stopping after fast forward or rewind there's almost always a loop of tape. This never happens in the play mode. After replacing the belts for poor rewind the fault became worse. We have tried new brakes, cleaning the carriers etc. and the unloading pulley as this appears to make the left-hand carrier bounce back, leaving the loop.

When eject is pressed the loading motor, under the deck, kicks to take up the tape slack via a belt coupling to the spool turntable. We suggest that you replace the loading belt (on the motor pulley) then if necessary check the clutch on the loading block assembly.

FERGUSON 3V35/JVC HRD120

This machine is reluctant to accept tapes. A cassette goes in so far then comes back out. The machine does this nine to ten times before it accepts the tape.

Cassette bounce-back is almost always caused by intermittent contact in the cassette-in switches at each side of the cassette cradle. Before having a go at the switches, make sure that the cassette is firmly held in its cradle by the spring-loaded retaining fingers. Floppiness causes the switches to flutter.

PHILIPS TX CHASSIS

The problem with this monochrome portable is very poor sync. Hold can just about be achieved by very careful setting of the line and field presets but any transient produces drop out.

The two 820kΩ resistors R370 and R371 that bias the sync separator transistor TS370 are the most likely culprits. If necessary check the coupling capacitor C370 (1μF) and TS370 (BC558). These components are slightly forward of the centre point of the PCB.

HITACHI VT8300

There is no line sync in the visual search mode, either forward or reverse. All other functions are o.k.

This problem is due to incorrect drum speed in the cue and review modes and often arises as a result of component ageing and drift. Adjust R687 in the cue and R688 in the review modes for correct line speed and good colour registration.

THORN 1500 CHASSIS

There's an objectionable sound buzz that's particularly noticeable at minimum and low settings of the volume control. Scope checks indicate that the smoothing is in order. When the field hold control is adjusted the tone of the buzz alters, suggesting that the problem is field derived. Connecting pin 1 (triode grid) of V2A to chassis via a rejector has no effect however. I've had this problem with several of these sets.

First check the 12μF decoupler C68 at the top of the audio output transformer T2. If this has no effect, you may well find that swinging the chassis out reduces the buzz. If so the cause of the trouble is pick-up from the scan coils. Experiment with the use of magnetic shielding.

SANYO VTC5000

The rewind function operates intermittently. When the key is pressed the machine usually goes into the fast forward mode. Rewind works correctly once one manages to select it, but if rewind search is then pressed the machine stops rewinding. The fast forward functions are o.k. A new belt kit has been fitted and IC3001, IC3008 and IC3007 have been replaced.

It appears that the changeover switch in IC3006 (BA6209) is failing to toggle. We suggest that you replace this chip along with the 7·5V zener diode D3008.

ECONOMIC DEVICES PO BOX 15, WOLVERHAMPTON, WV2 4AZ

15/80H	2.72
15/85R	3.28
17052	5.61
17053	5.61
17074	9.30
17089	3.45
17127	2.50
17376	1.58
1N4001	0.04
1N4002	0.05
1N4003	0.06
1N4004	0.05
1N4005	0.05
1N4006	0.08
1N4007	0.07
1N4148	0.03
1N4448	0.05
1N5401	0.11
1N5402	0.13
1N5403	0.18
1N5404	0.15
1N5408	0.14
1N914	0.04
1S1555	0.31
1S44	0.10
1S921	0.10
2N2219A	0.37
2N3053	0.35
2N3054	0.99
2N3055	0.79
2N3442	1.16
2N3702	0.14
2N3703	0.18
2N3705	0.16
2N3706	0.16
2N3707	0.16
2N3711	0.11
2N3771	2.04
2N3772	1.55
2N3773	2.20
2N3819	0.40
2N3823	1.17
2N3904	0.15
2N3906	0.62
2N4101	1.33
2N4240	2.00
2N4444	0.90
2N5293	0.50
2N5294	0.50
2N5296	0.48
2N5297	0.50
2N5298	0.61
2N6109	1.58
2N6130	0.85
2N6133	1.25
2N6180	0.73
2N6292	1.65
2SA1006	1.50
2SA1011	1.65
2SA1015	0.49
2SA1012	1.25
2SA1020Y	0.80
2SA1027R	0.45
2SA473	0.75
2SA766S	4.95
2SC1173Y	1.25
2SC1474	1.25
2SC1509	1.35
2SA1095	3.00
2SA1103	6.00
2SA329	0.40
2SA489	1.17
2SA490	1.32
2SA493	2.25
2SA562	0.57
2SA564	0.62
2SA614	4.88
2SA628	0.37
2SA639S	1.75
2SA659	0.49
2SA673	1.50
2SA684	1.20
2SA697	0.80
2SA699	1.25
2SA715	0.95
2SA748	1.95
2SA817	0.18
2SA835	2.50
2SA836	0.89
2SA844	0.65
2SA872	0.59
2SA884	2.15
2SA937R	0.97
2SA940	2.23
2SA940-2	2.14
2SA950	0.72
2SA951	1.75
2SA966-Y	0.85
2SA999	0.75
2SB774	0.65
2SB185	1.13
2SB375	3.87
2SB400	0.40
2SB405	1.03
2SB511	2.65
2SB54	1.39
2SB546	0.56
2SB56	2.80
2SB618A	2.22
2SB631	2.00
2SB643	0.50
2SB669	3.67
2SB681	3.96
2SB695	1.98
2SB774	0.65
2SB819	1.13
2SC1096	1.16
2SC1104	3.98
2SC1106	4.54
2SC1114	3.25
2SC1116	4.95
2SC1124	1.26
2SC1129	1.65
2SC1131	0.64
2SC1158	3.33
2SC1162	0.55
2SC1172	2.22
2SC1195	6.09
2SC1213	0.89
2SC1226	1.46
2SC1293	0.90
2SC1306	1.98
2SC1317	0.50
2SC1364	0.49
2SC1383	1.20
2SC1391	2.45
2SC1398	0.75
2SC1413A	5.00
2SC1446	1.25
2SC1447	2.07
2SC1475	0.60
2SC1505	1.00
2SC1514	1.37
2SC1573Q	1.63
2SC1583	0.34
2SC1617	3.89
2SC1678	1.92
2SC1741	1.25
2SC1810	1.70
2SC1815	0.20
2SC1826	0.67
2SC1829	2.25
2SC1875	4.50
2SC1883	3.02
2SC1906	0.98
2SC1921	1.37
2SC1923	0.30
2SC1929	2.25
2SC1942	1.98
2SC1959	0.26
2SC1957	0.95
2SC1953	1.93
2SC1962	1.93
2SC1969	1.78
2SC1983	3.28
2SC1985	1.55
2SC2009	0.34
2SC2029	2.33
2SC2028	2.11
2SC2063	0.99
2SC2078	3.39
2SC2073	1.54
2SC2085-Q	1.65
2SC2091	1.30
2SC2141	2.44
2SC2166	0.87
2SC2216	0.69
2SC2233	1.20
2SC2236	1.69
2SC2278	1.14
2SC2314	0.87
2SC2335+Kit	7.00
2SC2551	1.26
2SC2565	3.84
2SC2570	0.80
2SC2577	1.60
2SC2578	6.75
2SC2671	0.91
2SC288A	1.85
2SC3153	6.50
2SC372	1.40
2SC373	1.16
2SC383	1.33
2SC388	1.27
2SC394V	0.81
2SC403C	0.60
2SC458	0.34
2SC495	0.92
2SC515A	1.85
2SC535	0.79
2SC536	0.10
2SC537	0.54
2SC605L	1.16
2SC620	1.46
2SC643A	1.54
2SC668	0.67
2SC681	4.40
2SC682	1.88
2SC684	1.65
2SC693	0.63
2SC710	1.15
2SC711A	0.50
2SC717	1.28
2SC734	1.43
2SC783	3.98
2SC790Y	1.85
2SC828	0.28
2SC867A	3.04
2SC876	0.96
2SC930	0.54
2SC935	4.13
2SC940	4.68
2SD1128	2.90
2SD1138	0.94
2SD1273	1.30
2SD1453	1.33
2SD152K	2.64
2SD198	3.87
2SD234	0.47
2SD235	0.60
2SD24	2.29
2SD257	1.98
2SD292	4.09
2SD313	2.65
2SD325D	2.26
2SD350	3.05
2SD353	7.50
2SD389	2.41
2SD401	1.40
2SD414	1.98
2SD471	2.13
2SD560	2.95
2SD600	2.98
2SD601R	0.65
2SD613	1.03
2SD636	0.40
2SD639-R	0.72
2SD655	0.98
2SD657	2.80
2SD661A	0.80
2SD731	2.11
2SD773	0.60
2SD811	7.63
2SD823	1.98
2SD837	1.48
2SD841	2.00
2SD856	1.00
2SD857Q	1.84
2SD882	1.15
2SD894	1.75
2SD898	0.82
2SK105H	2.15
7805-T022	0.63
7808	0.45
7812-T022	0.35
7815	0.64
7905	0.80
AD140	1.06
AD143	1.93
AD145	1.60
AD161	0.30
AD162	0.45
AF114	2.47
AF115	1.24
AF118	1.20
AF127	0.65
AF139	0.40
AF178	1.45
AF179	0.55
AF180	0.55
AF181	0.53
AF186	0.53
AF239	0.53
AF279	0.88
AN115	3.98
AN155	1.89
AN206	2.58
AN208	3.55
AN210	2.28
AN211	3.25
AN214Q	2.40
AN234	5.09
AN236	3.33
AN240P	0.99
AN241	1.71
AN245	4.90
AN253	1.80
AN260	3.85
AN272	7.92
AN295	5.52
AN301	2.45
AN302	3.09
AN305	8.88
AN315	2.46
AN316	5.53
AN318	9.35
AN320	5.47
AN321	2.25
AN322	6.78
AN337	5.37
AN340P	1.53
AN355	5.98
AN362	1.50
AN370	3.95
AN5111	3.43
AN5120N	4.50
AN5132	4.42
AN5250	4.40
AN5610	7.43
AN5612	2.07
AN5613	4.20
AN5630	3.95
AN5701N	1.66
AN6250	2.95
AN6300	4.40
AN6310	4.54
AN6340	6.46
AN6341	1.42
AN6363	16.00
AN6531	1.95
AN6551	0.50
AN6552	0.68
AN6610	1.65
AN7111	1.25
AN7115	2.52
AN7145	2.80
AN7146	9.90
AN7151	2.37
AN7156	2.85
AN7158	2.34
AN7218	0.80
AN7223	4.55
AU107	5.87
AU110	5.69
AU113	6.95
AY105K	2.08
AY106	1.09
BA524	8.94
BA310	0.14
BA1310	1.98
BA1320	1.38
BA1322	3.95
BA1330	2.75
BA145	0.19
BA148	0.25
BA154	0.40
BA155	0.12
BA156	0.05
BA159	0.09
BA182	0.19
BA222	1.66
BA302	1.24
BA311	0.65
BA312	1.45
BA313	0.76
BA317	0.04
BA318	0.09
BA328	1.65
BA333	1.37
BA335	6.27
BA5102A	2.50
BA511	1.95
BA514	1.00
BA521	1.20
BA524	8.94
BA526	7.98
BA527	2.98
BA532	1.50
BA536	1.70
BA6209	3.10
BA656	1.00
BA7100	11.35
BA841A	28.98
BA843	3.96
BA854	5.76
BAV18	0.06
BAV19	0.11
BAV20	0.35
BAV21	0.12
BAW62	0.11
BAX12	0.11
BAX13	0.11
BAX16	0.08
BC107B	0.11
BC108B	0.15
BC109B	0.14
BC113	0.14
BC119	0.36
BC126	0.20
BC132	0.14
BC135	0.14
BC137	0.18
BC138	0.34
BC139	0.33
BC140	0.45
BC141	0.34
BC142	0.23
BC143	0.34
BC147	0.11
BC148B	0.13
BC148C	0.11
BC149B	0.13
BC153	0.14
BC154	0.14
BC159	0.16
BC160	0.40
BC161	0.28
BC168	0.36
BC169C	0.16
BC170	0.16
BC171	0.11
BC172B	0.27
BC173	0.17
BC174B	0.27
BC177	0.35
BC178	0.26
BC179	0.26
BC182	0.09
BC182LB	0.14
BC183LB	0.26
BC184	0.13
BC184LB	0.26
BC186	0.25
BC187	0.28
BC204	0.16
BC207	0.14
BC212B	0.26
BC213L	0.10
BC214	0.10
BC225	0.40
BC237	0.10
BC238	0.10
BC238B	0.08
BC239B	0.25
BC251A	0.31
BC294	0.50
BC300	0.35
BC301	0.23
BC302	0.53
BC303	0.30
BC307A	0.06
BC308A	0.11
BC309	0.17
BC317A	0.13
BC327	0.33
BC328	0.11
BC337	0.09
BC338	0.12
BC368	0.18
BC440	0.69
BC441	0.46
BC454	0.36
BC460	0.42
BC461	0.47
BC462	0.51
BC463	0.30
BC478	0.32
BC479	0.41
BC532	0.28
BC546	0.17
BC547	0.10
BC548	0.10
BC549	0.10
BC550	0.16
BC556	0.16
BC557	0.10
BC558	0.10
BC559	0.10
BC560C	0.14
BC635	0.34
BC636	0.20
BC637	0.24
BC639	0.36
BC640	0.24
BCX34	0.40
BD115	0.75
BD116	0.70
BD124	1.31
BD131	0.42
BD132	0.42
BD133	0.53
BD135	0.36
BD136	0.36
BD137	0.26
BD138	0.28
BD139	0.34
BD140	0.32
BD144	1.43
BD150	0.75
BD157	0.84
BD160	1.60
BD163	0.71
BD166	0.42
BD175	0.48
BD179	0.30
BD181	0.99
BD182	0.99
BD183	0.99
BD184	1.21
BD187	0.53
BD189	0.69
BD190	0.69
BD201	0.49
BD202	0.60
BD203	0.46
BD204	0.41
BD207	1.79
BD208	1.23
BD222	0.50
BD225	0.46
BD228	0.63
BD230	0.58
BD232	0.49
BD234	0.42
BD237	0.47
BD238	0.42
BD239	0.45
BD240	0.57
BD241	0.39
BD242	0.50
BD243A	0.37
BD243C	0.50
BD244	0.50
BD244C	0.72
BD245C	0.78
BD246C	0.80
BD253	1.05
BD278A	0.70
BD317	1.20
BD318	2.72
BD375	0.42
BD380	0.76
BD410	0.49
BD433	0.44
BD434	0.45
BD435	0.49
BD436	0.60
BD437	0.41
BD441	0.59
BD442	0.66
BD509	1.62
BD510	0.75
BD519	0.98
BD529	0.60
BD530	0.80
BD533	0.67
BD534	0.52
BD535	0.45
BD536	0.45
BD537	0.50
BD538	0.67
BD544B	0.83
BD677	0.40
BD679	0.57
BD680	0.52
BD681	1.48
BD696	2.47
BD699	1.85
BD700	3.70
BD707	0.60
BD709	0.60
BD710	0.80
BD809	0.80
BD810	0.69
BD879	0.74
BD895	2.18
BD901	0.99
BD902	0.65
BDW83C	0.99
BDW84C	0.99
BDX32	1.88
BDX53A	4.93
BDX53B	3.35
BDX54B	0.31
BDX62A	1.96
BDX63A	1.96
BDY20	1.21
BDY81	1.18
BF115	0.29
BF117	0.66
BF118	0.67
BF121	0.25
BF123	0.13
BF127	0.13
BF137	0.29
BF153	0.58
BF154	0.26
BF157	0.33
BF158	0.18
BF159	0.18
BF160	0.31
BF167	0.18
BF173	0.34
BF177	0.55
BF178	0.40
BF179	0.36
BF180	0.36
BF181	0.36
BF182	0.34
BF183	0.39
BF184	0.43
BF185	0.39
BF194	0.14
BF195	0.14
BF196	0.17
BF197	0.16
BF198	0.17
BF199	0.17
BF200	0.37
BF218	0.36
BF224	0.17
BF237	0.65
BF240	0.19
BF241	0.17
BF245	0.50
BF245B	0.49
BF246A	2.52
BF255	0.20
BF256	0.28
BF257	0.34
BF258	0.34
BF259	0.34
BF262	0.57
BF263	0.57
BF271	0.34
BF273	0.20
BF274	0.20
BF324	0.23
BF336	0.33
BF337	0.45
BF338	0.40
BF355	0.49
BF362	0.60
BF363	0.50
BF371	0.50
BF391	0.25
BF417	0.84
BF418	1.87
BF422	0.30
BF423	0.33
BF450	0.35
BF451	0.29
BF457	0.41
BF458	0.49
BF459	0.52
BF460	0.99
BF469	0.78
BF470	0.26
BF471	0.33
BF472	0.33
BF479	0.61
BF480	1.79
BF491	0.50
BF506	0.43
BF532	0.24
BF596	1.63
BF597	0.27
BF694	0.22
BF757	0.59
BF759	0.47
BF761	1.05
BF762	0.34
BF869	0.49
BF870	0.29
BF959	0.42
BF960	0.49
BF970	0.50
BFR39	0.44
BFR61	0.92
BFR79	0.29
BFR81	0.29
BFR86	1.08
BFR89	1.63
BFR90A	0.85
BFX29	0.34
BFX84	0.37
BFX85	0.41
BFX86	0.36
BFX87	0.55
BFX88	0.34
BFX89	0.30
BFY50	0.30
BFY51	0.33
BFY52	0.27
BFY79	0.49
BFY90	0.42
BLY49	2.20
BR100	0.22
BR101	0.70
BR103	0.80
BR303	1.15
BRC84	2.08
BRX44	0.60
BRX49	0.34
BRY39	0.69
BSS38	0.67
BSTB0140G	4.93
BSTC0246	8.64
BSTC0233	6.12
BSTCC0143	3.07
BSTD1043	2.85
BSV57B	3.91
BSW68	0.60
BSX19	0.34
BSX20	0.19
BSY52	0.50
BSY79	0.51
BT108	1.45
BT119	1.76
BT120	2.17
BT121	2.48
BT123	2.48
BT151-800R	1.03
BTT6018	2.42
BU105	2.48
BU108	1.50
BU109	2.25
BU110	5.69
BU125	2.48
BU126	1.10
BU137	6.53
BU205	1.15
BU206	1.27
BU207	1.65
BU208	1.12
BU208/02	1.88
BU208A	1.12
BU208D	1.43
BU209	1.93
BU226	2.45
BU326A	0.99
BU406	1.49
BU406D	1.53
BU407	0.82
BU412	5.29
BU426A	1.67
BU500	1.45
BU508A	1.89
BU536	1.65
BU608	1.65
BU705	2.50
BU806	0.85
BU807	1.40
BU826A	1.95
BUW84	1.39
BUX84	0.50
BUX85	0.69
BY126	0.13
BY127	0.13
BY133	0.06
BY164	0.44
BY176	0.52
BY179	1.42
BY182	1.05
BY187	0.77
BY189	1.76
BY198	1.62
BY207	0.22
BY208	1.11
BY210-400	0.18
BY210-600	0.27
BY210-800	0.19
BY223	1.43
BY224-600	1.88
BY226	0.25
BY227	0.20
BY228	0.60
BY229-1000	1.12
BY229-600	0.92
BY255	0.13
BY295-600	1.03
BY298	0.20
BY299	0.60
BY407	0.90
BY409	1.49
BY448	1.35
BY713	0.65
BYW56	0.14
BYX55-600	0.23
BYX71-600	0.85
BYX71-350	0.62
BYY56	1.20
BZY93C30	1.86
C106D	0.37
C106M	0.76
CA3046	1.55
CA3089	0.83
CA3090AQ	3.25
CA3094	2.20
CA3131EM	2.95
CD4001	0.34
CD4002	0.27
CD4008	1.35
CD4011	0.29
CD4012	0.24
CD4013	0.33
CD4016	0.36
CD4017	0.40
CD4020	1.23
CD4021	0.39
CD4023	0.28
CD4025	0.64
CD4028	0.84
CD4040B	0.60
CD4047	1.06
CD4049	0.24
CD4052	0.64
CD4066	0.21
CD4069	0.29
CD4070	0.25
CD4081	0.14
CD4093	0.40
CD4511	1.10
CD4528	2.04
CD4556	1.47
CR02AM-8	1.70
CV12E	4.09
CX095D	3.14
CX104	8.77
CX108	12.48
CX109	7.86
CX130	8.76
CX134	11.10
CX136	11.49
CX139	11.83
CX157	5.52
CX158	5.50
CX177	8.75
CX187	5.26
CX755	12.95
CX885A	6.85
E1222	0.40
E5024	0.28
E5386	0.25
GD243	4.34
GF758	0.84
HA11215	1.75
HA11211	2.53
HA11225	4.29
HA11229	3.46
HA11235	1.75
HA11124	5.25
HA1125	4.29
HA1137W	1.38
HA1138	5.03
HA11414	5.65
HA1156	1.16
HA1160	4.79
HA1166X	6.60
HA1167	6.45
HA11705	3.61
HA11703	4.22
HA11701	4.56
HA11710	3.45
HA11713	2.90
HA11711	2.00
HA11715	9.90
HA11714	7.76
HA11716	13.10
HA11725	18.26
HA11725MP	16.00
HA11755P	6.23
HA11781	21.15
HA1180	5.15
HA1196	7.43
HA13001	1.73
HA1306	2.26
HA13402	7.87
HA13342	2.65
HA13365	4.02
HA1366WR	1.38
HA1367	2.75
HA1368R	2.45
HA1368	2.07
HA1370	3.71
HA1374	1.80
AA117	9
HA1377	1.75
HA1389R	2.05
HA1389	2.39
HA1392	1.38
HA1394	2.37
HA1397	3.76
HA1398	2.95
HA1406	2.07
HA1452	0.85
HD14538	2.07
HD38702-A2	7.95
HD38750A53	5.77
HD38750A-7	7.25
HD38800A50	14.09
HD44801A05	12.50
HISH1010	8.59
HISH1004	6.00
HISH1002	9.50
HM6231	9.81
HM6232	10.95
HM6251	5.25
HM7103	4.85
HM9032	4.00
HM9012	3.22
HM9015	3.24
HT4207	13.25
HT4208	20.65
KA2101	1.00
KC581C	7.68
KC582C	4.85
L200CV	1.69
LA1201	0.75
LA1210	1.56
LA1230	1.44
LA1320	2.87
LA1357N	9.00
LA1363	1.05
LA1364	3.02
LA1365J	1.15
LA1385	1.53
LA1387	5.95
LA3350	1.43
LA3361	1.60
LA3390	5.52
LA4032P	2.35
LA4100	1.25
LA4101	1.30
LA4102	0.75
LA4112	0.56
LA4125	2.25
LA4138	4.98
LA4140	0.70
LA4192	1.50
LA4220	1.25
LA4420	1.72
LA4422	1.00
LA4430	1.29
LA4440	1.95
LA4445	1.80
LA4460	1.75
LA4461	1.70
LA5112N	1.18
LA7020	13.86
LA7025	11.97
LA7027	10.92
LA7040	9.20
LA7042	3.90
LA7800	1.03
LA7801	0.90
LB1274	3.61
LC7800	9.20
LD3120	1.13
LD3150	2.75
LM1017N	1.81
LM1877	3.50
LM2808	5.94
LM2877	7.45
LM317CKC	1.08
LM324N	0.98
LM339N	0.41
LM340K	11.85
LM348N	2.15
LM380N	2.80
LM567CN	1.71
LM6402/011	10.23
LM6402A093	10.15
LM748	0.69
LM8360	3.87
LM8361	3.57
LR3419	9.37
LR3471	9.37
LU1141	7.27
LU52012	5.95
LU52011	14.95
LU03112	12.37
M21C	1.30
M23C	1.98
M293	6.71
M51102L	1.69
M5115P	5.24
M51203L	3.15
M51231P	3.07
M5134-9341	4.13
M51353P	5.25
M51381P	5.98
M51393AP	9.48
M51394P	12.50
M5142P	6.85
M5144P	3.77
M51513L	2.55
M51515BL	2.75
M51517L	2.90
M5192	2.20
M5194AP	5.74
M5231L	4.80
M53274P	1.33
M54532P	1.50
M54544L	1.22
M58478P	6.75
M58485P	12.75
MA06	1.07
MA8001	0.82
MA8003	1.16
MB3705	1.98
MB3712	1.85
MB3713	1.69
MB3730	2.09
MC13002	3.90
MC1310P	2.25
MC1327P	1.33
MC1330P	1.98
MC1350P	0.90
MC1351P	1.32
MC1352P	1.40
MC1357P	2.15
MC1358P	1.48
MC14493P	4.20
MC14494P	2.15
MC14497	3.46
MC14510BAL	3.75
MC14511BCP	1.10
MC14528BCP	2.15
MC1712	3.88
MC5192	19.50
MC7724CP	3.49
MCR106-5/6	1.23
MCR220/7	2.28
ME0411	0.75
ME6002	0.26
ME6102	0.28
ME8001	0.34
ME0411	0.75
MJ2501	3.30
MJ3001	1.43
MJ481	1.53
MJE2955	1.89
MJE3055	1.25
MJE340	0.49
MJE520	0.49
ML231	0.99
ML232B	3.01
ML237B	2.51
ML238	5.77
ML923	3.10
ML926	3.58
MM5314N	8.99
MM5316N	9.16
MM5318N	3.11
MM5369N	2.01
MM5387AA/N	6.20
MM5841N	6.64
MN1400VL	13.65
MN1405	7.92
MN1435VX	9.50
MP1192	5.07
MP2794	4.00
MP2812	5.07
MP8512	1.57
MPC596	2.13
MPF256C	0.60
MPS6570	0.48
MPSA42	0.35
MPSA56	0.80
MPSA92	0.45
MPSU05	0.86
MPSU10	1.56
MPSU56	0.60
MPSU60	1.33
MR818	0.33
MR854	0.50
MR914	1.20
MSM5816RS	17.35
MSM5840H	13.95
MVS460-02	0.34
NE542	2.65
NE555	0.19
NE556	0.65
NP1106	11.51
OA202	0.11
OA47	0.16
OA91	0.14
OA95	0.09
OC28	2.52
OC29	2.15
OC36	7.53
OC44	0.35
OC45	0.18
OC72	0.44
OC75	0.44
ON236	1.06
ON782	1.98
OT121	1.45
PT6042	2.45
PT8504	4.98
R1038	2.19
R1039	2.19
R2008B	1.33
R2009	1.98
R2010B	2.98
R2029	1.33
R2030	1.33
R2257	2.35
R2265	1.49
R2305	1.18
R2322	0.67
R2323	0.76
R2354A	0.64
R2354B	2.01
R2443	1.36
R2461	1.50
R2540	1.91
R2540X	3.30
R2615	0.67
RCA2060	2.00
RGP01-15	0.70
RGP10	0.30
RGP30M	0.28
RT402	1.58
RT905A	2.38
S1299	5.34
S2800D	1.84
S2802	2.90
S2818	4.05
S3702S	5.21
S40W	13.10
S6080B	9.98
SA8063	5.17
SAA1006	1.85
SAA1020	4.76
SAA1025	4.40
SAA1024	2.81
SAA1075	4.25
SAA1121	7.44
SAA1124	2.45
SAA1130	4.99
SAA1174	7.77
SAA1250	3.95
SAA1251	3.20
SAA1351	8.11
SAA3027P	2.55
SAA5000	3.25
SAA5010	4.40
SAA5012	5.50
SAA5020	5.78
SAA5030	6.33
SAA5050	7.74
SAB1009B	5.98
SAB3011	7.34
SAB3013	2.47
SAB3021	7.90
SAB3024	6.36
SAB3209	5.82
SAB3210	3.10
SAF1032P	3.58
SAF1039	1.95
SAS5010	8.39
SAS560S	1.86
SAS560T	5.42
SAS570T	5.42
SAS570S	2.61
SAS580	2.85
SAS6600	1.33
SAS660	1.33
SAS5700	1.33
SAS670	1.33
SAS6710	2.21
SBA750	1.61
SC84203	19.35
SC9504P	1.95
SDA2006	17.95
SDA2112/2	10.28
SG264A	5.26
SG613	8.75
SG629	8.27
SG6533	10.31
SI1125H	7.50
SI1630HD	20.50
SKE2F1/04	1.39
SKE2G3/04	0.85
SKE4F1/06	0.35
SKE4F2/08	1.07
SKE4F2/06	0.80
SKE4F2/10	1.33
SKE4G2/02	0.96
SKE5F3/10	1.60
SKS1/10	2.15
SL1310	3.14
SL1430T	2.31
SL414	3.69
SL432A	3.44
SL439	2.48
SL471	2.88
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X0109CE	11.25
X0113CE	2.07
X0195CE	7.50
X0204CE	8.74
X0261CE	8.98
ZPY120	3.25

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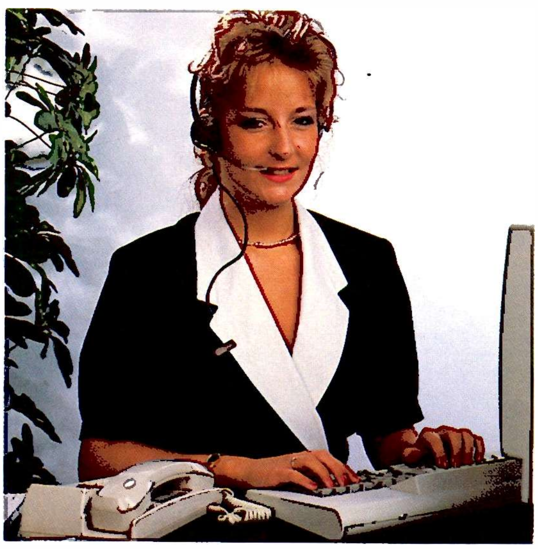

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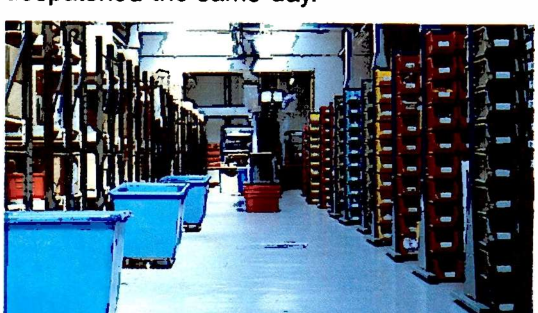

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New Products Selection

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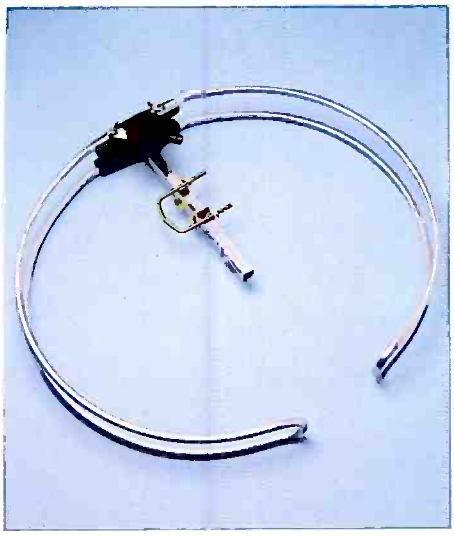
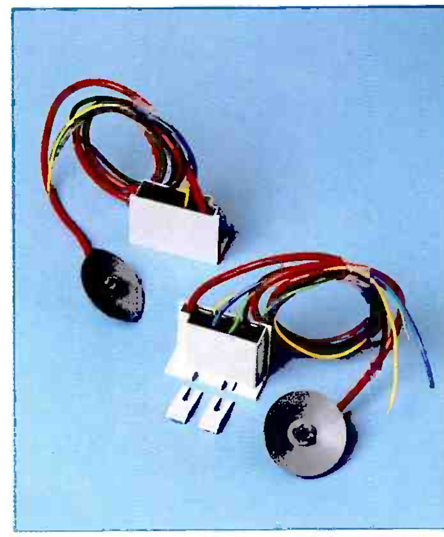


Antiference Omni-Directional Aerial page 13.

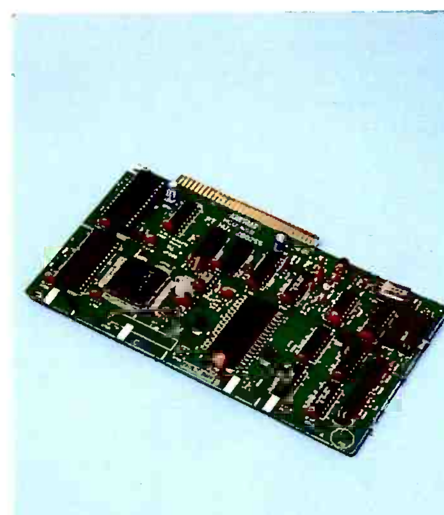
Duraplug High Impact Extension Sockets page 189.



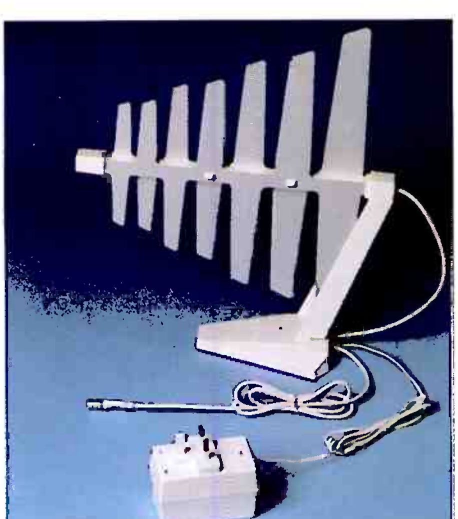
Miniature EHT Trays pages 127 & 128.

Antiference Aerial Accessories pages 14-17.

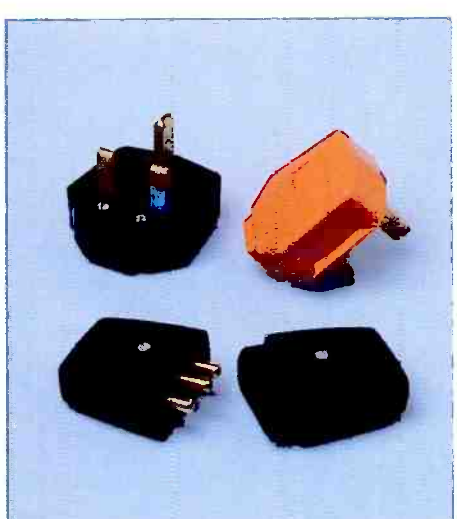
Duraplug Trailing Sockets page 187.



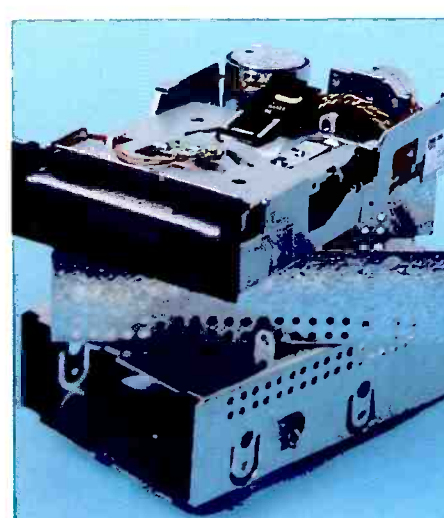
Amstrad PC2086 Exchange PCB page 203.



Antiference Power Sensor Set-Top Aerial with Amplifier page 12.



Duraplug Mains Plugs and 3-pin Connector pages 188 & 189.



Additional Disc Drives for Amstrad Computers pages 79 & 80.

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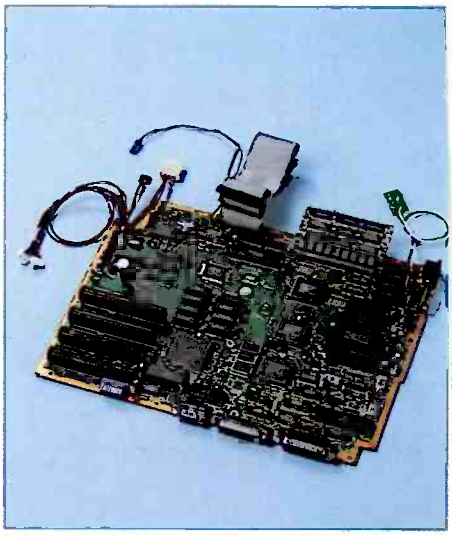
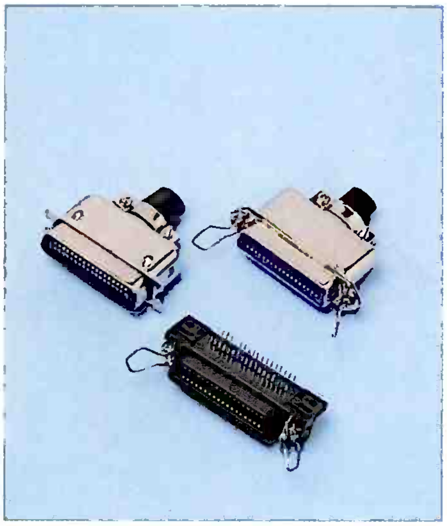
Bib VE 40 Video Head Cleaning System page 779.

Soldering Equipment by Antex pages 642-646.

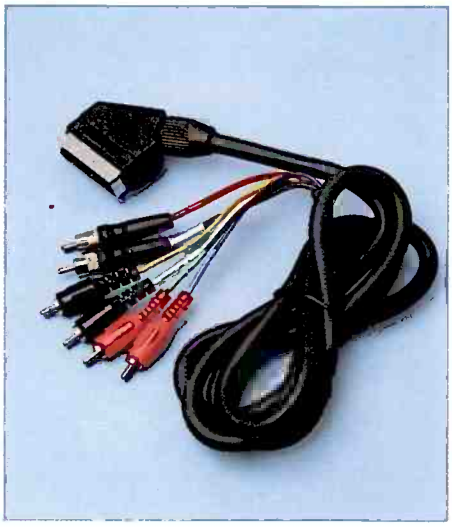


Amstrad PC2086 CPU Board page 203.

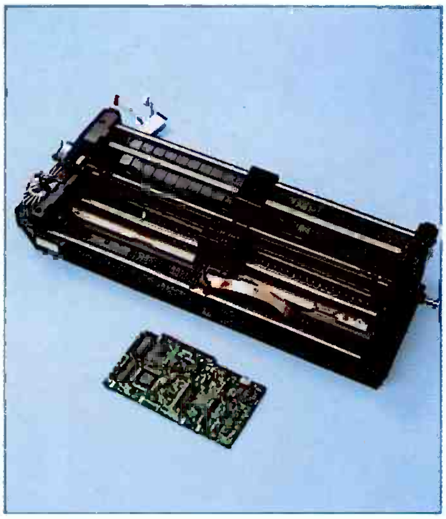


Centronics Connectors pages 120 & 121.

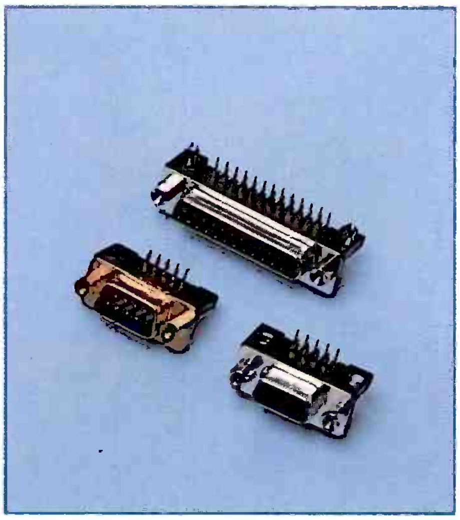
Bib CD Library and Care System page 29.



Scart Leads, many additions to the range, pages 770-777.



Printer Mechanisms for Amstrad and Hard Disc Controller Cards pages 202-206.



'D' Connectors, improved range, page 121.

Bib CD Care Products page 27.

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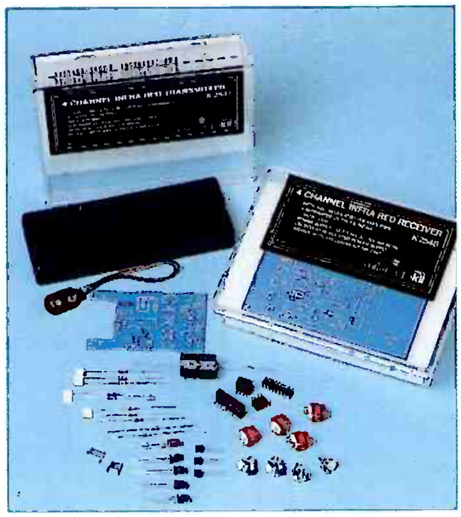
Ross Calibur Headphones
pages 38 & 39.



Velleman Hobby Kits
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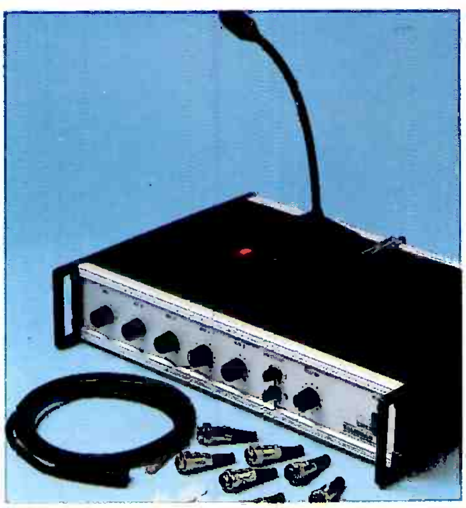
Volex Satellite and Downlead
Cable pages 74-76, 599-600.



Millbank P.A. Equipment
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Ross Camcorder Batteries
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Verbatim Computer Discs
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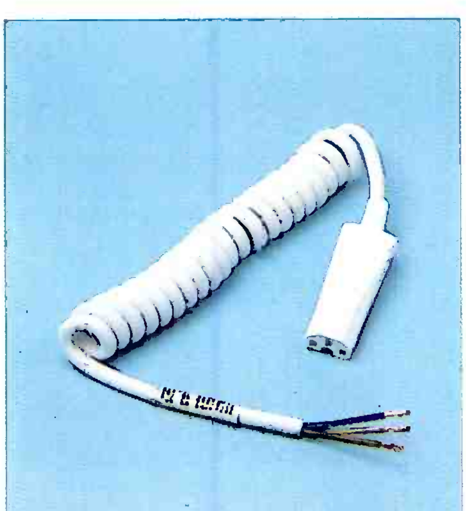
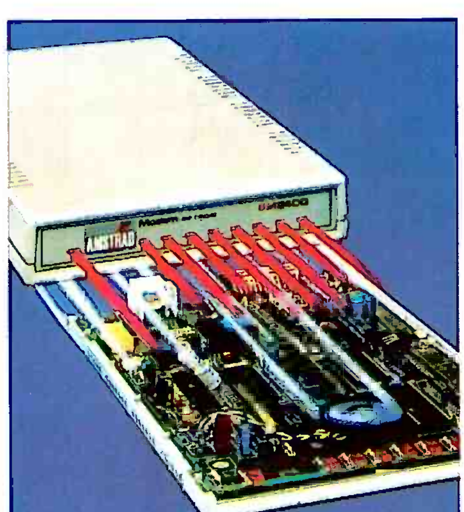
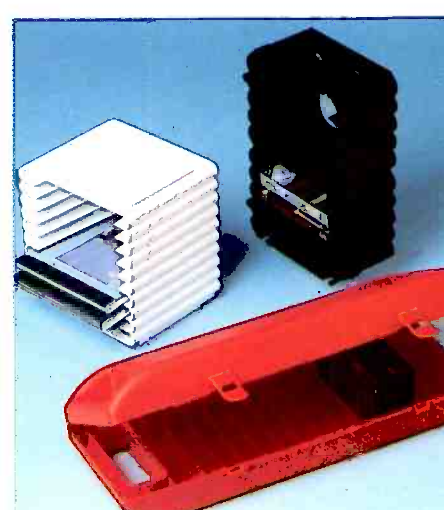


Quality Mains Leads page 188.



Amstrad SM2400 Stand-Alone
Modem page 82.



Ross Cassette and CD Storage
Systems pages 28 & 29.

New Products Selection

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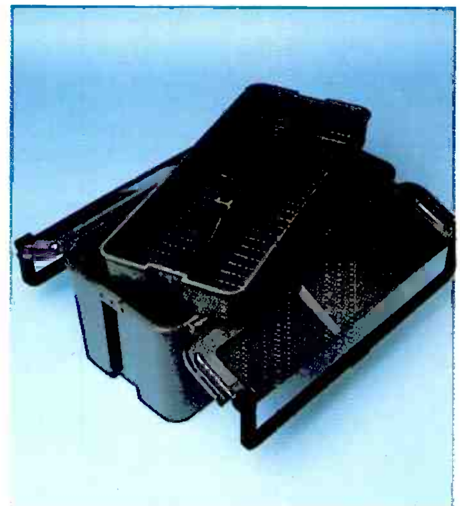
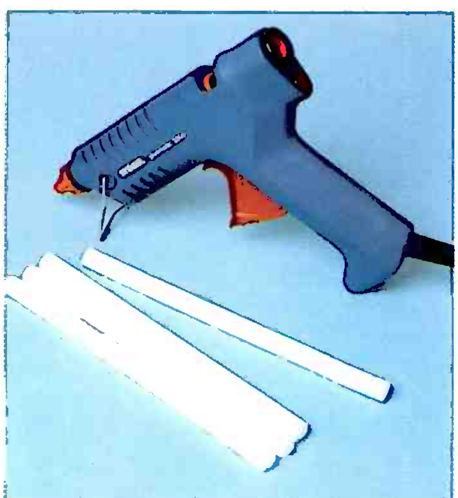
Panorama Cellular Telephone Aerials pages 1 & 2.



Raaco Tool Box page 732.

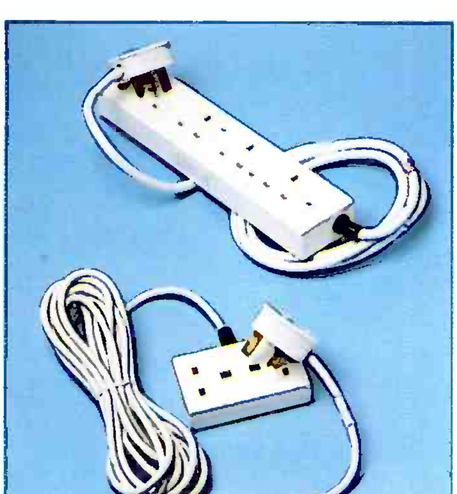
CME Replacement Remote Control Handsets, many additions to the range pages 545-594.



Steinel 3000 Glue Gun page 727.

Permabond Adhesives page 629.

CME Remote Controls Comprehensive Cross Reference Chart pages 545-549.



Laco, Quality Trailing Sockets page 187.

Tools by C.K. pages 735-739.

CME Replacement Remote Control Handsets, pictorial Cross Reference guide pages 550-594.

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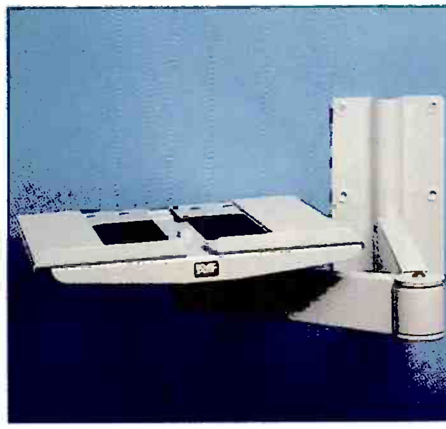
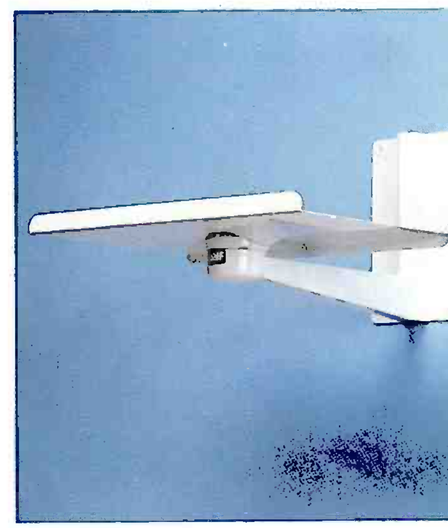
AVF Speaker Bracket page 651.



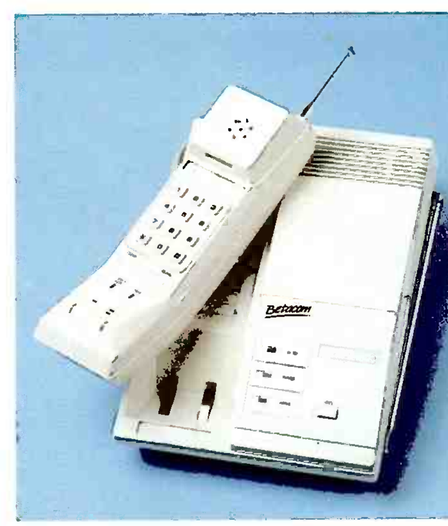
AVF Television Brackets
page 652.



AVF Little Twister TV/Monitor
Bracket page 652.

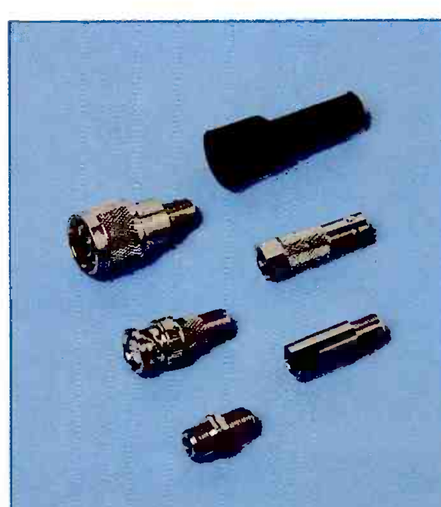
Betacom Telephones
pages 676-683.

Ferrari Testarossa Telephone
page 678.



Betacom Cordless Telephone
page 680.

Amstrad Satellite Spares
pages 205, 211 & 212.



Satellite Plugs and Connectors
pages 601-602.

Satellite Signal Strength Meter by
Kathrein page 718.

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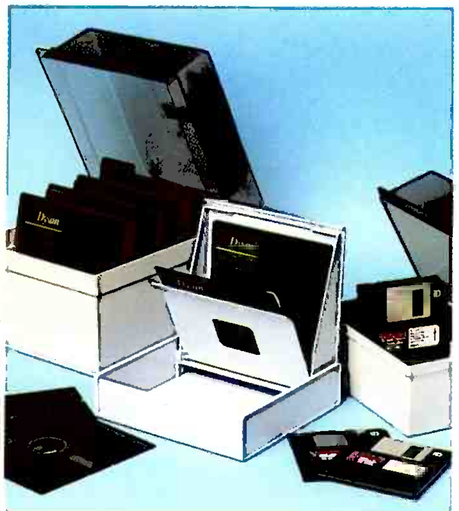
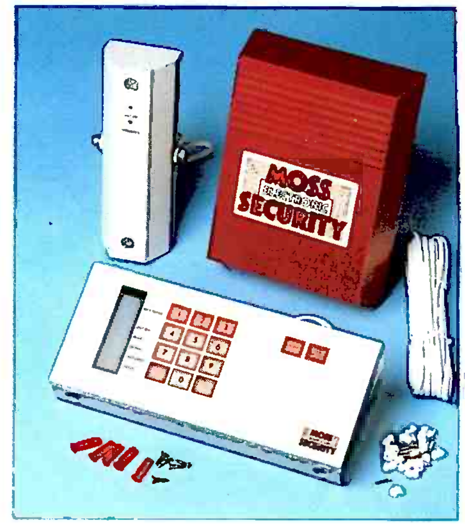


Rockfort Computer Disc Storage Boxes page 94.

Audioline Telephones pages 672-675.



Moss Security Systems pages 607-609.

Audio Plugs and Connectors page 45.

Secondary Disc Drives for Amstrad Computers pages 79 & 80.

Dysan Floppy Discs page 93.

Rayovac Computer Clock Battery BT844 page 67.

B.S. approved BRK Smoke Detectors page 639.

Headphone junction box page 32.

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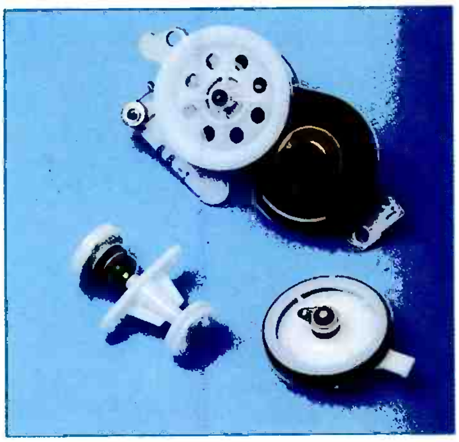
KÖNIG ELECTRONIC

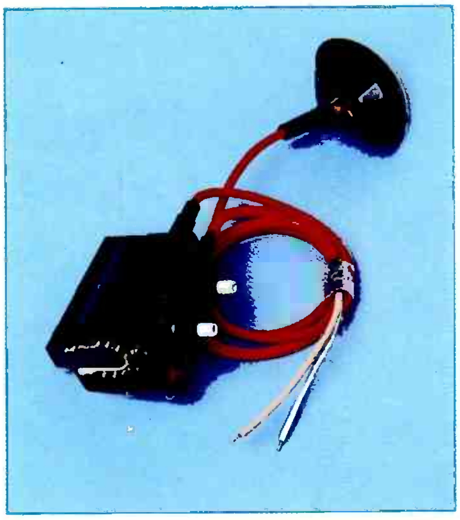


Comprehensive Range of Replacement Video Spares pages 792-850.

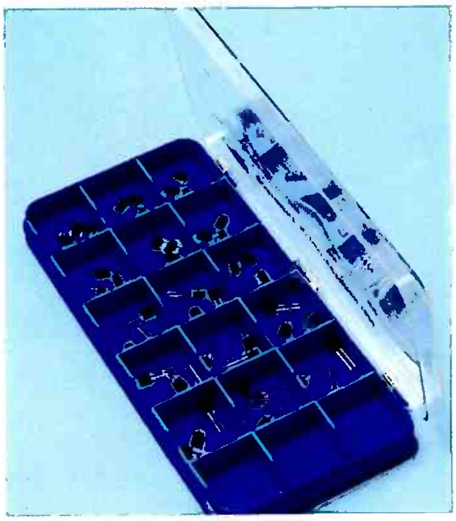
Quality Replacement Video Capstan and Reel Motors pages 804-809.

Replacement Pinch Rollers pages 810 & 811.

Remote Control Tester page 594.

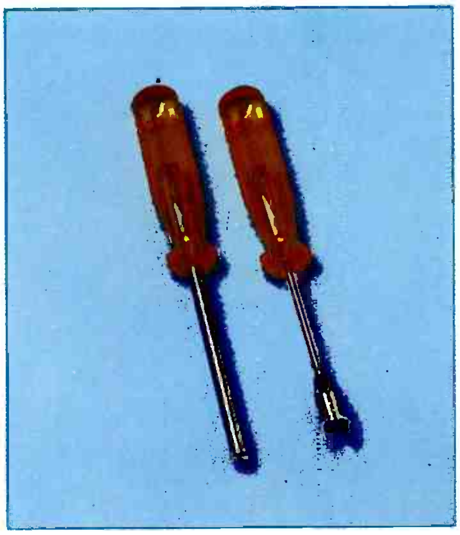


Replacement Ferguson TX100 Line Output Transformer page 754.

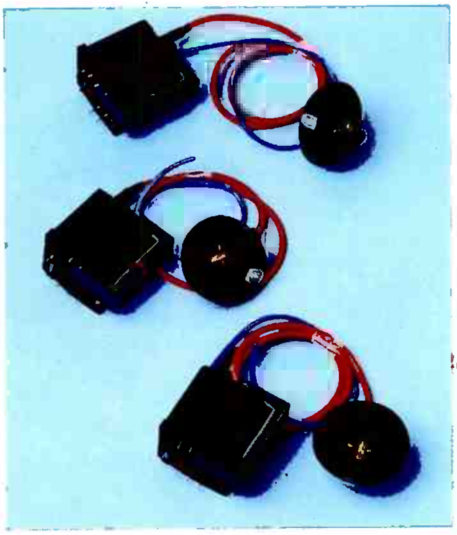


Comprehensive I.C. Protector Kit page 131.

Telescopic Aerial Kit page 9.



Video Adjustment Tools page 766.



Replacement ITT Line Output Transformers page 750.

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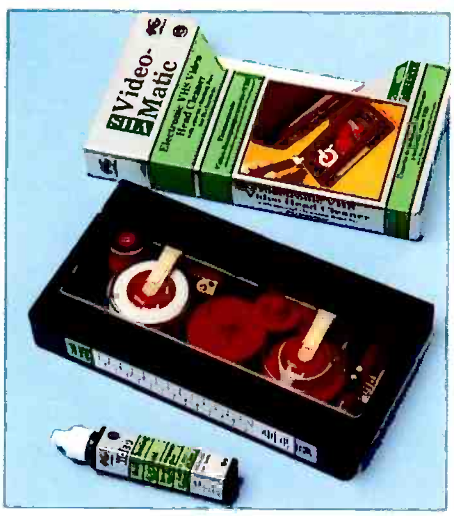
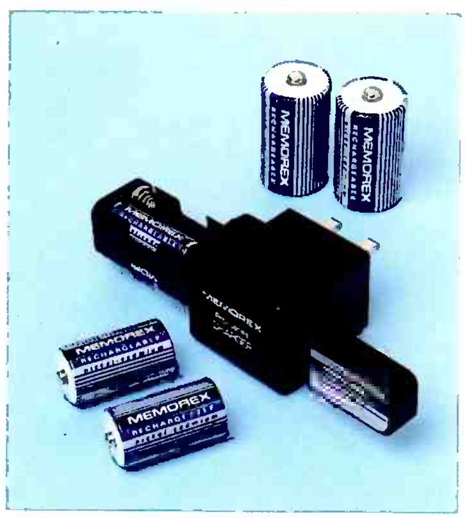
Memorex Universal Battery Charger page 69.

Memorex Video Tape page 782.

Memorex Cassette and Record Care Products pages 24-26.

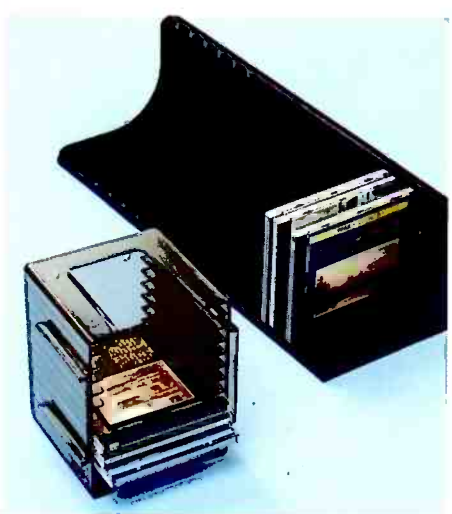


Memorex Electronic Video Cleaning System page 780.



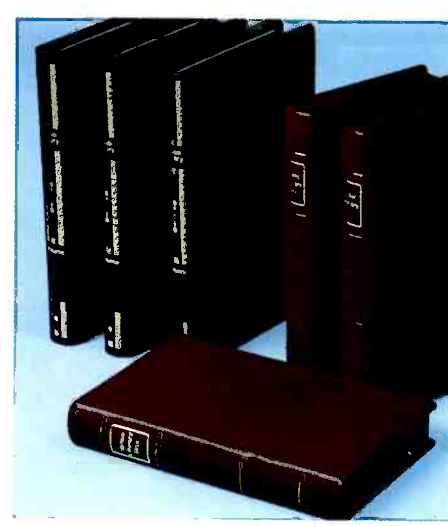
Ni-Cad Batteries and Chargers page 69.

VHS-C and Video 8 Cassettes page 782.



Storage Systems page 29.

Audio Tape Storage Racks by Memorex page 28.



Video Library Cases page 781.

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PHILIPS

De-solder Pump page 640.

Philips Wire Stripper
pages 605, 734.

Service Aids
pages 630, 631, 633 & 634.

E180 Philips H.Q. Video Tape
page 782.

Philips Digital Multimeter Model
SBC812 page 707.

RC5992 illustrated

Manufacturers Remote Control
Handsets pages 431-436, 524-532

Halogen Torch with useful Cord
Necklace page 733.

Top Quality Analogue Multimeters
page 704.

Wide Selection of Quality Service
Aids pages 630, 631, 633 and 634.

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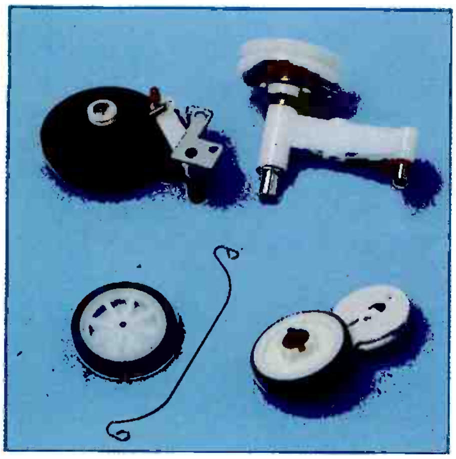
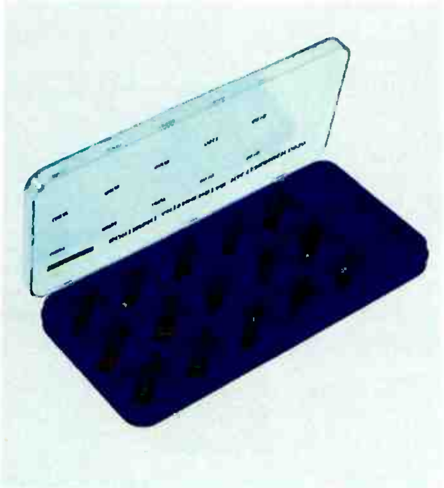
KÖNIG ELECTRONIC



Video Component Cross Reference Chart pages 814-850.

Audio Test Cassettes pages 721 & 722.

Top Quality Replacement Video Lamps page 796.



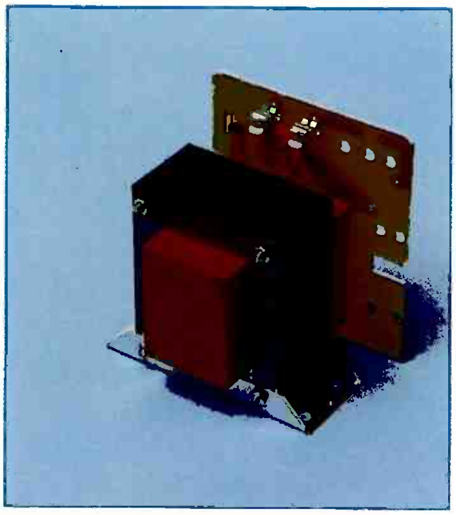
Mounting/Pivot Posts for Fold-down Aerials pages 10-11.

VHS Alignment Cassette page 723.

Replacement Remote Control Handsets pages 545-594.

Telescopic Aerials pages 3-11.

Comprehensive Audio Head Kit page 56.



Replacement Ferguson 3V35 Mains Transformer page 745.

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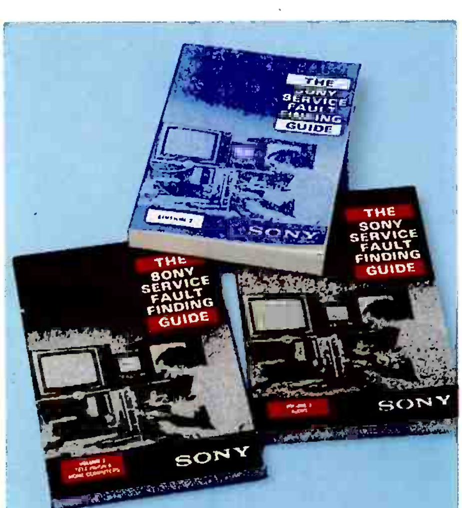
Nisshoku Replacement Video Heads, many new additions pages 785-791.



Books including Fault Finding Guides by Sony page 476.

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Sony Technical Books page 476.

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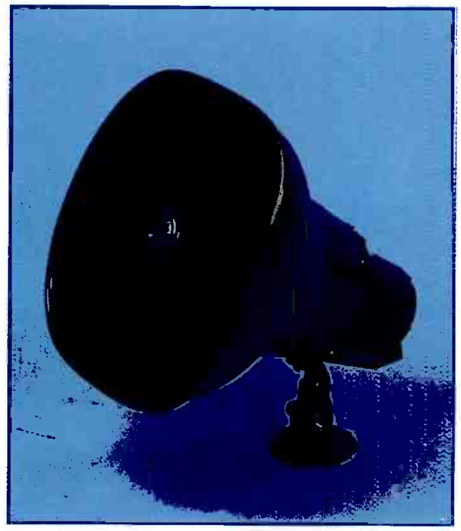
P.A. Amplifier by Inkel
page 485.



Atlas Sound Horns with Lifetime Guarantee page 503.

Inkel PA2 Multi P.A. Combination
page 485.

B + K CRT Rejuvenators
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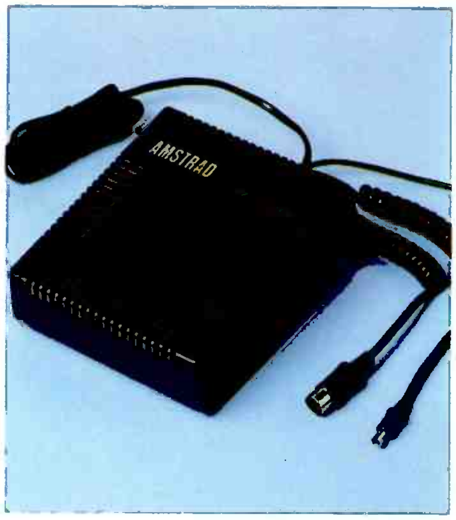
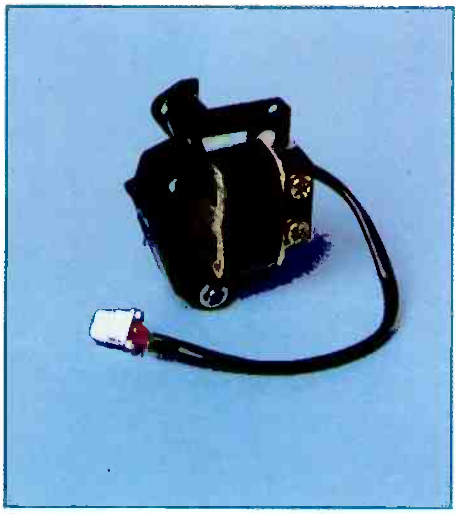
Microphone Stands page 503.



Modulator/Power Supply MP2
page 83.



Hammer Magnet Assy. (complete)
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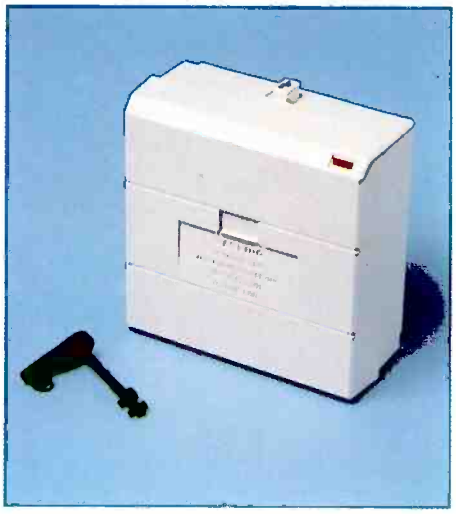
Quality Range of P.A. Horns
page 503.



Commtel Callminder
page 688.

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Machine Nos.: VP77 VP88 VP7100 VP7200 VS1 VS2 VS3 VS5 VS10 VS9300 VS9500 VS9700 VS-P1 VS-P5 — VHS A

AMSTRAD
Machine Nos.: VCR4500 VCR5200 VCR9000 — VHS T
Machine Nos.: VCR7000 — VHS R
VCR4600 — 9VH4600

FERGUSON/JVC
Machine Nos.: 3292 8903 3V00 3V01 3V06 3V16 3V22 3V23 3V24 3V29 3V30 3V31 3V35 3V36 3V38 3V39 3V49 — VHS A

FISHER
Machine Nos.: FVH — D520 D530 D620 D720 P420 P510 P520 P530 P615 P620 P622 P710 P720 P721 P722 — VHS U

GEC
Head Part Nos.: 5458161 5458165
Machine Nos.: 4000H 4001H 4002H — VHS I
Head Part Nos.: 5458282 5458413 5458415 5458992
Machine Nos.: 4001H 4004H — VHS K

HITACHI
Machine Nos.: VT3000 — VHS A
Head Part Nos.: 5458104
Machine Nos.: VT4000 VT4200 VT5000 VT5500 — VHS H
Head Part Nos.: 5458161 5458165
Machine Nos.: VT6500 VT7000 VT8000 VT8040 VT8100 VT8500 VT8700 VT9000 VT9300 VT9500 VT9700 VT9900 — VHS I

Head Part Nos.: 5458282 5458413 5458415 5458992
Machine Nos.: VT11 V14 VT33 VT34 VT330 VT340 VT5030 VTP10 VTP30 — VHS K

ITT
Machine Nos.: VR3605 VR3033 VR3905 VR3913 VR3914 VR3935 VR3943 VR3963 VR3993 VR3975 VR3985 VR3986 VR3833 — VHS A

JVC (see also Ferguson)
Machine Nos.: HP4000 HR2200 HR3300 HR3320 HR3330 HR3350 HR3360 HR3660 HR3750 HR3860 HR4100 HR7200 HR7600 HR7610 HRD110 HRD111 HRD120 HRD121 HRD140 HRD150 HRD220 HRD225 — VHS A

MITSUBISHI
Machine No.: HS200 — VHS A
HS700 HS303 HS304 — VH700

NATIONAL PANASONIC
Head Part Nos.: VEH0099 0103 0115 0121 0131
Machine Nos.: NV300 NV322 NV332 NV333 NV340 NV390 NV2000 NV3000 NV7000 NV7200 NV7500 NV7800 NV7850 NV8170 NV8200 NV8400 NV8600 NV8610 NV8620 — VHS B
Head Part Nos.: VEH0171 VEH0218
Machine No.: NV370 NV3708 — VHS M
Head Part Nos.: VEH0171
Machine Nos.: NV330 NV777 — VHS N
Head Part Nos.: VEH0286
Machine No.: NV430 — VHS W
Head Part Nos.: VEH0174
Machine No.: NV366 — VHS X

SHARP
Head Part Nos.: DDRMU 0002 HE17/21/27
Machine No.: VC581/2/3 651 681/2/3/5 659 699 — VHS S
Head Part Nos.: DDRMU 0001 HE00 0002 HE02 04 05 06
Machine No.: 2C9 VC110 VC200 VC220 VC300 VC381 VC384 VC386 VC387 VC388 VC477 VC481 VC482 VC930 VC970 VC3300 VC9100 VC9300 VC9400 VC9500 VC9600 VC9700 — VHS C
Head Part Nos.: DDRMU 0001 HE09
Machine No.: VC7300 VC7700 VC7750 — VHS D
Head Part Nos.: DDRMU 0001 HE10
Machine No.: VC6300 — VHS E
Head Part Nos.: DDRMU 0001 HE12
Machine No.: VC8300 — VHS L
Head Part Nos.: DDRMU 0001 HE14
Machine No.: VC2300 — VHS F

SANYO
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Machine No.: VTC5000 VTC5150 VTC5300 VTC5400 — BETA D
Head Part Nos.: 1430242 T02200
Machine No.: VTC5350 VTC5500 — BETA D
Head Part Nos.: 1430762 T02000
Machine No.: VTC9300 VTC9455 VTC9500 — BETA X
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Machine No.: VTC9300PS VTC9350 — BETA X

SONY
Head Part Nos.: A6762 044A, 044B, 054A, 147A
Machine No.: SL3000, 8000, 8080, SLT 6Me, 7, 7E, 7ME — BETA A
Head Part Nos.: A6762 012A, 038A, 055A, 129A
Machine No.: SL5W, 5000 5100 SLC5, C6, C7 — BETA B
Head Part Nos.: A6762 072A, 122A, 136A, 139A, 213A
Machine No.: SLC20, C30, C33, C40, C44 SLF1, F30, HF72, T20, T30 — BETA W

Please see next col. for prices.

HEADS

Head Part No.	Price 1 +
BETA A	£16.95
BETA B	£16.95
BETA D	£27.50
BETA E	£34.49
BETA T	£21.00
BETA W	£19.95
BETA X	£31.92
VHS VIDEO	
VHS A	£13.95
VHS B	£13.95
VHS C	£18.75
VHS D	£81.76
VHS E	£75.43
VHS F	£81.69
VHS H	£21.25
VHS I	£21.25
VHS K	£21.25
VHS L	£81.87
VHS M	£14.75
VHS N	£26.95
VHS R	£21.00
VHS S	£18.75
VHS T	£19.95
VHS U	£20.50
VHS V	£29.00
VHS W	£21.95
VHS X	£35.00
VHS Z	£14.25
ORIGINAL FERGUSON	
01X0 003 222	£31.35
01X0 027 085	£46.02
01X0 033 825	£47.05
01X0 040 002	£48.32
01X0 056 013	£61.55
01X0 057 002	£31.36
01X0 082 001	£46.02
01X0 083 063	£66.03
PHILIPS	
310 274 44	POA
691 200 54	£49.68
691 200 98	£62.02
691 201 12	£61.66
691 201 66	£61.93
691 201 78	£49.96
691 202 87	£55.37

FERGUSON/JVC

VID1	01X0-003-381	Tension band T3292/PU545904A	2.55
VID2	01X0-018-024	Take up idler T3292/PU47752	5.00
VID3	01X0-018-025	Rewind idler assembly T3V16/PU49282	6.20
VID4	01X0-018-729	Take up idler T3V00/PU49280	6.95
VID5	01X0-040-006	Loading belt T3V29/30/PU48941-2	0.26
VID6	01X0-033-454	Roller Assy. (cass. Housing) T3V23/PU49042	4.50
VID7	01X0-040-007	Take up idler 3V29/30/PU48967B	2.90
VID8	01X0-040-017	Reel motor assembly 3V29/30/PU51381V	27.95
VID9	01X0-065-009	Capston motor 3V35/36/38/39/PU55371V	22.10
VID10	01X0-065-016	Cass. housing Assy. 3V35/36/38/39/PU29825	22.00

GEC/HITACHI

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VID12	V6413663	GEC 4000/Hitachi VT33 f/f rewind arm	2.75
VID13	V6861471	GEC 4001/2/Hitachi 93/9500 f/f rewind arm	1.95
VID14	V6861482	GEC 4001/2/Hitachi 93/9500 play idler assy.	4.20
VID15	V6886971	GEC 4004/Hitachi VT33 f/f rewind arm	1.80
VID16	V2423461	ET541 Tuner Unit	6.00

NATIONAL PANASONIC

VID17	VXP0329	Fast forward idler NV2000	0.85
VID18	VXP0344	Idler NV7000/7200	0.85
VID19	VXZ0078	Tension Band NV7000	3.50
VID20	VXP0521	Idler NV370	2.65
VID21	VXP0463	Reel Idler NV777	3.40
VID22	VXP0432	Pinch Roller NV333	3.30
VID23	VXP0401	Idler wheel NV333	1.25

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SANYO/FISHER

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~~VID25~~	~~1430662T01201~~	Reel drive pulley VTC 5000	4.95
VID26	PR2758	Pinch roller VTC5000/5150	3.85
VID27	1430490400900	Gear idler Fisher FVH-P615	4.50
VID28	1430420400300	Heart idler Fisher FVH-P615	2.95

SHARP

VID29	RMOTP1029	Capston motor 73/9300	33.55
VID30	RMOTV1008	Reel motor VC9700	17.95
VID31	NIDL0006	Idler VC387H etc	1.75
VID32	NIDL0005	Reel idler VC9300 etc	1.85
VID33	NIDL0004	Idler wheel VC2300	2.15

VIDEO LAMPS/BULBS

VID34	LA9295	Universal lamp without socket 290mm	0.45
VID35	LA9210S	Universal lamp with socket 310mm	0.50
VID36	NAT/PAN.	P.C. MTG. leadless lamp	0.50
VID37	SHARP 9300	Etc. lamp plus plastic shroud.	2.53

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VP 68	DBK135	£0.86
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VS 2 EG	DBK101	£1.08
VS 3	DBK134	£1.76
VS 5 EG	DBK101	£0.68
VS 10	DBK136	£1.65
VS 9300	DBK103	£1.42
VS 9500	DBK103	£1.42
VS 9700	DBK102	£1.96
VS 9800	DBK103	£1.42
FERGUSON		
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3 V 01/16	DBK103	£1.42
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3 V 23	DBK108	£0.83
3 V 24	DBK137	£0.68
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VBS 7600	DBK105	£2.34
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VBS 9000	DBK10	£1.76
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V 4001 H	DBK129	£0.68
V 4002 H	DBK129	£0.68
V 4100 H	DBK128	£1.95
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VT 5000	DBK125	£1.46
VT 6500	DBK142	£0.77
VT 7000	DBK143	£0.68
VT 8000	DBK129	£0.68
VT 8500	DBK144	£0.68
VT 9300	DBK129	£0.50
VT 9500	DBK129	£0.50
SANYO		
VTC 5000,5150	VID7807	£1.19
VTC 6000	VID7807	£1.19
VTC 5300	DBK105	£0.70
VTC 5400	DBK105	£0.70
VTC 5500	DBK106	£1.76
VTC 6500	VID7533	£0.78
VTC 9300	DBK104	£2.66
VTC 9350	DBK145	£2.66
VTC M10/11/20	VID7809	£0.61
VTC M21/30/31	VID7809	£0.61
VTC M50	VID7809	£0.61
JVC		
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HR 3300	DBK107	£1.65
HR 3330	DBK126	£1.65
HR 3360	DBK103	£1.42
HR 3600	DBK107	£2.66
HR 3660	DBK103	£1.42
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Norman's Satellite TV Installation

J. LeJeune

Sid Bias, service manager of Topcut's electrical/ electronics emporium, sniffed the autumn air as he walked the half mile to work. When he got there he found the van, emblazoned with the Topcut new-image trading name "Electric Dreams", standing in the yard. Its back doors were open and Gareth and Norman were loading cartons into it. Untypically, Norman was wearing overalls.

"What's all this?" asked Sid.

"Special orders from Mr. T" replied Norman. "Our first satellite TV installation is wanted right now."

Sid recalled that he had booked the installation for the day after tomorrow – it was his day off and he didn't want to have anything to do with the stuff. Transistors he could barely tolerate, microcircuits were sheer anathema and microwaves were strictly for cooking.

"I don't want to know" he said. "It's bad enough to have to deal with video recorders and microwave ovens. Satellites are way above my head." He stalked off, oblivious of his last truism. Once in the workshop he removed his jacket and parked it on the back of his chair. Two kettles, a food-mixer, a Dansette record player and a Ferguson 3845 monochrome portable had been arranged awaiting his attention. Small jobs that blended neatly with his responsibilities for general service administration.

Gareth and Norman were preparing to leave for the site of their first satellite TV installation. Norman had studied the books and manuals about dish alignment and considered, rightly, that this was the crucial part of the operation. Gareth was looking forward to the event. "Do you think it'll work?" he asked. "Of course it will" said Norman. "I've surveyed the site and found that it has an unobstructed view of the satellite's position. Unless the electronics are faulty it's bound to work."

At the Site

They soon arrived at Greystones Farm. The south wall of the farmhouse was bathed in sunshine and had a clear view from its hillside position. They unloaded a carton, a TV set, a mains extension cable and the ladders from the van's roof. A place for the dish had been agreed with the owner – close to the eaves, with the connecting cable running down the wall and into the lounge some twenty feet below. Gareth scaled the ladder and drilled the wall ready for the mounting bracket. Below, Norman assembled the dish and the LNB.

When all was ready Norman said "up you go with it then and set the azimuth angle." Gareth took it all very seriously. "The satellite is at 19°E" he muttered, "the compass reads 7°E for true south, so I need to set it at about 26° . . . anyway it's near enough for a start." He descended the ladder and picked up the inclinometer. Back up at the dish he raised the elevation to the value shown in the installation manual's map and tightened the screws sufficiently to hold the dish still. Norman had installed the receiver unit and was bringing the cable through and up the wall. Soon they were ready to switch on.

Disappointment. There was nothing but snow on all channels. "Where did you set the dish azimuth?" asked Norman. "I calculated about 26°E by the compass was about right, so that's where it is . . . the elevation is o.k." said Gareth.

"Just where did you go to school?" commented Norman. "What's wrong?" asked Gareth, beginning to doubt his assumptions. "It's 19° *minus* the 7° for magnetic variation" replied Norman. "That makes 12° by the magnetic compass!"

When the dish azimuth was altered the signals came in, as if by magic. Norman went up the ladder to set the exact dish position. They'd no signal-level meter, but with a 5in. portable colour TV set connected to the satellite receiver via a long cable he was able to view the results at the top of the ladder, as he worked on the dish.

By placing his thumb over the throat of the feedhorn Norman slightly attenuated the signal level at the LNB. This enabled him to peak the signal level – by repeatedly attenuating the level with his thumb and adjusting the dish for optimum signal pick-up. Eventually he found the best position. He tightened the mountings and descended.

"Why did you go to all that bother to set the dish exactly right?" asked Gareth.

"On a fine day like this the signal from the satellite will be at its strongest" Norman explained. "But the Ku band is also known as the Water Absorption Band. Rain and snow will attenuate the signal, so the more the merrier is the best policy."

"But the LNB isn't straight" Gareth pointed out. "That's because the polarisation is about 5° out at that orbital position" said Norman as they packed their kit back into the van. "I'll just give the farmer a quick driving lesson on the remote control, then we should be back at the workshop in time for lunch."

F Connectors

On their way back Gareth complained about the screw-on connectors. "Why do they use them? – they're horrible to fit."

"Well F connectors won't pull off" said Norman, "but it seems to be something of a tradition – satellite receiver manufacturers have always used them. BNC connectors would work just as well, but they're expensive and just as difficult to fit in the field. What we need is the crimping type F connectors and the right tool. I'll have a word with Sid."

Back at Base

Andy greeted them when they got back to base. "How did it go?" he asked. They were busy discussing it as they went inside, where Sid sat amongst the pieces of a toaster. He listened in silence as Gareth recounted the morning's work, glumly reassembling the assorted parts until he had something resembling an electric toaster. When he plugged it in and switched on something somewhere gave a brief grunt after which the workshop was plunged into gloom.

Ralph Topcut, who had been demonstrating a compact disc player in the shop, scurried through and began complaining. Norman grabbed his tools, Gareth some fuses and a card of fusewire, while Andy found a torch. They dashed around making a great commotion. In the midst of all this Sid yawned, picked up his jacket and strolled out through the yard to the Belvedere Cafe, his usual lunching place. The toaster could wait till this afternoon.

A Bout of Despair

Les Lawry-Johns

When an old friend carried in his almost new colour portable I thought it was going to be a five minute job. I started by assuming that it was a Fidelity receiver hiding behind another name (Goodmans), but though I looked here, there and everywhere I couldn't find the correct circuit diagram. It seemed to be similar to the ZX3000 chassis, but the layout was different. The line output transformer was at the rear centre. It looked like the one in the earlier Fidelity ranges, with the integrated focus and first anode supply knobs sticking out. The chopper transistor and its control chip were where you'd expect them, on the left side viewed from the rear, but the chip was a TDA4601 instead of a TDA4600. I checked the legs, and they seemed to have the same layout. Anyway, as the set wasn't working I fitted a TDA4600 and checked the voltages, which all seemed to be low.

Perhaps there was an overload? I checked the line output transformer etc. carefully and got nowhere. In fact I spent a whole week on it, checking this, that and the other. When I say a whole week what I mean is that during the course of a week I spent several hours on it without achieving anything. I don't spend all that much time in the shop nowadays – I suppose I'm getting lazy in my old age. Finally I decided to let someone with a more active mind have a go. So I carted the set off to Geoff in Sun Lane. He kept it a week and then asked me to collect it before it drove him barmy. He'd thought it was the line output transformer loading down the supply, and I'd run one up to him just in case I'd made a mistake earlier. As it was my last one I ordered another from SEME Stan, along with some other items I might require. Geoff didn't need the transformer however as the replacement didn't make any difference. So out it came and back went the original. He also checked the field output stage, in case an overload there was shutting everything down.

What was I to do when it came back? I assumed that there was a problem with the start-up system, and ordered a TDA4601 just in case. This didn't make any difference either, so I got down to checking every component in the chip's supply circuit, taking each item out in turn to be sure. In due course I came to a 100μF, 25V electrolytic which acts as the reservoir capacitor for the start-up and also the running supply to the chip – it's connected to pin 9. I checked it carefully and it claimed to be in order. Substitution seemed to be a sensible double-check however, and when a replacement had been fitted normal results were restored.

At this I went into seventh heaven. I can't tell you the hours I'd spent checking various possible culprits, as well as phoning up everyone I thought might be able to help. I feel ashamed at troubling so many people, but there you are – all because of an electrolytic that tested o.k. The start-up feed comes via a 15kΩ resistor, and I noticed that one end of this is very close to the h.t. fuse. Maybe the electrolytic had been disturbed by a nasty shock at some time. If all this sounds trivial to you, just wait until you get something like it!

Things have been much as usual here apart from that wicked set. The shop still hasn't sold, the cat still won't come in, the two male dogs still can't agree not to fight, the weather seems to be getting colder and H.B. has decided to sell our car which I've just taxed and reinsured. She's going to sell it to her sister's husband who is not having much luck with his car at the moment. Our Renault 18 has been very reliable and just as it's in sparkling form she's going to pass it on. Apparently we are going to get a smaller car, a Renault 5 or something like that. I don't seem to have too much say in our business lately.

The Lady with the CVC5

As I was jotting that down the phone went and a sexy sounding lady asked me to call and look at her set which had gone on the blink. It turned out to be an ITT CVC5 that had been left on with a faulty tripler. This hadn't done the line output stage much good of course. A new tripler and a PL509 line output valve restored fairly good results, but I replaced the PY500 efficiency diode as well in case it had suffered. What about payment? It seemed that the lady had other ideas. Other than cash, that is. But I didn't fall for it and asked for my money. I told her I was sixty six and couldn't even if I wanted to. After a small argument she paid up and I departed in haste.

A Waltham Portable

An old customer phoned to say that he wanted to bring a Waltham portable along to the shop. I got there just in time and when I put the set on the bench I found that there was a small, dark picture, with pulling all over the place. I thought it would be the reservoir capacitor, but bridging this with a 4,700μF test capacitor made no difference. I then looked carefully for a cracked track as I'd had this trouble with the panel before. All relevant tracks showed continuity however. So I dabbed around with the 4,700μF capacitor to see whether I could find a point where it did any good. At one point the picture cleared up wonderfully, though there was still a slight gap at either side of the raster. I couldn't see exactly where this point was – it was not far from the bridge rectifier. As I wasn't prepared to argue about it I left the set on soak test for a while. I then ran it back to its owner and showed him it working with a good picture. He paid his fiver (he's an old man) and I departed for the bungalow.

I'm getting worried about having this bungalow since the bridging loan is costing me plenty and the shop just doesn't seem to attract any serious buyers. I feel sure that something will happen soon however. Is anyone out there interested?

TEST CASE

324

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

This was one of those rare occasions when everyone in the Test Case workshop wanted the job. The simple reason was that the machine had a cassette strapped to the top of its cabinet – Naughty Swedish Nights No. 2. In the event there was a disappointment. Inside the box the gathered lads found an ordinary Scotch E180 cassette that was much chewed and had, by way of software, an episode of Coronation Street. By this means the customer had got his cassette repaired and spliced, and priority attention for his machine. Good thinking!

The VCR itself was a five year old Hitachi Model VT33. It had chewed the tape because the reel idler was shot. No surprise here. We've plenty of these idlers, which have earned the trade a bob or two over the years, in stock.

Before making out the job card we do a final check on all the VCR's functions. We found that this one wouldn't record a picture, though the E-E picture was fine once a button had been tuned to the local transmitter. The sound was recorded normally, and played back o.k. while the monitor's screen was filled with snow. The fact that the sound "wowed" when the tracking control was rocked during playback suggested that control pulses were being recorded on the tape, so it seemed that the trouble was somewhere in the luminance record circuit.

This was as far as Workshop Sage got with the machine. He was called away and left another technician, John, to sort the problem out. Armed with an oscilloscope, John delved into the bottom PCB where the luminance and chroma circuitry lives. His first check was for carrier drive to the recording heads. There was none at pins 1 and 6 of PG217. Tracing back he found no drive at the coupling capacitor C211 and none at pin 25 of the drive chip IC201. During playback, Q205 shunts any signal here to chassis. Perhaps this transistor was leaky or being turned on in error in the record mode? John disconnected its collector lead from the PCB land, but there was still no record signal. He could have saved himself the trouble by checking first at pin 28 of IC201, where the signal enters the recording amplifier, since there was virtually nothing here either. There was a good carrier signal, complete with chroma information, at the collector of the driver transistor Q201 however – over 200mV worth.

John decided that the signal was being dropped across the coupling capacitor C248 because pin 28 of the chip was earthed. Certainly there's an earthing switch within the chip. It's operated by the record mute line, which enters IC201 at pin 27. Muting occurs when pin 27 goes high, but the meter showed zero voltage here. Hopefully, pin 27 was earthed by connecting it to pin 11, but there was still no record current to the heads. It seemed that the i.c. was faulty, with some sort of heavy leakage to chassis at pin 28. Maybe the amplifier's input was short-circuit, or possibly the internal electronic muting switch was stuck on. Maybe Sage should complete his jobs instead of lumbering other people with them . . . Be that as it may a replacement chip was ordered. One off type HT4207, part number 5328611. Did it cure the problem? See next month.

ANSWER TO TEST CASE 323
– page 49 last month –

Last month's sorry saga culminated in a cruel assault on the inside of the recalcitrant satellite TV tuner. In the user's house the tuning drifted about like a log in the ocean, but on test in the workshop it was rock steady. The joint view of the workshop worthies was that the next step should be to fit a complete replacement tuner/i.f. module. That must clear the problem, they reasoned. What else was there?

This is a trap that's perhaps easily fallen into by technicians who've spent all their working lives with ordinary TV receivers. The input signal provided by the broadcast transmitter cannot possibly drift in frequency. Nor, we pray, can the carriers from a satellite's transponders. But satellite TV reception is a double superhet process, with the first local oscillator in the LNB up at the dish and the second local oscillator inside the satellite TV tuner. The first conversion process produces an i.f. at around 1GHz. If either local oscillator drifts, the effect is similar, though the tuner's a.f.c. system can compensate over a limited range.

What was happening in this case was that the oscillator inside the LNB was drifting a bit with temperature – it's the first time that we've encountered this. Repair of the frequency converter section of an LNB is out of the question, even for the keenest of retailers' service engineers. A replacement LNB assembly solved Mr. Todd's problem, but gave us another one when we tried to get it replaced under guarantee. The struggle continues . . .

Published on approximately the 22nd of each month by IPC Magazines Limited, King's Reach Tower, Stamford Street, London SE1 9LS. Filmsetting by Trutape Setting Systems, 220-228 Northdown Road, Margate, Kent. Printed in England by the The Riverside Press Ltd., Thanet Way Whitstable, Kent. Sole Agents for Australia and New Zealand – Gordon and Gotch (A/sia) Ltd.; South Africa – Central News Agency Ltd. Subscriptions: Inland £20, overseas (surface mail) £24 per annum, payable to Quadrant Subscription Services Ltd., Oakfield House, Perrymount Road, Haywards Heath, Sussex RH16 3DH. "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 out 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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The components are of excellent quality, in packs originally intended to sell at £1 each. To make sure you get a good variety, the 20-pack parcel will have no more than two of any one pack, the 100 pack parcel will have at most five of any one pack. Packs supplied as they come – our choice.

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PARCEL 1B: 100 PACKS for £39! + VAT

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This parcel contains nothing but ICs. The mixture offers TTL and CMOS logic, interface ICs, linear, data converters, op-amps, special functions, and so on. Some of the ICs are pre-packed with data sheets, some (TTL, CMOS, op-amps) we expect you to identify for yourself, others will be covered by the free *data pack* provided, and the rest you'll have to identify under your own steam. If you know your ICs you'll be in for a few nice surprises.

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PARCEL 5A: 1000 ELECTROLYTICS for £10 + VAT
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A mix of general purpose silicon transistors, mostly bipolar NPN and PNP, with a few FETs and unijunctions thrown in (when available) to spice the mixture. The contents vary from month to month – at the moment there are BC212s, BC213s, BC548s, BC238Bs, MTJ210s, and so on. Next month – who knows? All top quality components.

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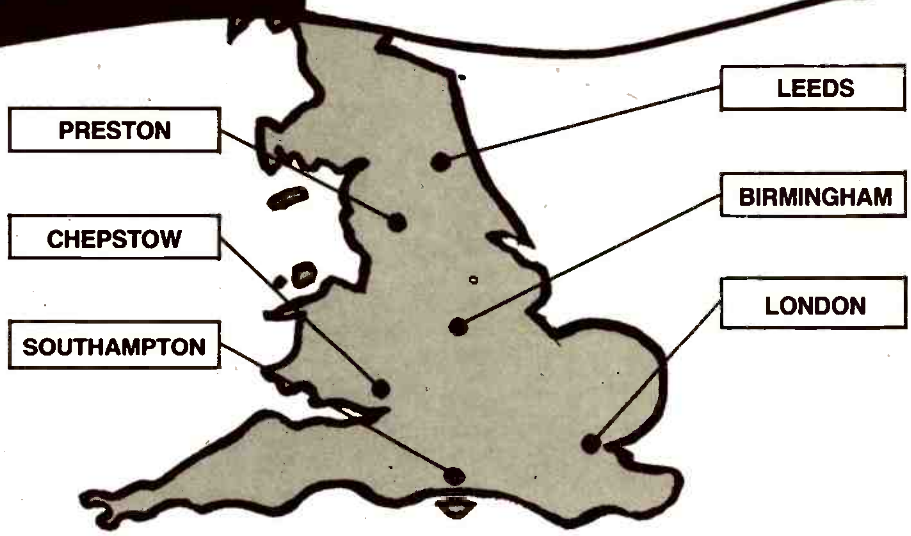

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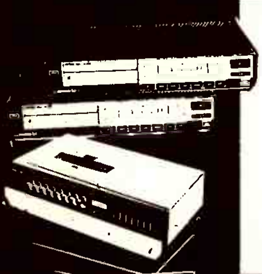

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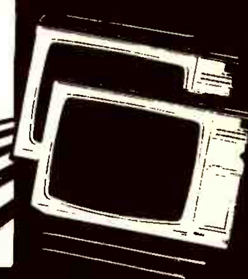

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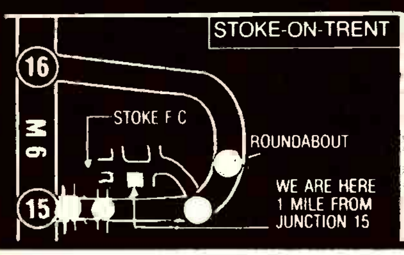

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For further information please contact:

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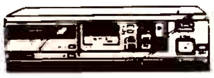

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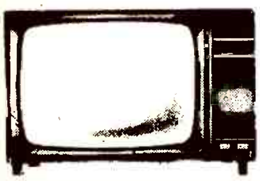

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P.172

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G11 Transient Suppressors 245V 20p
G11 Scan Coils £5.00
G11 100K tuner pots 12 for £1
KT3 IF panel £6.00
KT3 line OSC transformer £1
KT3/K30 infra-red receiver head £1
K30 drawer unit with IC's (home) £10
K30 drawer unit with IC's (export) £10
KT3 AE Sockets 50p
KT3 receiver panel £8
KT3 line driver transformer £1
Pye, K30, GEC, etc. Pre-mains stand-by switch £1
Decca 80/100 IF panel £5
NPN PNP 80V 6 Amp TO66 O.P. Trans. pair 25p
5 button touch tuner BBE1/2 TTV1/2 video with ic SAS 560T/570T £7.00
Control panel 5 sliders + mains lead £1.50
G11 8 touch button unit replaces old 6 P.B.U. £24
Tube base + base unit for 820 Euro chassis £4.00
GEC Line O/P Trans. & Rec Stick for Portable £3.00
CVC 20/25/30/35/40 decoder panel £10
CVC 20/25/30/35/40 decoder panel (untested) £5
CVC 40/45 IF panel £5
40K Transducer 50p
PHILIPS NE511N £1.20
LM337M Reg. 30p
20 GEC Black Spark Gaps £1.00
KT3 Front Panel Control Assy. £2.50
BTW 30/50 50p

International Rectifier EHT Diodes G770/HV34 6KV 3 for 8p
6A/600V Stud Diodes 20p BTW 92/800R £3
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Thorn TX90 Chassis with Line Linearity Width P.C.B. PC1183 £20.00

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2SD1878 £1.00
TDA8443/C3 £1.00
TDA3506 £1.00
SAA5241 P/A £5.00
SAA7020 /01 £3.00
HD614080SA90 £4.00

225m + .25m 380v £1.00
220m 385v £1.00
240m 400v £1.00
G11 470m 250v £2.00
400m 400v £1.00
75m/100m/100m 350v £1.00
TX9 500m + 500m 175v £1.00

G8 LOPT Panel £7.00
G8 Tuner Unit + Panel £4.00
G8 IF & Chroma £6.00
G8 Chroma £3.00

G11 Chroma Panel £4.00
G11 LOPT Panel £6.00
G11 IF Panel £5.00

G11 IF Detector £3.00
G11 Selector gain module £3
Pye G11 Front panel with transducer, pots, tuner pots, 6 pb switch+lead £5.00
Pye 6 button switch portable £1.00
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GEC Line O/P PC 659B3 £6.00
2110 GEC Power Panel £8.00
CVC 20 Front panel with sliders + mains input panel £4

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Z718 Focus Unit £1.50
T20 Focus Unit £1.00
Large Type 75p
Decca Small 75p
KT3 Focus Unit 75p
K30 Focus Pot 75p
K30 Tube base on panel £1.00
TX10 Focus Units £8.50
CVC 32 Focus Unit 75p
Fidelity Focus Unit 14R-14S 30p
3500 Thorn Focus Unit £1.00
ITT Small for use with Split Diode £2.00
Z718 Bush Focus 50p
Remo TV12SP 50p
1600 Thorn EHT Rec and Lead 50p
TV14 50p
TV20 £1.00
TV45 50p

TX9 8 Button Unit £6.00

TX90 8 Button Unit £6.00

TX90-TX925 8 Button £6.00

TX100 8 Button Unit £6.00

TX10 8 Button Unit £10.00

TX10/TX100 16 Button UHF-VHF BAND S.W. £10.00

G11 drawer ASS 3 pots Mains switch and lead £2.00

K30 Drawer Ass with pots cable forme £1.00

TX10 Drawer with 8 way pots. ass. £2.50

TX10 Ex. port with band switch (drawer) and U.H.F. only £2.50

Hills Meter for the car man, volts, amp, ohm with dwell and r.p.m. £35.00

Hills 9 piece tool kit in case £5.00

Abbey Security Smoke Alarm Model 101 £5.00

Philips Coaxial Cable Stripper SBC325 £7.50

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470M 380V £1.00
220/400V £1.00
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.01 2KV 10p
150m-385v 50p
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4.7M/100 6800pf-1000v 5p
470/100 20p
4700/100 75p
47/160 10p
300 300/300V in 1.6KV 80p
800/160 50p
.1/250 Pulse 5p
2.2 250v 10p
3n3/250 A.C. 15p
7N5 1500V 15p
.33/250V 20p
.39/250V 15p
4n7/250 tested 5KV 25p
22/250 15p
47/250 10p
100/250 20p
GEC600/250 60p
700/250 £1
2.200PF-2Kv 10p
300+300 MFD 350v £1.00
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32/300 20p
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4.7M/350v 10p
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KT3 E/W .39/400 15p
.56K/400v 20p
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.22/400 10p
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.0105/1500 10p
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2n2/1500 15p
.01/1600 15p
G11.8200/2KV 15p
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0.0015/2KV 10p
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2n2/2KV 15p
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3000PF/3000V 10p
4n7/2KV 10p
6n2/2KV 10p
7n1/1500V 10p
8n2/1500V 10p
9n1/2000V 10p
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4.7nf/5KV 10p
170/8KV 10p
180/8KV 10p
210/8KV 10p
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Rank Secam Decoder Panel UHF & VHF T115A £13.00
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RANK & ITT Remote Switch 2800 ohm £1.50
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GEC Mains Switch 4 amp 30p
KT3 Mainswitch £1.00
G8 Mains Switch 75p
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Mains Switch Philip Long Type TAG 75p
Mains Switch GEC Long Type TAG 75p
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250V/4A White Lorlin Mains Switch 60p
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Teletext Adaptor Kit TY-500 Panasonic £12
Philips Battery Tester All Types and charger vis £6
Philips K4 Mains Switch with standby 80p

SENDZ

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MAB 8440P-D070 £3.00
MAB 8440P-D033 £3.00
MAB 8440P-D056 £3.00
MAB 8441P-T001 £3.00
MAB 8441P-T132 £2.00

M58484P £2.00

Hand Sets
Fidelity
£15.00 to £35.00

ITT 8 and 6 Push Button £1.00
Pye 725 LOPTs £6.00
Pye 731 LOPTs £6.00
Thorn 8500-8800 LOPTs £5.00

CMC 301 front panel £5.00
CMC 303 front panel £5.00

CMC 302 Panel with TC mains switch etc £5.00

CMD 800 Decoder £8.00

C7 Hand Set £6.00

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Meters Hills 520 £17.00
Meters Hills 420 £10.00
Hills HD5000 Digital Meter 1000V DC 750AC 10 Amp 20 MRG Rangers £28

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HT300 Multimeter £7.75
HT500 Multimeter £9.00
HT700 £15.00
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NEW Type RC4001 9 CH not 12 £6.00

GEC Full Remote Infra-red, 1983 models £15.00

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CT9185 £4.00
CT9176 £4.00
CT9133 £4.00

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32 Button CT983 Videotext £6.00

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Large type ITT TV and V.C.R. Handset £15.00

GEC Ultrasonic 8CH Full Remote £10.00

G11 Full Remote Ultrasonic £32.00
G11 Ultrasonic Teletext Handset £20.00
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New Replacement for G11 Ultrasonic Full Remote £12.00
Thorn 4000 insert with 7 buttons £5.00
Decca RC 11 £14.00
Decca RC 12 £14.00
G11 Infra-red full teletext £20.00
Dynatron-Full remote CTV 62, 63, 64 £19.00
Hitachi infra red handset £18.00
Philips full remote KT3, 16C928/20C934; 7228/7324; K12 26C 797/1ST 66K 1826 £12.00
G11, Full remote top button assy. £12.00
G11, Full remote repair service (exchange unit) £18.00
GEC infra red full remote 8 channel (I.C.SAA1250) £14.00
Philips infra red full remote 9 channel for 60 CP2605 £6.00
Philips infra red full remote 12 channel for 60 CP2605 £12.00
K35
KT3/K30 T/Text £12.50
KT3/K30 Full remote £15.00
KT3 Power supply £4.00
GEC infra-red 2236-2026 £4.00
GEC 8 button full remote £14.00
GEC push pad handset button blobs each 10p
Pye & Philips handset KT3-K30 chassis. No RC5150-RC5176-RC5171-RC5177. £13.00
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TX9 with Text £12.50
TX9 & TX10 button print £2.00
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Thorn TX Tuner V/Cap eqv.to ELC1043	£4.50
Min. UHF Tuner 40dB gain 2"x1½"x½"	£1.50
VHF-UHF with Data Tuner MEC1-F51	£3
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Thorn TX10 Export V/Cap UHF, VHF	£3
V/Cap Rank UHF Z776T/Unit	£6
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ELC2000 on Panel	£2.50
GEC 2110 V/Cap	£5
FE618Q	£20.00
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ELC2000 NEW	£4.00
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GEC Tuner V/Cap Hitachi After 1979 ET548, ET547, ET541B	£8.00
ET546	£6.00
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ET566P UHF Very Small	£2.50
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UHF. ET566P. small	£6.00
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HITACHI 20 Turn Pot	40p
U321 on panel	£6.00
Tuner unit VHS Sylvania GTR Videon MTS 900	£2.50
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Mullard Video Modulator. Application, video tape recorders, TV cameras, video games, closed circuit T/V. C.C.I.R. system. Data supplied.	£10.00
4 button Rank Z18 Tuner	£4.00

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BDV64B	50p
BDU65	50p
BF761	30p
BF769	30p
BF788	20p
BF819A	30p
BF858	30p
BF869	30p
BF871	30p
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CA920AE	£1.00
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BFY90	25p
BLY49	25p
BPW41	25p
BRC116	25p
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BRX48X	10p
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BSS68	10p
BSY79	10p
BSY95a	10p
BTY80	20p
BSX19	17p
BSX20	17p
FT3055	30p
TCE82	30p
TCE520	30p
2N930	5p
2N2221	8p
2N2222	8p
2N2906	10p
2N3055	40p
2N3566	10p
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2SK30A	10p
BC107	10p
BC108	10p
BC109	10p
BC113	10p
BC114	10p
BC115	10p
BC116	10p
BC117	20p
BC119	20p
BC125	10p
BC126	10p
BC139	10p
BC140	30p
BC141	25p
BC143	25p
BC147	10p
BC148	10p
BC149	10p
BC153	10p
BC154	10p
BC157a	10p
BC158	10p
BC159	10p
BC160/16	25p
BC171	5p
BC172	5p
BC173	5p
BC174	5p
BC183	5p
BC184	5p
BC204	5p
BC207	5p
BC212	5p
BC213	5p
BC214	5p
BC237	5p
BC238	5p
BC239	5p
BC250	5p
BC251	5p
BC252	5p
BC262	10p
BC263b	20p
BC294	30p
BC298	10p
BC300	10p
BC301	30p
BC303	30p
BC307	7p
BC308	7p
BC309	10p
BC327	10p
BC328	10p
BC328/338 pair	15p
BC337	10p
BC338	10p
BC347	10p
BC349b	10p
BC350	20p

BC365	10p
BC368	10p
BC369	10p
BC384	10p
BC394	10p
BC413	10p
BC414	10p
BC416	10p
BC440	30p
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
BD124 (metal)	30p
BD130Y	25p
BD131	30p
BD132/238	30p
BD135	25p
BD136	30p
BD138	30p
BD140	30p
BD176	25p
BD182	£1.00
BD183	70p
BD202	30p
BD204	30p
BD207	60p
BD221	20p
BD222	30p
BD228	30p
BD226	20p
BD233	30p
BD234	25p
BD235	30p
BD238	30p
BD239	15p
BD240	50p
BD243c	30p
BD244	30p
BD250a	20p
BD252	20p
BD253B	50p
BD331	20p
BD373b	20p
BD416	25p
BD433	25p
BD437	25p
BD438	30p
BD439	30p
BD544D	40p
BD650	50p
BD678	30p
BD681	30p
BD682	30p
BD507	50p
BD508	20p
BD509	30p
BD510	30p
BD517	30p
BD519	30p
BD534	30p
BD535	30p
BD544D	30p
BD562	30p
BD610	40p

other tranny spares

Thorn

ML926	£1.00
MAB8400B-C	£2.00
MAB8440 P-D070	£2.00
MAB8441 PT001	£3.00
MAB8420PC035	£2.00
MAB8422P-O005	£2.00
MAB8440P	£2.00
MAR8400XX	£3.00
M708LB1	£2.00
MM5387	£1.00
MM5611	£1.00
MM5840	£3.00
PCD8571P	£3.00
K35 Philips Receiver IC	
MA1250 BJC	£3.00
M491BB1	£3.00
M5840A-84	£5.00
M5840H-84	£5.00
MM5290N-4	75p
MM53108N	£4
MN1250BJC	£2
MR1366	20p
N64100	£1.00
NE555P	60p
NE555	60p
NE556	50p
NE646	50p
HD38980C	£3.00
IL-1	20p
OPT600	20p
OPT601	20p
PCD8571P	50p
SAA611	£1.00
SAA661	£1.75
SAA1021	£4.00
SAA1024	£2.50
SAA1025	£2.50
SAA1073	£3.00
SAA1074	£3.00
SAA1075	£3.00
SAA1124	£2.00
SAA1130	£2.50
SAA1174	£3.00
SAA1176	£2.00
SAA1250	£3.00
SAA1251	£4.00
SAA1272	£3.00
SAA1274	£3.00
SAA1276	£3.00
SAA1292	£10.00
SAA1293	£3.00
SAA3027P	£4.00
SAA5000A	£1.50
SAB3013	£2.00
SAB3037	£2.00
SAB3205	£3.00
SAB3210	£2.00
SAB4209	£2.00
TBO0124	£1.00
SAA3008P	£3.00
SAA5000A	£2.00
SAA5010	£2.20
SAA5012A	£5.00
SAA5020	£3.50
SAA5025D	£3.00
SAA5030	£4.50
SAA5040	£2.00
SAA5040A	£3.00
SAA5042A	£3.00
SAA5043	£4.00
SAA5050	£4.50
SAA5051	£2.00
SAA5052	£2.00
SAA5053	£2.00
SAA5241 P/A TEX IC	£5.00
SAF1032p	£2.50
SAF1039	£2.00
SAS560	£2.00
SAS560T	£1.00
SAS570T	75p
SAS660	£1.00
SAS670	£1.00
SAS580	75p
SAS590	75p
SAS3210	£2.00
SL437F	£4.00
SL480	£1.00
SL901B	£4.50
SL971B	£3.00
SL918	£4.50
SL1430	£1.00
STK4793	£3.00
STK5471	£3.00
TA7122	£1.15
TAA320A	50p
TAA470	£1.50
TAA570	75p
TAA611B	£1.00
TAA621	£2.00
TAA641	£1.50
TA7108P	£1.00
TA7117	50p
TA7120P	50p
TA7315AP	50p
TA7137P	50p
TA7240AP	£3.00
TA7265	£3.00
TA7609P	50p
TA7227P	£1.00p
TA7265AP	£3.00
TA7680AP	£3.00
TA7699P	£1.00
TA7750P	30p
TBA120A	40p
TBA120AS	50p
TBA120SA	40p
TBA120B	40p
TBA120SB	40p
TBA120T	50p
TBA120SQ	£1.00
TBA120U	75p
TBA120Q	30p
TBA120C	40p
TBA1440	£1.00
TBA1441	£2.00
TBA231	75p
TBA395Q	50p
TBA396Q	£1.00
TBA396	75p
TBA440P	£1.00
TBA1440C	£1.00
TBA480Q	£1.00
TBA520	£2.00
TBA530	£2.00
TBA540	£1.00
TBA560CQ	£1.00
TBA570	£1.50

TV Crystals

4MHz	
4.433-619	
6MHz	
8.867238	
11.059.000	
Large or small	50p each
Antistatic Isolators	
Disc Type Black	10p

Filters

CSA 3.97M		15p
6MEG	CDA	25p
6MHz	SFE	12p
6-5MHz		20p
SFD460B		15p
CSB455A		15p

TBA625	50p
TBA651	£2.00
TBA673	£1.00
TBA750Q	£1.50
TBA780	£1.50
TBA800	50p
TBA810AP	60p
TBA810S	60p
TBA820	60p
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TBA890	£1.00
TBA920	£1.50
TBA920Q	£1.50
TBA950	£1.50
TBA990Q	£1.00
TMS1000NL	£2.00
TMS1943 N2L (clockchip)	£1.00
TMS9980	£4.00
TMS9901	£1.00
TMS2708JG45	45p
TMS2716JL	£1.00
TMS3529	£1.00
TMS3720ANS	£3.00
TMS4014	70p
TX-012	£1.00
TMS9902	£1.20
ULN2004P	£1.50
ULN2216	75p
UPC566H	£1.00
UPC585C	£1.00
UPC1009C	£2.00
UPC1031H	£2.00
UPC1353C	£1.00
UPC1363C	£2.75
UPC1365C	£3.00
UPC1366C	£1.00
UPC1378H	£2.00
UPC1514C	£3.00
UPC2002	35p
UPD8049HC	£2
SN29848	50p
SN29770BN	£2.00
SN29771BN	£1.00
SN29772BN	£1.00
SN7402N	£1
SN7472N	£1
SN74107	£1.00
SN74167	70p
SN7472N	20p
SN75108AN	£1.00
SN76001	£1.00
SN76013ND	£2.00
SN76018	£1.00
SN76110N	£1
SN76115AN	50p
SN76131	50p
SN76141N	£1.00
SN76226	£1.00
SN76227N	£1.00p
SN76228N	£1.00
SN76270	£1.00
SN76532N	£1.00
SN76545N	£3.00
SN76546	£3.00
SN76550	30p
SN76552	30p
SN76570	£1.00
SN76620	50p
SN76650	50p
SN76660N	40p
SN76620AN	50p
SN76666	£1.00
SN76705N	£1.00
SN76707N	75p
SN76708AN	75p
SN76720	£1.00
SN76709N	£2.00
UA783P3C	40p
BT100A/02	40p
BT138/10A	70p
BT146	30p
TBA540Q	£1.50
TCA270	£1.00
TCA270Q	£1.00
TCA270S	£1.00
TCA270SQ	£1.00
TCA740	£1.00
TCA800	£1.50
TCA830	£1.00
TCA940	£1.00
TCEP100	£1.00
TCE120CQ	£1.00
TCE520	30p
TD6306P	£3.00
TDA440Q	50p
TDA1003A	£1.00
TDA1010	£1.00
TDA1013	£1.00
TDA1012	£1.00
TDA1013A	£1.00
TDA1060A	£1.50
TDA1035T	£1.00
TDA1035SB	£1.00
TDA1072	£1
TDA1150	50p
TDA1151	30p
TDA1154	50p
TDA1170S	£1.00
TDA1180	£2.00
TDA1190	£1.00
TDA1200	75p
TDA1270	£1.50
TDA1327A	69p
TDA1365	£3.00
TDA1512	£2.00
TDA1540P	£3.00
TDA1670A	£2.00
TDA1908A	£1.00
TDA2002	£1.00
TDA2003	25p
TDA2004	£2.00
TDA2008	£2.00
TDA2010	£1.00
TDA2020	£1.00
TDA2030	£2.00
TDA2140	£3.50
TDA2160	£1.00
TDA2320	50p
TDA2525	£1.00
TDA2545A	£1.00
TDA2600	£4.80
TDA2640	£2.00
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
TDA2560	75p
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	£5.75
TDA2611A	£1.00
TDA2611AQ	£1.00
TDA3651A	£1.00
TDA3652	£2.50
TDA2653	£4.00
TDA2640	£2.00
TDA2680	£1.00
TDA2690	£1.00
TDA2593	£1.00
TDA3047	£1.00
TDA3048	£3.00
TDA3083	£2.00
TDA3190	£1.00
TDA3300B	£5.00
TDA3301B	£4.00
TDA3505	£3.00
TDA3560	£4.00
TDA3561A	£3.00
TDA3562A	£3.00
TDA3566	£3.50
TDA3564	£4.00
TDA3565	£1.80
TDA3571A	£2.75
TDA3581	£3.00
TDA3590	£3.00
TDA3591	£1.00
TDA3592A	£3.00
TDA3650	£3.50
TDA3651	£3.00
TDA3651AQ	£3.50
TDA3652	£3.50
TDA3653AQ	£2.00
TDA3653	£3.00
TDA3654	£3.00
TDA3654Q	£2.00
TDA3710	£3.50
TDA3800	£4.00
TDA3180	£2.00
TDA4260	50p
TDA4505N4	£3.00
TDA4420	£2.00
TDA4600/2D Dil	£1.00
TDA4600-2 Flat	£3.00
TDA4601	£2.00
TDA8190	£3.00
TDA9403	£3.00
TDB2033	£1.00
TDD1610S	50p
TD6306P	£2.00
TDA1060	£3.00
TEA1009	50p
TEA1039	£2.00
TEA1060	£2.00
TEA2017	£2.00
TEA5114	£1.00
TDA3300B	£6.00
SN74LS 125AN	30p
SN74LS 248	50p
SIL4516	50p
SN16861NG	50p
SN16862AN	£1.00
SN16964AN	50p
SN29764AN	£1.00
UA721	40p
UA7300	40p
MPS43A	25p
MJ13005	30p
MJE51T	25p
MJE340	28p
MJE660	25p
MJE661	25p
MJE3055	£1.00
MJE2801	30p
MJE2955	50p
MJE13005	50p
Sanikron Diode	30p

Power FET

VN88AF	50p

Transistors

A1222	25p	BF181	20p
A1223	25p	BF182	20p
AC106	25p	BF184	20p
AC121	25p	BF194	10p
AC124	25p	BF195	10p
AC128	25p	BF196	10p
AC137	25p	BF197	12p
AC151	25p	BF198	10p
AC131	25p	BF199	10p
AC138	25p	BF200	20p
AC152	25p	BF222	10p
AC153K	25p	BF224	15p
AC142K	25p	BF238	20p
AC169	25p	BF240	16p
AC176	25p	BF244	40p
AC178K	25p	BF245b	20p
AC179	25p	BF255	20p
AC186	25p	BF256	20p
AC188	25p	BF257	20p
ACY21	25p	BF258	25p
AD143	50p	BF262	15p
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AD161/162 pair	40p	BF264	15p
		BF271	10p
AF17A	25p	BF273	10p
AF139	25p	BF274	10p
AF181	£1.00	BF324	25p
AF239	25p	BF337	50p
AF367	25p	BF355	30p
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AU110	£1.50	BF363	15p
BLY49	50p	BF367	15p
BF115	20p	BF391	15p
BF121	20p	BF394	10p
BF127	20p	BF419	30p
BF137	20p	BF422	15p
BF157	20p	BF423	15p
BF160	20p	BF448	30p
BF161	20p	BF470	30p
BF164	60p	BF471	30p
BF179	30p	BF597T	10p
BF180	20p	BF694	10p

Thorn Transformers

DT2076/78	£10
90D3-035-003	£10
90D4-106-003	£1
90D3-038-001	£5
OT204130	£3

Thorn Panels

7 off mixed	£5

Rec IC KT3-K30

H044-8328 SAB 3013	
SAA3027	£3 pack
Large EHT Cap and Lead	25p

I.C.s

MA721PC	£1.00	UPD114LC-2	£1.00
M50430-8505P	£1.00	MN1250BJC	£1.00
TD6359P	£1.00	M50441-5505P	£1.00
M58657P	£1.00	M491BB1	£2.00
PCD8572	£1.00	HA513385	£1.00
HD74HC86P	£1.00		