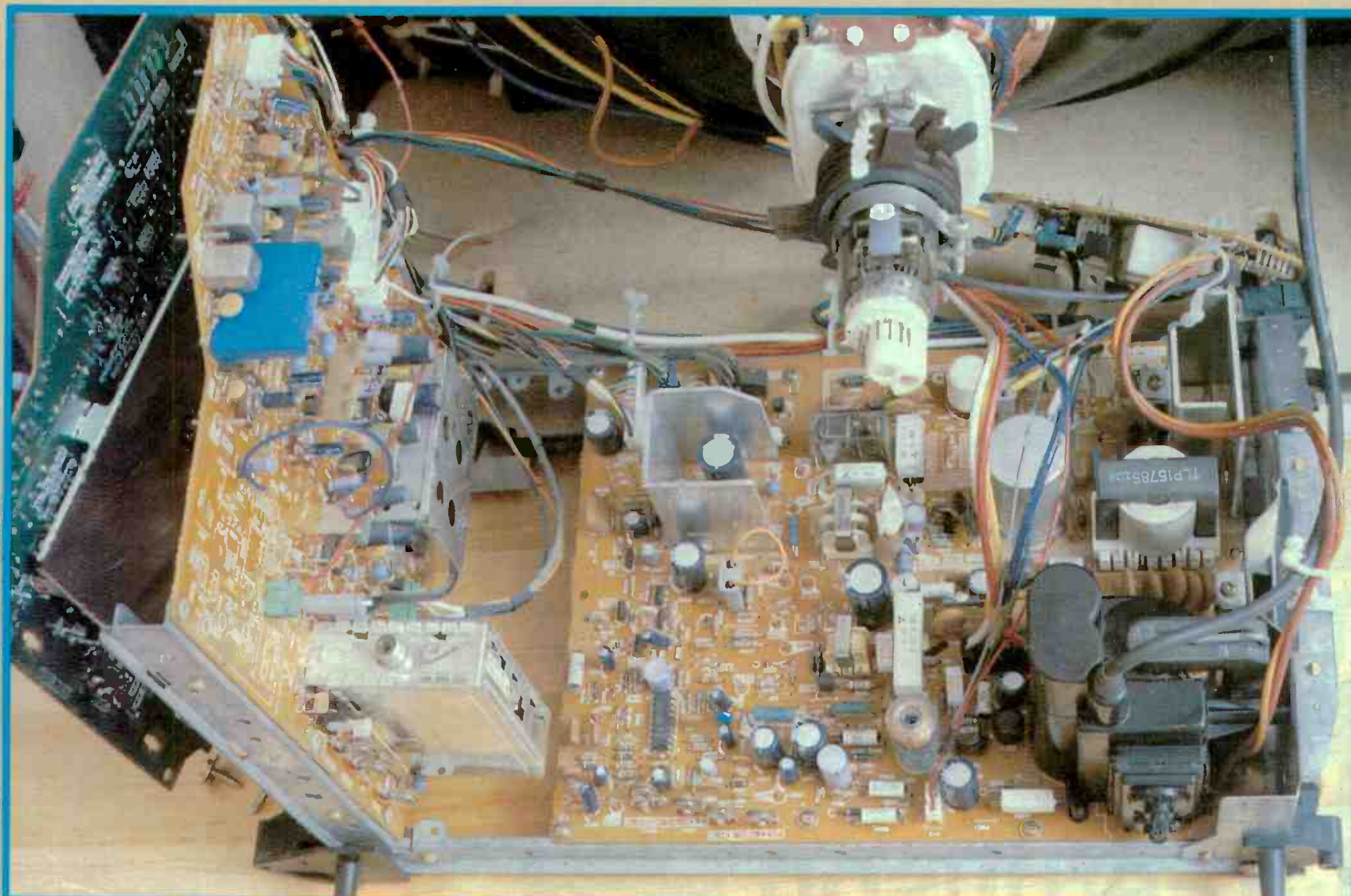
AUGUST 1990

Ireland £IR2·35 (inc. VAT) £1·60

TELEVISION

SERVICING·PROJECTS·VIDEO·DEVELOPMENTS



Servicing the Panasonic U4 Chassis
TX9 PAL/SECAM Modification
Component Tester Use • DX-TV
Test Report • TV Fault Finding
Ferguson's BSB Satellite Receiver
VCR Clinic • CD Player Casebook

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TELEVISION

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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.

INDEXES AND BINDERS
Indexes to Vols. 36 and 37 are available at 80p each from the Editorial Office (address above).

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SUBSCRIPTIONS
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BACK NUMBERS
Subject to availability, copies of issues published during the last 12 months are available at £1·80 each from Television, John Denton Services, Unit 13, Thornham Grove, Stratford, London E15 1DN. Please make cheques/postal orders payable to IPC Magazines Ltd.

QUERIES
We regret that we cannot answer technical queries over the telephone nor supply service sheets. We will endeavour to assist readers who have queries relating to articles published in *Television*, but we cannot offer advice on modifications to our published designs nor comment on alternative ways of using them. Correspondents should enclose a stamped addressed envelope.

this month

757 Leader

758 Teletopics
News, comment and developments.

759 Next Month in Television

761 Letters
Including a blanking modification for the Philips G8 chassis to remove teletext interference and advice on selling second-hand equipment and repairing valve radio receivers.

765 Long Distance Television — *Roger Bunney*
DX conditions and reception and news from abroad.

768 VCR Clinic
Reports from Eugene Trundle, Philip Blundell, AMIEIE, Colin McCormick, Alfred Damp, Bob McClenning and S. Da Costa.

770 Ferguson's BSB Receiving System — *Ian Bowden*
The characteristics and performance of Ferguson's BSB satellite TV system.

772 Servicing the Panasonic U4 Chassis — *Nick Beer*
This chassis was used in a very wide range of models, all with remote control and many with teletext. Operation of the switch-mode power supply and guidance on various fault conditions including the early microcomputer control/tuning system that gave trouble.

775 CD-I Conference — *George Cole*
The companies that back the CD-I system recently held a conference to outline the current state of the system and its potential for users.

776 TX9 SECAM Modification — *Richard Edeson, G4FBA*
Many French programmes are now available via satellite transponders but have SECAM colour. How to adapt the Ferguson TX9 chassis for dual-standard colour decoding, using the TDA3561 chip. With a satellite TV receiver you can then sit back and enjoy French TV in colour.

779 Triple Trouble — *Les Lawry-Johns*

780 CD Player Casebook
Reports from Mike Leach, Philip Blundell, AMIEIE, Joe Cieszynski, Ronald Aranha, Nick Beer and Keith H.C. Parker.

782 Test Report: Muter BMR90 CRT Tester-Rejuvenator — *Eugene Trundle*
The BMR90 analyser-rejuvenator was tried out on a wide range of tubes that had various faults. It proved to be one of the best.

786 TV Fault Finding
Reports from Philip Blundell, AMIEIE, Sergio Roncella, Hugh MacMullen, Chris Avis, Roger Burchett, Joe Cieszynski, A.P. Farnborough and Stephen Leatherbarrow.

788 Could Some Japanese Gent Explain? — *Steve Beeching, T.Eng.*
Dealing with some recent camcorder faults was not helped by curious design features.

789 Test Case 332

790 De Luxe Component Tester, Part 2 — *David Botto*
How to use the de luxe component tester to check a wide variety of components and make signature waveform, continuity and in-circuit tests.

OUR NEXT ISSUE DATED SEPTEMBER WILL BE PUBLISHED ON AUGUST 15

AA119	9p
AAY32	9p
AC107	40p
AC125	25p
AC126	25p
AC127	21p
AC128	21p
AC128K	26p
AC141K	30p
AC142K	30p
AC176	22p
AC176K	28p
AC187	21p
AC187K	28p
AC188	21p
AC188K	28p
ACY18	48p
ACY19	48p
AD142	100p
AD149	60p
AD161	35p
AD162	35p
AF124	50p
AF125	50p
AF126	50p
AF127	50p
AF139	30p
AF239	30p
AF379	45p
ASZ15	100p
ASZ17	100p
BA145	10p
BA148	10p
BA154	6p
BA157	12p
BA526	188p
BB105B	18p
BB205B	24p
BC107	8p
BC108	8p
BC109	8p
BC109C	10p
BC115	10p
BC118	11p
BC140	20p
BC141	20p
BC142	20p
BC143	20p
BC147	8p
BC148	8p
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BC159	8p
BC160	30p
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BC179	14p
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BC537	25p
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BC558	8p
BC559	8p
BC560	8p
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BC638	20p
BC639	20p
BC640	20p
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BCY33	200p
BCY34	200p
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BCY71	16p
BCY72	16p
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BD124	110p
BD131	25p
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BD133	50p
BD135	20p
BD136	20p
BD137	20p
BD138	20p
BD139	20p
BD140	20p
BD142	45p
BD144	90p
BD150	30p
BD157	38p
BD158	38p
BD166	30p
BD175	30p
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BD179	32p
BD181	45p
BD182	60p
BD184	60p
BD187	30p
BD201	33p
BD202	38p
BD203	42p
BD204	42p
BD222	31p
BD225	31p
BD232	31p
BD233	30p
BD234	32p
BD235	28p
BD236	30p
BD237	21p
BD238	24p
BD239	30p
BD240	40p
BD241A	40p
BD243A	50p

BD244	50p
BD245	50p
BD246A	50p
BD265	45p
BD267	45p
BD269	45p
BD278	50p
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BD312	100p
BD313	100p
BD314	100p
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BD318	150p
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BD442	40p
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BD536	38p
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BD538	40p
BD643	50p
BD645	50p
BD647	50p
BD649	50p
BD651	50p
BD675	40p
BD676	40p
BD677	38p
BD678	40p
BD679	40p
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BD681	45p
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BD705	50p
BD707	50p
BD709	50p
BD711	50p
BD736	50p
BD826	50p
BD828	50p
BD875	50p
BD897	50p
BD899	50p
BD901	50p
BD977	50p
BDX32	100p
BDX33	60p
BDX53	60p
BDX65	80p
BDW23	55p
BDW24	55p
BDW93	50p
BDW94	50p
BDY20	100p
BDY92	100p
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BF154	25p
BF167	30p
BF173	40p
BF178	30p
BF180	16p
BF181	18p
BF183	20p
BF185	20p
BF194	7p
BF195	7p
BF196	8p
BF197	10p
BF198	10p
BF199	8p
BF200	16p
BF225	30p
BF240	16p
BF245	25p
BF254	15p
BF255	12p
BF256	18p
BF257	18p
BF258	18p
BF259	18p
BF262	25p
BF263	25p
BF270	18p
BF273	15p
BF311	21p
BF324	25p
BF336	20p
BF337	20p
BF338	20p
BF355	28p
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BF367	13p
BF371	17p
BF392	18p
BF420	16p
BF421	18p
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BF455	14p
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BF462	62p
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BF471	28p
BF472	28p
BF479	30p
BF493	18p
BF494	16p
BF495	16p
BF506	25p
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BF757	40p
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BF760	40p
BF763	40p
BF869	22p
BF870	22p
BF871	22p
BF872	23p
BF960	38p
BF961	35p
BF963	40p
BF964	38p
BF966	40p
BFR40	25p
BFR79	25p
BFR90	52p
BFR91	99p
BFT37	130p
BFT42	30p
BFT43	30p
BFW84	30p

BFW92	35p
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BFX84	20p
BFX85	20p
BFX87	15p
BFX88	16p
BFX89	60p
BFY17	30p
BFY18	40p
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BFY51	14p
BFY52	14p
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BR100	14p
BR101	43p
BR103	37p
BR303	85p
BRY39	55p
BRY49	38p
BRY56	33p
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BSX26	18p
BSX29	19p
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BT146	99p
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BU930	130p
BUT11A	90p
BUT56A	250p
BUX80	180p
BUX82	180p
BUX84	50p
BUX85	50p
BUY69A	200p
BUY71	300p
C106D	28p
J174	38p
J300	50p
MEO411	38p
MEO414	125p
ME3001	12p
ME4103	12p
ME6001	12p
ME6002	15p
ME8001	15p
ME9021	12p
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MJ900	200p
MJ1000	200p
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MJ15002	300p
MJ15003	325p
MJ15004	370p
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MPSA43	15p
MPSA65	25p
MPSA66	25p
MPSA70	15p
MPSA92	20p
MPSA93	20p
MR510	35p
MR856	36p
OC28	250p
OC29	250p
OC35	250p
OC36	250p
OC45	50p
OC71	30p
OC72	50p
OC200	180p
OT121	120p
R2008B	100p

R2010B	100p
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S2800M	72p
T2800D	52p
T2800M	72p
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TIP31C	30p
TIP32	24p
TIP32A	24p
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TIS61	15p
TIS90	15p
TIS91	18p
TIS93	20p
VK1010	88p
VN.10KM	60p
VN.66AF	100p
VN.88AF	115p
ZTX107	11p
ZTX108	11p
ZTX109	12p
ZTX212	27p
ZTX300	13p
ZTX301	16p
ZTX302	16p
ZTX303	24p
ZTX304	17p
ZTX320	29p
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ZTX501	13p
ZTX502	18p
ZTX503	18p
ZTX504	25p
ZTX550	24p
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2N.697	22p
2N.698	40p
2N.706	22p
2N.708	22p
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2N.930	18p
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2N.1132	28p
2N.1613	24p
2N.1711	24p
2N.1893	30p
2N.2102	50p
2N.2218A	24p
2N.2219	24p
2N.2221	23p
2N.2222	23p
2N.2369	15p
2N.2484	20p
2N.2646	40p
2N.2904	20p
2N.2905	20p
2N.2906	18p
2N.2907	18p
2N.2926	8p
2N.3019	28p
2N.3053	18p
2N.3054	40p
2N.3055	38p
2N.3055H	50p
2N.3440	58p
2N.3442	85p
2N.3583	90p
2N.3585	120p
2N.3702	9p
2N.3703	9p
2N.3704	9p
2N.3705	9p
2N.3706	9p
2N.3707	9p
2N.3708	9p
2N.3710	12p
2N.3711	12p
2N.3771	85p
2N.3772	90p
2N.3773	110p
2N.3799	18p
2N.3819	29p
2N.3866	68p
2N.3903	11p
2N.3904	11p
2N.3905	11p
2N.3906	11p
2N.4031	25p
2N.4036	25p
2N.4037	25p
2N.4062	12p
2N.4064	100p
2N.4401	12p
2N.4403	12p
2N.4443	76p
2N.4444	76p
2N.5061	20p
2N.5088	20p
2N.5163	45p
2N.5192	50p
2N.5241	500p
2N.5245	45p
2N.5294	30p
2N.5296	30p

2N.5320	90p
2N.5321	60p
2N.5366	25p
2N.5401	12p
2N.5448	12p
2N.5496	80p
2N.6107	40p
2N.6109	40p
2N.6254	110p
2N.6292	40p
2N.6384	120p
2N.6385	120p
2N.6403	160p
3N.143	65p

DIODES

Rectifier Diodes

AA119	9p
BY100	40p
BY103	32p
BY126	6p
BY127	8p
BY133	8p
BY164	40p
BY179	35p
BY184	32p
BY196	20p
BY206	11p
BY207	11p
BY208	18p
BY210	22p
BY225	120p
BY226	18p
BY227	19p
BY228	32p
BY296	20p
BY298	26p
BY299	28p
BYX10	15p
BYX55/350	30p
BYX55/600	30p
BYX70/500	32p
BYX70/800	36p
OA47	6p
OA90	6p
OA91	8p
OA200	7p
OA202	7p
IN.914	2p
IN.4001	4p
IN.4002	4p
IN.4003	4p
IN.4004	4p
IN.4005	4p
IN.4006	4p
IN.4007	5p
IN.4148	2p
IN.5400	9p
IN.5401	10p
IN.5402	10p
IN.5403	11p
IN.5404	11p
IN.5405	12p
IN.5406	13p
IN.5407	13p
IN.5408	13p
SKE4F2/06	60p
SKE4F2/08	70p
SKE4F2/10	90p

I.C. SOCKETS

8pin	6p
14pin	8p
16pin	9p
18pin	12p
20pin	14p
22pin	18p
24pin	18p
28pin	20p
40pin	25p

ZENER

400MV BYZ88 RANGE 2V7 to 39V	6p
1.3W BZX61 RANGE 2V7 to 39V	12p

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	120p
14.0	125p
14.756	200p
15.0	160p
16.0	130p
18.0	130p
18.432	130p
24.0	250p
48.0	160p

VOLTAGE REGULATORS

7805	35p
7806	35p
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
78L08	28p
78L12	28p
78L15	28p
78L18	28p
78L24	28p
79L05	40p
79L08	40p
79L12	40p
79L15	40p
7818KC	100p
7824KC	100p
LM309K	100p
LM317K	220p
LM317T	180p
LM323K	420p
LM723	40p
78HGKC	570p
78HO5KC	800p
78H12KC	700p

78GU1C	190p
79GU1C	215p
79HGKC	800p

VALVES

DAF96	60p
DF96	50p
DL92	60p
DY86	50p
DY87	60p
DY802	75p
EABC80	80p
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
EL95	85p
EL500	100p
EL504	130p
EY86	45p
EY87	45p
EY88	65p
EZ35	65p
EZ80	70p
EZ81	65p
GZ34	200p
PC97	100p
PCC85	60p
PCF80	80p
PCF200	135p
PCF801	110p
PCF802	80p
PCF806	115p
PCH200	100p
PCL81	62p
PCL82	80p
PCL84	50p
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
AN-252	150p
AN-259	250p
AN-262	140p
AN-271	230p
AN-272	480p
AN-274	250p
AN-301	330p
AN-303	250p
AN-304	360p
AN-305	320p
AN-315	210p
AN-316	350p
AN-318	460p
AN-360	100p
AN-362	140p
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TDA-2840	200p
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TDA-3303	400p
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TDA-3501	400p
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TDA-8140	300p
TDA-8170	320p
TDA-8190	280p
TDA-8440	380p
TDA-9403	250p
TDA-9503	240p
TDA-9513	350p

LINEAR IC'S — Cont.

TEA-1002	650p
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TLO-64	80p
TLO-71	38p
TLO-72	55p
TLO-74	92p
TLO-81	40p
TLO-82	46p
TLO-83	67p
TLO-84	80p
ULN-2002	70p
ULN-2003	60p
ULN-2004	69p
ULN-2068	270p
ULN-2803	130p
ULN-2804	170p
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UPC-20C	220p
UPC-554	130p
UPC-555	60p
UPC-556H	80p
UPC-566	60p
UPC-571	220p
UPC-574	60p
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UPC-576	200p
UPC-577	64p
UPC-580	300p
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UPC-595	190p
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ZN 448	510p
ZN-459	190p
ZN-1034	170p
ZN-1040	640p
ZNA-134H	2150p
ZNA-234E	920p

JAPANESE TRANSISTORS

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2SD-734	60p
2SD-741	120p
2SD-743	130p
2SD-756	100p
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2SD-762	140p
2SD-763	140p
2SD-768	180p
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2SD-773	40p
2SD-774	60p
2SD-777	400p
2SD-784	650p
2SD-786	100p
2SD-787	80p
2SD-788	100p
2SD-789	80p
2SD-792	400p
2SD-794	100p
2SD-795A	140p
2SD-811	450p
2SD-819	400p
2SD-820	450p
2SD-821	550p
2SD-822	400p
2SD-826	100p
2SD-836	150p
2SD-836A	200p
2SD-837	80p
2SD-838	400p
2SD-841	160p
2SD-844	200p
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2SD-850	260p
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2SD-864	200p
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2SD-866A	140p
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2SD-1407	160p
2SD-1409	190p
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2SD-1425	430p
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2SD-1427	380p
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2SD-1457	220p
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2SD-1505	120p
2SD-1554	500p
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2SD-1591	310p
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2SD-1604	200p
2SD-1608	210p
2SD-1609	100p
2SD-1632	500p
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2SD-1651	270p
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VS-9700 160p
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ITT
VR3605, 3905, 3935, 3985 100p
VR3913, VR3914 100p

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HR-3300, HR-3330, HR-3360, HR-3660 150p
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MITSUBISHI
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VC-9300, VC-9500 135p

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4002	13p
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4008	38p
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4011	13p
4012	13p
4013	19p
4014	32p
4016	18p
4017	29p
4018	30p
4019	28p
4020	33p
4021	36p
4022	36p
4023	13p
4024	25p
4025	13p
4026	60p
4027	18p
4028	29p
4029	34p
4030	17p
4031	90p
4032	52p
4033	60p
4034	76p
4035	42p
4036	180p
4037	75p
4038	46p
4039	180p
4040	30p
4041	36p
4042	30p
4043	36p
4044	36p
4045	72p
4046	42p
4047	45p
4048	27p
4049	18p
4050	20p
4051	38p
4052	35p
4053	35p
4054	53p
4055	52p
4056	52p
4060	40p
4063	52p
4066	20p
4067	120p
4068	13p
4069	13p
4070	13p
4071	13p
4072	13p
4073	13p
4075	13p
4076	42p
4077	13p
4078	13p
4081	13p
4082	13p
4085	36p
4086	30p
4089	75p
4093	18p
4094	44p
4095	58p
4098	50p
4099	42p
4501	27p
4502	36p
4503	30p
4504	55p
4505	180p
4506	58p
4507	30p
4508	67p
4510	32p
4511	30p
4512	38p
4513	80p
4514	65p
4515	65p
4516	36p
4517	100p
4518	36p
4519	28p
4520	36p
4521	86p
4522	43p
4526	38p
4527	41p
4528	38p
4529	65p
4532	48p
4551	75p
4553	140p
4555	29p
4556	36p
4557	140p
4583	60p
4584	30p
4585	40p
40100	120p
40101	78p
40102	150p
40103	120p
40104	80p
40105	140p
40106	35p
40107	50p
40108	260p
40109	74p
40110	170p
40114	180p
40117	180p
40147	240p
40160	55p
40161	55p
40162	55p
40163	55p
40174	48p
40175	60p
40181	170p
40182	70p
40192	48p
40193	48p
40194	58p
40208	240p
40257	120p

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7401	16p
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7403	20p
7404	35p
7405	10p
7406	36p
7407	36p
7408	25p
7409	20p
7413	30p
7414	45p
7416	40p
7417	32p
7420	22p
7421	25p
7425	15p
7430	25p
7437	28p
7438	32p
7442	38p
7447	60p
7450	22p
7451	10p
7454	25p
7470	30p
7473	25p
7474	35p
7475	25p
7481	90p
7482	60p
7485	28p
7486	28p
7489	75p
7490	35p
7492	45p
7493	35p
7495	48p
7497	80p
74107	30p
74111	52p
74116	85p
74119	85p
74122	40p
74123	20p
74125	40p
74126	45p
74132	42p
74141	55p
74145	70p
74153	45p
74155	45p
74157	45p
74160	50p
74164	50p
74167	35p
74173	50p
74174	60p
74175	65p
74176	45p
74180	50p
74182	45p
74192	40p
74196	40p
74197	45p
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74HC08	18p
74HC10	20p
74HC11	14p
74HC14	26p
74HC20	19p
74HC21	20p
74HC27	20p
74HC30	20p
74HC32	20p
74HC42	30p
74HC51	20p
74HC73	24p
74HC74	24p
74HC75	28p
74HC76	28p
74HC77	35p
74HC85	33p
74HC86	29p
74HC93	50p
74HC107	28p
74HC109	28p
74HC112	28p
74HC113	28p
74HC123	35p
74HC125	32p
74HC126	33p
74HC131	36p
74HC132	33p
74HC133	33p
74HC137	52p
74HC138	33p
74HC139	22p
74HC147	42p
74HC148	38p
74HC151	32p
74HC153	32p
74HC154	90p
74HC155	48p
74HC157	34p
74HC158	34p
74HC160	44p
74HC161	44p
74HC162	44p
74HC163	44p
74HC164	44p
74HC165	56p
74HC166	60p
74HC173	52p
74HC174	38p
74HC175	38p
74HC181	180p
74HC182	60p
74HC190	46p
74HC191	55p
74HC192	53p
74HC193	41p
74HC194	46p
74HC195	46p
74HC221	80p
74HC237	50p
74HC238	55p
74HC240	48p
74HC241	47p
74HC242	55p
74HC243	60p
74HC244	44p
74HC245	48p
74HC251	25p
74HC253	36p
74HC257	40p
74HC258	50p
74HC259	52p
74HC273	42p
74HC279	35p
74HC280	61p
74HC283	61p
74HC298	50p
74HC299	105p
74HC354	38p
74HC356	48p
74HC365	34p
74HC366	36p
74HC367	36p
74HC368	36p
74HC373	46p
74HC374	48p
74HC375	52p
74HC377	52p
74HC386	20p
74HC390	50p
74HC393	47p
74HC423	65p
74HC533	65p
74HC534	61p
74HC540	70p
74HC541	70p
74HC563	60p
74HC564	60p
74HC573	68p
74HC574	65p
74HC583	90p
74HC595	85p
74HC597	80p
74HC620	110p
74HC623	110p
74HC640	90p
74HC643	90p
74HC646	120p
74HC648	120p
74HC651	100p
74HC652	100p
74HC670	75p
74HC688	80p
74HC690	110p
74HC691	110p
74HC4002	25p
74HC4015	85p
74HC4016	75p
74HC4017	48p
74HC4020	50p
74HC4022	40p
74HC4024	34p
74HC4028	40p
74HC4040	34p
74HC4049	38p
74HC4050	38p
74HC4051	85p
74HC4052	85p
74HC4053	85p
74HC4059	85p
74HC4060	33p
74HC4066	33p
74HC4072	31p
74HC4075	26p
74HC4078	32p
74HC4094	50p
74HC4316	100p
74HC4351	110p
74HC4352	160p
74HC4510	120p
74HC4511	70p
74HC4514	120p
74HC4515	120p
74HC4516	125p
74HC4518	55p
74HC4520	60p
74HC4538	75p
74HC4543	75p
74HC7266	75p
74HC22106	580p
74HC40104	190p
74HC40105	250p

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74LS00	12p
74LS01	12p
74LS02	12p
74LS03	12p
74LS04	12p
74LS05	12p
74LS08	12p
74LS09	14p
74LS10	12p
74LS11	12p
74LS12	12p
74LS13	20p
74LS14	24p
74LS15	14p
74LS20	14p
74LS21	14p
74LS22	14p
74LS24	35p
74LS26	14p
74LS27	14p
74LS28	14p
74LS30	14p
74LS32	15p
74LS33	15p
74LS37	15p
74LS38	15p
74LS40	15p
74LS42	25p
74LS47	52p
74LS48	48p
74LS51	13p
74LS54	13p
74LS55	15p
74LS73	24p
74LS74	18p
74LS75	24p
74LS76	24p
74LS78	24p
74LS83	37p
74LS85	37p
74LS86	25p
74LS90	26p
74LS91	55p
74LS92	32p
74LS93	26p
74LS95	41p
74LS96	52p
74LS107	28p
74LS109	28p
74LS112	28p
74LS113	28p
74LS114	28p
74LS122	35p
74LS123	35p
74LS124	85p
74LS125	30p
74LS126	30p
74LS132	30p
74LS133	30p
74LS136	30p
74LS138	28p
74LS139	28p
74LS145	65p
74LS147	90p
74LS148	75p
74LS151	27p
74LS153	31p
74LS154	78p
74LS155	36p
74LS156	36p
74LS157	22p
74LS158	27p
74LS160	38p
74LS161	38p
74LS162	38p
74LS163	36p
74LS164	36p
74LS165	50p
74LS166	55p
74LS168	60p
74LS169	55p
74LS170	68p
74LS174	30p
74LS175	32p
74LS190	47p
74LS191	43p
74LS192	41p
74LS193	41p
74LS194	41p
74LS195	44p
74LS196	45p
74LS197	42p
74LS221	45p
74LS240	45p
74LS241	42p
74LS242	43p
74LS243	50p
74LS244	40p
74LS245	40p
74LS247	40p
74LS248	40p
74LS249	70p
74LS251	24p
74LS253	36p
74LS256	52p
74LS257	32p
74LS258	35p
74LS259	50p
74LS260	30p
74LS266	22p
74LS273	44p
74LS279	33p
74LS280	88p
74LS283	51p
74LS290	26p
74LS293	26p
74LS365	26p
74LS366	31p
74LS367	28p
74LS368	30p
74LS373	45p
74LS374	45p
74LS375	46p
74LS390	42p
74LS393	37p
74LS399	68p
74LS629	95p
74LS641	88p
74LS642	105p
74LS644	105p
74LS645	105p
74LS670	62p
74LS674	310p
74LS687	250p

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2532	330p
2716	200p
2732	280p
2732A	300p
2764	240p
27C64	550p
27128	350p
26256-25	400p
41256-12	250p
256DRAM	250p
4116	75p
4164	150p
6116	180p
6264	270p
6502	300p
6502A	400p
65C02	930p
6503	570p
6520	170p
6522	330p
6530	1050p
6532	460p
6545	880p
6551	530p
6800	210p
6802	220p
6803	800p
6808	500p
6809	600p
6810	150p
6818	380p
6820	140p
6821	140p
6840	310p
6845	620p
6850	110p
8080A	400p
8085A	300p
8086	500p
8088	500p
8155	360p
8156	360p
81LS95	120p
81LS96	130p
81LS97	130p
81LS98	130p
8224	240p
8226	240p
8228	270p
8243	250p
8250	850p
8087	11000p
8251	270p
8253	230p
8255	200p
8256	1200p
8257	220p
8259	280p
8271	3400p
8272	1200p
8279	270p
8282	300p
8283	400p
8284	440p
8287	360p
8288	650p
8748	1100p
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SP0256AL2	500p
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Z80AS10-1	580p
Z80BP10-2	580p
Z80ADART	500p
74S289	180p
74S387	200p
75107	65p
75110	75p
75113	100p
75122	110p
75150	95p
75154	100p
75162	700p
75182	95p
75183	95p
75188	55p
75189	55p
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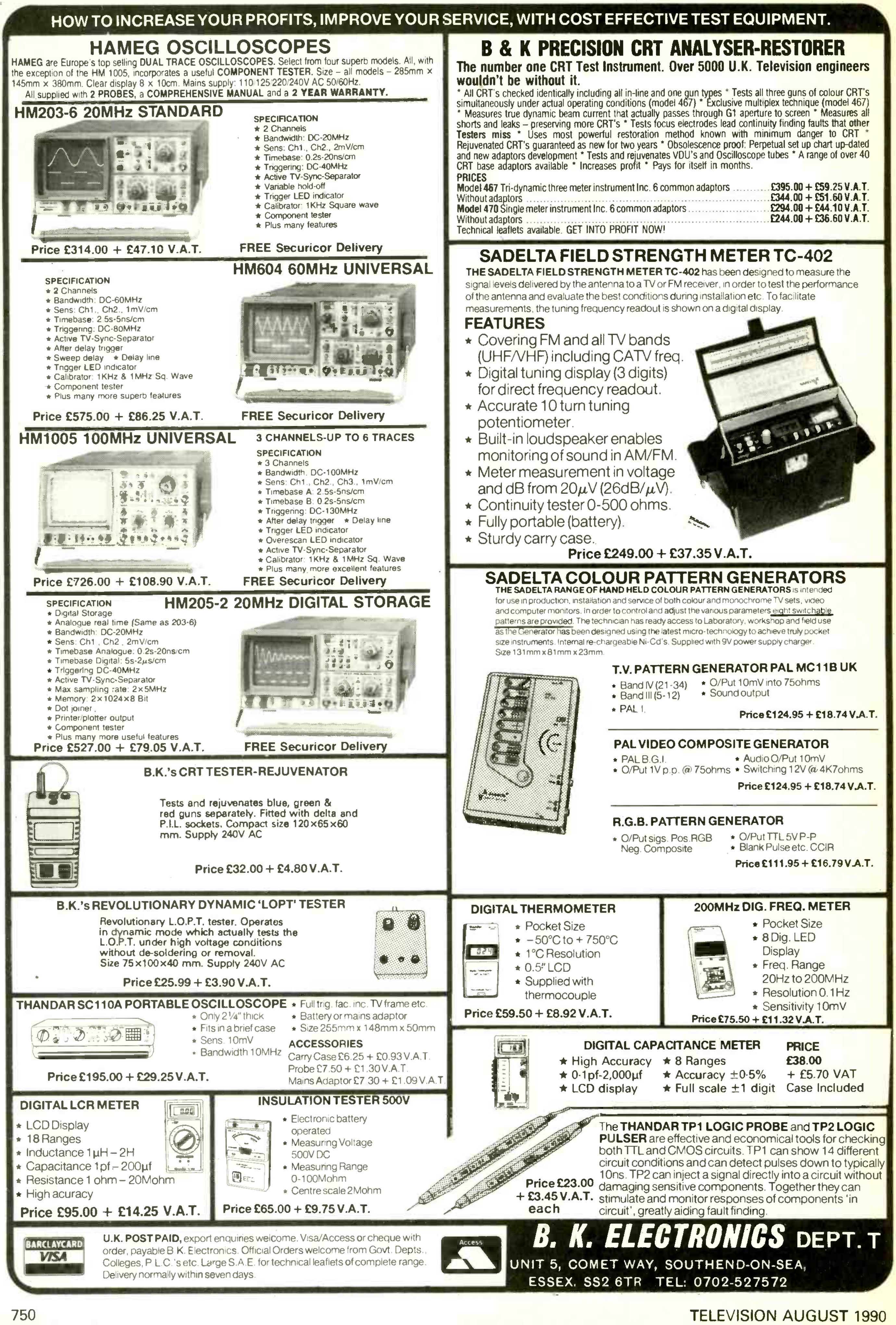
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Tests and rejuvenates blue, green & red guns separately. Fitted with delta and P.I.L. sockets. Compact size 120x65x60 mm. Supply 240V AC
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B.K.'s REVOLUTIONARY DYNAMIC 'LOPT' TESTER
Revolutionary L.O.P.T. tester. Operates in dynamic mode which actually tests the L.O.P.T. under high voltage conditions without de-soldering or removal.
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DIGITAL THERMOMETER
* Pocket Size
* –50°C to +750°C
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* Only 2¼" thick
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* Bandwidth 10MHz
* Full trig. fac. inc. TV frame etc.
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* Accuracy ±0·5%
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* Resistance 1 ohm – 20Mohm
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INSULATION TESTER 500V
* Electronic battery operated
* Measuring Voltage 500V DC
* Measuring Range 0-100Mohm
* Centre scale 2Mohm
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The THANDAR TP1 LOGIC PROBE and TP2 LOGIC PULSER are effective and economical tools for checking both TTL and CMOS circuits. TP1 can show 14 different circuit conditions and can detect pulses down to typically 10ns. TP2 can inject a signal directly into a circuit without damaging sensitive components. Together they can stimulate and monitor responses of components 'in circuit', greatly aiding fault finding.
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ONE POUND PACKS

All packs are £1 each. Note the figure on the extreme left is the pack ref number and the next figure is the quantity of items in the pack, finally a short description.

BD2	5	13A spurs provide a fused outlet to a ring main where devices such as a clock must not be switched off.
BD9	2	6V 1A mains transformers upright mounting with fixing clamps.
BD11	1	6½in speaker cabinet ideal for extensions, takes our speaker, Ref BD137.
BD13	12	30 watt reed switches, it's surprising what you can make with these – burglar alarms, secret switches, relay, etc., etc.
BD22	2	25watt loudspeaker two unit crossovers.
BD30	2	Nicad constant current chargers adapt to charge almost any nicad battery.
BD32	2	Humidity switches, as the air becomes damper the membrane stretches and operates a microswitch.
BD42	5	13A rocker switch three tags so on/off, or change over with centre off.
BD45	1	24hr time switch, ex-Electricity Board, automatically adjust for lengthening and shortening day, original cost £40 each.
BD49	5	Neon valves, with series resistor, these make good night lights.
BD56	1	Mini selector, one use is for an electric jigsaw puzzle, we give circuit diagram for this. One pulse into motor, moves switch through one pole.
BD67	1	Suck or blow operated pressure switch, or it can be operated by any low pressure variation such as water level in water tanks.
BD103A	1	6V 750mA power supply, nicely cased with mains input and 6V 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 pcb boards etc. Normal cost about 80p each.
BD132	2	Plastic boxes approx 3in 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	Microphones inserts – magnetic 400 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	8	Safety cover for 13A sockets – 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 make a low cost disco panel.
BD199	1	Mains solenoid, very powerful, has 1in 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 soiled but OK.
BD252	1	Panostat, controls output of boiling ring from simmer up boil.
BD259	50	Leads with push-on ¼in 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.
BD305	1	Tubular dynamic mic with optional table rest.
BD653	2	Miniature driver transformers. Ref. LT44. 20k to 1k centre tapped.
BD548	2	3.5V relays each with 2 pairs changeover contacts.
BD667	2	4.7 µf non-polarised block capacitors, pcb mounting.

There are over 1,000 items in our Catalogue. If you want a complete copy please request this when ordering.

12-220V INVERTER KIT. This kit will convert 12V DC to 220V AC. It will supply up to 130 Watts with a large transformer. As supplied it will handle about 15 Watts. Heatsink required. Price is £12.00. Ref. 12P17.

PERSONAL STEREOS. Again customer returns but complete and with stereo headphones a bargain at only £3.00 each. Our ref. 3P83.

MAINS OPERATED MICROWAVE CONTROL PANEL with touch switches. This unit has a 4 digit display with a built in clock & 2 relay outputs – one for power & 1 for pulsed power level. Could be used for all sorts of timer control applications. Only £6.00. Our ref. 6P18.

EQUIPMENT WALL MOUNT. It is a multi-adjustable metal bracket that could be used for mounting flood light, loud speaker, TV camera, even a fan and on almost any sort of wall or ceiling even between wall and ceiling. Our price only £3. Our ref 3P72. Or 2 for £5. Our ref 5P152.

STABILIZED POWER SUPPLY KIT 2-25V 2A. A kit for a bench or lab power supply containing PCB, transformer, heatsink and all other components. Short circuit protected. Case required. Priced at £20.00 Ref. 20P25.

GEIGER COUNTER KIT. Complete with tube, PCB and all components. 9V operation. Only £39.00. Ref. 39P1.

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.

POWERFUL IONISER

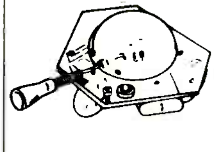
Generates approx. 10 times more IONS than the ETI and similar circuits. Will refresh your home, office, shop workroom etc. Makes you feel better and harder work – a complete mains operated kit, case included **£18.00**. Our ref 18P2.

REAL POWER AMPLIFIER for your car, it has 150 watts output. Frequency response 20hz to 20Khz and signal to noise ratio, better than 60 d/b. Has built in short circuit protection and adjustable input level to suit your existing car stereo, so needs no pre-amp. Works into speakers. Ref. 30P7 described below. A real bargain at only £58.00. Order ref: 57P1.

REAL POWER CAR SPEAKERS. Stereo pair output 100w each. 4-Ohm impedence and consisting of 6½" woofer, 2" mid range and 1" tweeter. Ideal to work with the amplifier described above. Price per pair £30.00. Order ref: 30P7.

STEREO CAR SPEAKERS. Not quite so powerful – 70w per channel. 3" woofer, 2" mid range and 1" diameter. Again, in a super purpose built shelf mounting unit. Pnce per pair: £28.00. Order ref: 28P1.

VIDEO TAPES. These are three hour tapes of superior quality, made under licence from the famous JVC Company. Offered at only £3 each. Our ref: 3P63. Or 5 for £11. Our ref: 11P3. Or for the really big user 10 for £20. Our ref: 20P20.



ELECTRONIC SPACESHIP. Sound and impact controlled, responds to claps and shouts and reverses when it hits anything. Kit with really detailed instructions. Ideal present for budding young electrician. A youngster should be able to assemble but you may have to help with the soldering of the components on the pcb. Complete kit £10. Our ref 10P81.

12" HIGH RESOLUTION MONITOR. Amber 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. Order ref: 22P2.

MICROWAVE TURNTABLE MOTOR. Complete with weight sensing electronics that would have varied the cooking time. Ideal for window displays etc. Only £5.00. Ref: 5P185.

MAINS FANS. Snail type construction approx 5"×4" mounted on a metal plate for easy fixing. New. £5.00 each. Ref: 5P166.

COMPUTER KEYBOARDS. Brand new uncased. Only £3.00 each. Ref: 3P89.

PANEL METERS. 270 deg movement. New. £3.00 each. Ref: 3P89.

SURFACE MOUNT KIT. Makes a super high gain snooping amplifier on a PCB less than an inch square! £7.00. Ref: 7P15.

CB CONVERTERS. Converts a car radio into an **AM** CB receiver. £4.00. Ref: 4P48.

EHT TRANSFORMER. Television type line output transformer, good for high voltage experiments. £2.00 each. Ref: 2P277.

COMPOSITE VIDEO KITS. These convert composite video into separate H. sync, V. sync and video. Price £8.00. Our ref: 8P39.

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.

3½in FLOPPY DRIVES. We still have two models in stock. Single sided, 80 track, by Chinon. This is n the manufacturers metal case with leads and ICD connectors. Price £40, reference 40P1. Also a double sided, 80 track, by NEC. This is uncased. Price £60.00, reference 60P2. Both are brand new.

ASTEC PSU. Mains operated switch mode, so very compact. Outputs: +12v 2.5A, +5v 6A, ±5v .5A, ±12v .5A. Size: 7¼in long × 4⅜in wide × 2¾in high. Cased ready for use. Brand new. Normal price £30+, our price only £13.00. Our ref 13P2.

VERY POWERFUL 12 VOLT MOTOR. ⅓rd Horsepower. Made to drive the Sinclair C5 electric car but adaptable to power a go-kart, a mower, a rail car, model railway, etc. Brand new. Price £20. Our ref 20P22.

SINCLAIR C5 WHEELS
INCLUDING INNER TUBES AND TYRES
13" AND 16" DIAMETER SPOKED POLY CARBONATE WHEELS
ONLY £6 EACH. 13" Ref 6P10, 16" Ref 6P11.

PHILIPS LASER

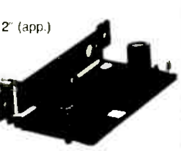
This is helium-neon and has a power rating of 2mW. Completely safe so long as you do not look directly into the beam when eye damage could result. Brand new, full spec, £35. Mains operated power supply for this tube gives 8kv striking and 1.25kv at 5mA running. Complete kit with case £15, ditto for 12v battery. Also £15. Our ref 15p22.

ORGAN MASTER. Is a three octave musical keyboard. It is beautifully made, has full size (piano size) keys, has gold plated contacts and is complete with ribbon cable and edge connector. Can be used with many computers, request information sheet. Brand new, only £15 plus £3 postage. Our ref 15P15.

1990 BULL ELECTRICAL CATALOGUE packed with bargains. Easy to use. Please request with your next order or send stamped A5 size envelope.

12 VOLT BRUSHLESS FAN. Japanese made. The popular square shape (4½in × 4½in × 1¾in). The electronically run fans not only consume very little current but also they do not cause interference as the brush type motors do. Ideal for cooling computers, etc., or for a caravan. **£8 each.** Our ref 8P26.

MINI MONO AMP. on p.c.b. size 4" × 2" (app.) Fitted volume control. The amplifier has three transistors and we estimate the output to be 2W rms. More technical data will be included with the amp. Brand new, perfect condition, offered at the very low price of **£1.15 each of 13 for £12.00**



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POPULAR ITEMS – MANY NEW THIS MONTH

YUASHA LEAD ACID BATTERIES 6V 10A

Superb value at only £12.00. Ref 12P24 or 2 for £20.00. Ref 20P29. Also some 12V 1.9AH £7.00. Ref 7P19.

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

TELEPHONE TYPE KEY PAD. Really first class rear mounting unit. White lettering on black buttons. Has conductive rubbers contacts with soft click operation. Circuit arranged in telephone type array. Requires 70mm by 55mm cut out and is connected by 10-pin IDC socket. Price: £2.00 each. Order ref: 2P251.

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

AA CELLS. Probably the most popular of the rechargeable NICAD types. 4 for £4.00. Our ref. 4P44.

20WATT 40OHM 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.

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.

MOSFETS FOR POWER AMPLIFIERS AND HIGH CURRENT DEVICES. 140v 100w pair made by the famous Hitachi Company. Available in H pack. Ref: 2SJ99 and 2SK343. Ref. 4P51.

TIME AND TEMPERATURE LCD MODULE. A 12 hour clock a Celsius and Fahrenheit thermometer a too hot alarm and a top cold alarm. Approx 50×20mm with 12.7mm digits. Requires 1AA battery and a few switches. Comes with full data and diagram. Price £9.00. Our ref: 9P5.

REMOTE TEMPERATURE PROBE FOR ABOVE. £3.00. Our ref: 3P60.

600 WATT AIR OR LIQUID MAINS HEATER. Small coil heater made for heating air or liquids. Will not corrode, lasts for years. Coil size 3in × 2in mounted on a metal plate for easy fixing. 4in dia. Price £3.00. Ref: 3P78 or 4 for £10.00. Our ref: 10P76.

EX-EQUIPMENT SWITCHED MODE POWER SUPPLIES. Various makes and specs but generally + – 5, + – 12v ideal bench supply. Only £8.00. Our ref: 8P36.

ACORN DATA RECORDER. Made for the Electron or BBC computer but suitable for others. Includes mains adaptor, leads and book. £12.00. Ref: 12P15.

PFTE COATED SILVER PLATED CABLE. 19 strands of .45mm copper will carry up to 30A and is usually indestructable. Available in red or black. Regular price is over £120 per reel. Our price only £20.00 for 100m reel. Ref. 20P21 or 1 of each for £35.00. Ref 35P2. Makes absolutely superb speaker cable!

NEW PIR SENSORS. Infra red movement sensors will switch up to 1000w mains. UK made. 12 month manufacturers warranty, 15-20m range with a 0-10min timer, adjustable wall bracket. Only £25.00. Ref: 25P16.

10 MEMORY PUSHBUTTON TELEPHONES. These are customer returns and 'sold as seen'. They are complete and may need slight attention. Price £6.00. Ref: 6P16 or 2 for £10.00. Ref: 10P77. BT approved.

25 WATT STEREO AMPLIFIER IC STK043

with the addition of a handful of components you can build a 25 watt stereo amplifier. Supplied with circuit diagram. £4.00. Ref 4P69.

SPECTRUM SOUND BOX. Add sound to your Spectrum with this device. Just plug in. Complete with speaker, volume control and nicely boxed. A snip at only £4.00. Our ref. 4P52.

BBC JOYSTICK INTERFACE. Converts a BBC joystick port to an Atari type port. Price £2.00. Our ref: 2P261.

TELEPHONE EXTENSION LEAD. 5mm phone extension lead with plug on one end, socket on the other. White. Price £3.00. Our ref: 3P70 or 10 leads for only £19.00! Ref. 19P2.

LCD DISPLAY. 4½" digits supplied with connection data £3.00. Ref. 3P77 or 5 for £10. Ref: 10P78.

CROSS OVER NETWORK. 8 Ohm 3 way for tweeter midrange and woofer nicely cases with connections marked. Only £2.00. Our ref: 2P255 or 10 for £15.00. Ref: 15P32.

REVERSING LIGHT ALARM. Fits to car reversing light and sounds when reversing. Only £2.00. Our ref: 2P248.

BASE STATION MICROPHONE. Top quality uni-directional electret condenser mic 600r impedence sensitivity 16-18Khz – 68db built in chime complete with mic stand bracket. £15.00. Ref: 15P28.

MICROPHONE STAND. Very heavy chromed mic stand, magnetic base 4" high. £3.00 if ordered with above mic. Our ref: 3P80.

SOLAR POWERED NICAD CHARGER. 4 Nicad AA battery charger. Charges 4 batteries in 8 hours. Price £6.00. Our ref: 6P3.

HIGH RESOLUTION MONITOR. 9in black and white, uses Philips tube M24/306W. Made up in a lacquered frame and has open sides. Made for use with OPD computer but suitable for most others. Brand new, £20.00. Our ref: 20P26.

MAINS 15 WATT SOLDERING IRON. Price £3.00. Our ref: 3P65.

SOLDERING IRON STAND. Price £3.00. Our ref: 3P66.

SHARP PLOTTER PRINTER. New 4 colour printer originally intended for Sharp computers but may be adaptable for other machines. Complete with pens, paper etc. Price £16.00. Our ref: 16P3.

CENTRONICS ADAPTER KIT for above plotter printer converts it to Centronics compatible. Price is £4.00. Ref: 4P57.

CAR IONIZER UNIT. Improve the air in your car, clears smoke and helps prevent fatigue. Case req. Price £12.00. Our ref: 12P8.

NEW FM BUG KIT. New design with PCB embedded coil 9v operation. Priced at £5.00. Our ref: 5P158.

NEW PANEL METERS 50UA. Movement with different scales that are brought into view with a lever. Price only £3.00. Ref: 3P81.

STROBE LIGHTS. Fit a standard edison screw light fitting 240V 40/min. flash rate available in yellow and green. Complete with socket. Price £10 each. Ref. 10P80 (state colour required).

ELECTRONIC SPEED CONTROL KIT. Suitable for controlling our powerful 12v motors. Price £17.00. Ref: 17P3 (heatsink required).

EXTENSION CABLE WITH A DIFFERENCE. It is flat on one side making it easy to fix and look tidy. 4 core, suitable for alarms, phones etc. Our price only £5.00 for 50m reel. Ref: 5P153.

METAL PROJECT BOX. Ideal for battery charger, power supply etc. Sprayed grey size 8" × 4" × 4½". Louvred for ventilation. Price £3.00. Ref: 3P75.

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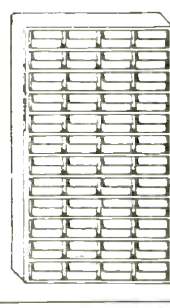

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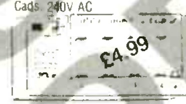
NI-CAD CHARGER
Charges AAA, AA, C, D & PP3 Ni-Cads. 240V AC



NI-CAD RECHARGEABLE BATTERIES

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AAA	£1.50	£1.30
AA	95p	85p
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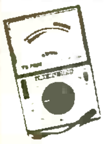
D	£2.00	£1.85
PP3	£3.90	£3.75

VIDEO HEAD TESTER



A VHS video head tester for determining whether a video head is in good condition by detecting the wear state and displaying it on a meter. Complete with carrying case and leads.
SPECIAL PRICE £35

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EC92	[illegible]
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ECC82	1.08
ECC83	[illegible]
ECC84	0.65
ECC85	1.20
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ECF82	1.35
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ECH81	1.15
[illegible]	0.80
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[illegible]	8.05
[illegible]	1.30
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PY801	1.35
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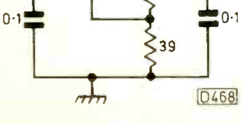
COVER PHOTO
This month's cover photograph shows the Panasonic Model TX2000, which is fitted with the U4 chassis. See article on pages 772-4.

CORRECTION
An error occurred in Fig. 3, page 698 last month. The 5V stabiliser circuit is as shown below.



Historical Changes

We seem to be living through a period of particularly rapid historical change. The crumbling of the communist regimes in Eastern Europe and the break-up tendencies of the Soviet Union are two such examples. Just a short while ago such changes would have been almost inconcievable. Look what happened when previous attempts were made. Then all of a sudden the situation changes dramatically. So much so that whereas in 1960, 1970 or 1980 one would have felt fairly safe in predicting how things would be ten years later, in 1990 one can have no such assurance.

Ten years ago there were two super powers and everything seemed to revolve around this fact. In the West the powerful US economy was the kingpin of the economic system. But the US position has changed markedly since then. In just seven years the USA has changed from being the world's largest net creditor to being the world's largest net debtor. The year 1985 saw the USA become a debtor for the first time since 1914. The US economy remains strong of course, but the country's poor trading performance in recent times highlights a relative decline and the growing importance of other economies, notably Japan's.

One is brought up rather sharply to reflect on these things by the untimely death of Robert Noyce in early June, at the age of 62. Robert Noyce had amongst other things been the president and chief executive of Sematech, a consortium of major US semiconductor manufacturers whose aim is to regain for the US its pre-eminent position in semiconductor technology.

Robert Noyce and the silicon chip were intimately linked. It was as a young scientist in his thirties, working at Fairchild Semiconductor, that he created some of the earliest integrated circuits. Jack Kilby came up with similar ideas at the same time, working at Texas Instruments. There followed a ten-year patents battle between the two companies, and in the end the rights of both were upheld. Exactly who achieved what first is not too important. Both companies had by then developed the basic processes that came to be used in chip manufacture, and as we all know the world changed as a result, with products and processes that would have been economically impossible before suddenly becoming feasible. A decade or so later, in 1968, Robert Noyce with Gordon Moore formed Intel and in due course the microprocessor revolution came about. Intel produced a 4-bit microprocessor in 1971 and, rather more significantly, the first 8-bit microprocessor not long after.

These were major steps in the development of electronics as we know it today. Earlier of course the transistor itself had been invented in the USA. The point-contact transistor was described by John Bardeen and Walter Brattan, working at the Bell Laboratories, in 1948. Then in 1949 William Shockley came up with the junction transistor. It seemed that for many years all major advances in electronics came from the USA. That's where it all happened. Money for defence and space projects helped to maintain the pace of development of course, but even without it a culture favourable to innovation had been created, particularly in the famed Silicon Valley. US pre-eminence in electronics seemed unassailable.

The current situation is somewhat different. According to a recent US Commerce Department study, if relative growth rates continue it won't be too long before the Japanese electronics industry becomes the world leader. It's not only a question of semiconductor devices. The worldwide market share of US producers of a wide range of products from silicon wafers and memory chips to communications networks and computer displays has declined rapidly. The way in which things are going is highlighted by the fact that the share taken by US companies in new electronics patents has dropped reflecting, as the study puts it, "the declining capabilities of US firms relative to the Japanese in the research and development phases of bringing key electronic technologies to market".

The study is critical of US government policies, commenting that "in contrast to foreign governments the US government has not had a co-ordinated set of policies directed to this sector. In general, the US has followed an ad hoc approach, the effect of which has been to place the US electronics sector at a competitive disadvantage vis-a-vis some of its foreign competitors." It concludes that US leadership in electronics "may very well be eclipsed unless continued tenacity by the US private sector is accompanied by a higher degree of consensus within the industry and improved co-ordination with academic, federal, state and local governments." As if to cap all this Hitachi has just announced the development of a prototype 64-bit dynamic RAM, said to be the first of its kind in the world, making Hitachi a front-runner in the race to develop the next generation of memory chips.

Quite how it will all develop is hard to tell. The Japanese electronics industry goes from strength to strength, but the US industry has always shown a capacity to pull itself up, as happened after the launch of Sputnick in 1957. As mentioned at the outset, these are particularly fast moving times when even the immediate future is hard to see. The outstanding factor however is the sheer quantity of research effort being put in by the Japanese. Europe nowadays seems to be rather a backwater in the electronics world. As for the UK, well we were quite good at developing valves. And then there was television and radar. But that was rather long ago and right now the UK electronics research and development scene seems to be a particularly arid one.

Teletopics

FLAT TRADING

The latest BREMA figures, for the first quarter of 1990, confirm the flat trading conditions during the period. CTV deliveries dropped by 8 per cent to 732,000, with small-screen sets down 12 per cent at 367,000 and large-screen sets down 4 per cent at 365,000. VCR deliveries declined by two per cent to 423,000 while camcorder deliveries showed a substantial increase of 42 per cent at 61,000. At least the UK was in surplus during the period, with a £2·8m surplus on the CTV side and a £10·3m surplus with VCRs.

FUZZY LOGIC

Fuzzy logic is a strange term that you may start to come across since it's now being used in certain domestic electronic products, in particular a recent Sanyo camcorder. The concept of fuzzy logic was first put forward over twenty years ago by an American computer scientist, Professor Lofti Zadeh, at the University of California. His starting point was the fact that conventional computing depends on exact information whereas much of the information on which we rely in everyday life is imprecise. For example, if someone tells you that something is beautiful you know what he means. But how do you define beauty, and how could a computer recognise it? Fuzzy logic was developed to enable computer systems to operate on the basis of probability, by assessing imprecise information. It's now widely used in process control. The programming is such that the outcome of actions under given circumstances can be predicted. In that Sanyo camcorder the fuzzy logic system is used to provide an accurate response to sudden changes in illumination and subject position. Not fuzzy at all really!

CD-I, DVI and CD-TV

The CD-I (compact disc interactive) system is by now widely known and equipment is due to be launched in the European consumer electronics market in 1992. A recent conference report appears on another page in this issue. There are however alternative approaches, and it seems that we could be faced with a systems battle of the type we've experienced in the past in the TV and video fields. Intel for example is pushing a system called DVI – digital video interactive. Its advantage is compatibility with existing IBM PC/AT computers and full-screen, full-motion video from the start. Meanwhile Commodore has announced that it intends to launch its CD-TV system in the UK later this year. The player incorporates a conventional CD deck and a Commodore Amiga computer and is expected to sell for around £700. A prototype was demonstrated at this year's Chicago consumer electronics show. At present it doesn't have full video motion, being restricted to animation effects which enable the system to be used for games etc. It uses CD-ROM technology.

COMPANY AFFAIRS

JVC and Philips have formed a joint venture to produce VHS VCRs in Malaysia. Production will begin in early 1991 at a rate of 700,000 machines a year and is expected to rise to two million a year. The company is known as Philips/JVC Video Manufacturing Malaysia SDN.BHD. In Europe Philips has formed a joint venture with Matsushita to develop a digital interconnection bus for consumer electronics products. The system is known as domestic digital bus (D2B) and is being supported by Thomson and Sony. It will initially be used in TV sets and VCRs. Agfa-Gevaert is to transfer its magnetic tape operations to BASF. The two companies have signed a declaration of intent but this has to be accepted by the German monopolies authority. Matsushita is to buy a 25 per cent interest in W. German consumer electronics manufacturer Loewe Opta. The aim is to work on joint development of digital TV, including HD-TV, and other areas of CTV production. The Matsushita link will enable Loewe Opta to develop new products quickly and economically and widen Matsushita's European manufacturing base while giving it access to Loewe Opta's digital electronics technology.

TRADE NEWS

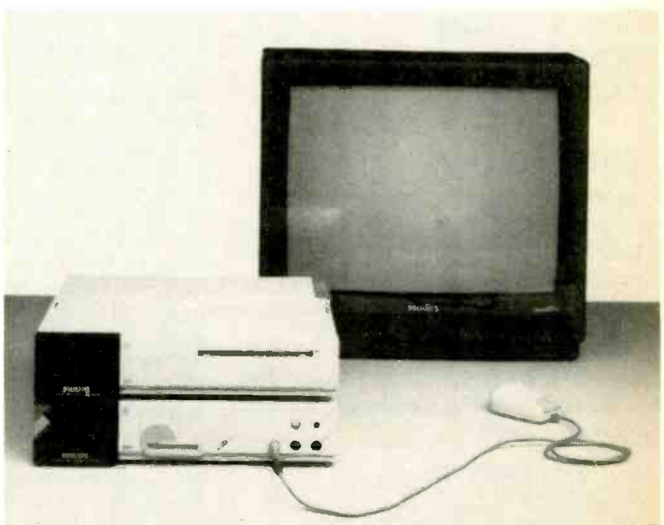
Serviscope's head office has moved to 103 The Avenue, Bentley, Doncaster, South Yorkshire – telephone 0302 890 450. The company was recently bought from Granada by Computec.

Amstrad has set up a subsidiary Amstrad UK Spares at Unit 24, Rosevale Road, Parkhouse Industrial Estate, Newcastle-Under-Lyme, Staffs ST5 7QS. The sales office telephone number is 0782 563 388.

NICAM sound on ITV and Channel 4 is now available from the Black Hill transmitter and its dependent relay stations excluding the Torosay group.

TV DEVELOPMENTS

ITT Semiconductors has announced that it is expanding its range of digital chips for use in TV sets. The 2205 video processor has been developed for HD-TV applications. It incorporates a 2H adaptive comb filter to separate the luminance and chrominance components of a PAL or NTSC signal, the result being optimum luminance output without cross-colour effects. It also uses vertical peaking to improve picture quality in the vertical direction and a black-level expander for improved gamma correction. The 2205 is pin-compatible with the present 2203 and 2204. The 2400 is a multi-standard audio processor which can decode most TV stereo sound systems including NICAM. ITT hopes to introduce a multi-function video processor chip next year to form virtually a single-chip TV set. It will carry



The Philips CDI180 and CDI181 CD-I units shown with a monitor. See CD-I, DVI and CD-TV and the CD-I conference report elsewhere in this issue.

out video processing and decoding, deflection control and audio processing, the consumption being 3W.

Hitachi has introduced a 10·4in. (diagonal dimension) colour liquid-crystal flat-panel display screen using integral colour filters and thin-film transistor switching. It's intended for use in VDUs where high resolution is required – there are 640 × 480 pixels. The filters are arranged as vertical stripes, each pixel being formed by three adjacent dots (one for each filter colour). Panel depth is an inch, including the backlight. Built-in video data conversion circuitry enables the panel to be used with c.r.t.-type signals.

Philips has introduced a new CMOS microcomputer chip, type PC383C562, that's suitable for the control of equipment such as satellite TV receivers, VCRs and high-end CD players. It's based on the 80C51 with various extras including an 8-bit ADC, a dual DAC with PWM outputs to drive stepper motors and a 16-bit timer/counter. The latter makes the device well suited to such applications as automatic tuning while the 8-bit ADC can be used to track parameters such as battery voltage or the position of a CD player's laser unit.

The VideoCipher division of General Instruments has developed a compatible HD-TV system which has been proposed to the FCC for use as a US standard. It uses proprietary technology to compress the video signal so that it will fit into a standard channel bandwidth. The compression system also eliminates interference and ghost images. The system, known as DigiCipher, will be tested by the FCC along with proposals from four other sources.

TECHNICAL INFORMATION

U-View, 29 Warmsworth Road, Doncaster, South Yorkshire DN4 0RP (telephone 0302 855 017) has published *Television Servicing 1989-90*. It includes data for some 749 models with cross-references to preceding years and equivalent models. Because Alba, Bush, JVC, Hinari, Matsui, Saisho and Sony were not in the previous book some earlier models from these manufacturers have been included. An advertisement with further details appears elsewhere in this issue.

Satellite UK, Citybridge House, 235-245 Goswell Road, London EC1V 7JD (071 837 3388) has introduced a City and Guilds course covering satellite master antenna TV. The courses are held at the Polytechnic of Central London.

J. and N. Bull Electrical, 250 Portland Road, Hove, Brighton, Sussex BN3 5QT has published a mail order catalogue for 1990 containing a thousand electronic and electrical products. It's priced at 25p.

ELECTROSTATIC PROTECTION

Elremco Products Ltd., The Fairway, Bush Fair, Harlow, Essex CM18 6LZ (0279 24285) has introduced an earth bonding plug which provides a readily accessible earth point for all fixed and portable antistatic work stations. The plug earths equipment directly to a standard three-pin, 13A socket. It complies with the requirements of BS1363:1984.

SCREEN SCRATCH REMOVAL

Novus Windscreen Repair, 4 Ashley Court, St. Johns Road, Tylers Green, Bucks HP10 8HN (0494 813 583) is offering a TV screen scratch removal service. The company charge £30 plus VAT (per set) to visit the customer and remove the scratch in situ. A highly-controlled grinding system called fining is used to remove the scratch, after which the area is polished to give a perfectly clear finish.

Letters

ELECTRIC SHOCK WARNING

A nasty accident in our workshop prompts me to write to warn readers of an unexpected shock hazard when dealing with TV sets. A colleague picked up the set concerned to move it from one bench to another. In doing so he wrapped his hand round the pins of the 13A mains plug and got a violent electric shock which was sufficient to make him drop the set on to a concrete floor and smash the picture tube. The set had been disconnected from the mains supply for some while before, so the voltage sitting at the exposed L and N pins of the plug must have come from the reservoir capacitor inside the set's power supply section.

The particular model bore the Expert brand name and was fitted with the Luxor SX9 chassis. It may well be that other TV makes and models (also VCRs with a switch-mode power supply?) are capable of doing the same thing, so beware.

E. Trundle,
Hastings, East Sussex.

LEGISLATORS PLEASE NOTE

Reading Dave Hennicker's letter (July) I'm convinced that it's time for our legislators to get busy. Mains switches and fuses should be physically isolated from the rest of the circuitry. It can be dangerous when the serviceman has to handle panels arranged around mains wiring and components. I always considered it bad practice to combine mains switches with potentiometers and am glad that this is not done these days.

Two different makes of TV set, both continental, have caused fires by having the mains voltage on print at the front and sparking across to other circuitry. I now cut out the print on these sets and replace it with insulated wiring.

On the subject of legislation, I wish it was law that all sets had robust headphone sockets, ¼in. at least. In my experience the 2·5mm and 3·5mm sockets do not stand up to wear and tear. Deaf people can be a menace when they turn up the sound until they can hear it. Perhaps headphone sockets would stop them annoying their neighbours.

K.J. Treeby,
Plymouth, Devon.

RECEIVING SATELLITE TV AT VHF/UHF

In reply to the point raised by D.H. Davies (July), there are several explanations for receiving satellite signals directly with TV sets of either old or new design. The first and obvious assumption, that somehow a v.h.f. TV set is also sensitive to Ku band (11GHz) satellite TV signals, can be discounted since even if it were the signal strength would be so low that a picture would not be visible quite apart from the differing frequency.

There are two likely explanations. First, there are a number of so-called "video senders" on the market. When one of these is connected to a satellite TV receiver it will retransmit the signal at a low power level in the normal u.h.f. band to enable the user to view the programme anywhere in his house, for example on a portable with a set-top aerial. These senders are clearly illegal though many thousands are in use. Some are very crude and operate fundamentally on the v.h.f. band, with harmonics extending to u.h.f. – rather like the TV games machines of the early Seventies. If a neighbour within a radius of about half a mile has one everybody in the neighbourhood can tune their TV sets to his Sky signal. To test this explanation Mr. Davies should continue to view the Sky signal on his v.h.f. set to establish whether it periodically changes station or disappears as a result of his neighbour changing Sky channels. If this is so and the signal always appears only as various satellite TV stations then this is the cause.

The second explanation is that a close neighbour has a perfectly legal satellite TV system and that Mr. Davies is simply receiving a harmonic of the vision i.f. radiated directly from his neighbour's TV set. To test for this Mr. Davies has only to continue viewing: if he finds that the signal periodically changes from Sky to terrestrial TV as a result of his neighbour changing channels then this is the cause.

My bet is the first explanation but I would be interested to know whether the signal remains as only one single Sky channel and can be viewed at all times of the day. As most people switch off their TV sets at some point in the day then if the signal does continue for 24 hours it's probable that Sky TV really is being received directly on v.h.f. TV sets!

Les Sage, Sage Audio Electronics,
Bingley, West Yorkshire.

PROFIT FROM SECOND-HAND EQUIPMENT

Some years ago I realised that car dealers go to some trouble to have their second-hand vehicles spruced up and gleaming to attract customers. They valet the insides and really go to town on cosmetic presentation. Selling second-hand TV sets and VCRs can be a very similar kind of operation.

I buy only TV sets and VCRs that are basically unscratched and of known makes which, by their service record, will guarantee good reliability. They can be very dirty, but more of that later. A very quick check can tell whether a set and its tube is good. Anything with a dud or obviously whacked-up tube is put aside and used for spares.

I then strip both TV sets and VCRs down and give them a thorough clean. By this I mean clean to the state as when new if possible. Every plug and socket is removed and cleaned, smeared with silicone grease and then refitted twice – the pins will self-clean. Pluggable i.c.s should all be dealt with in the same way – remove, clean, smear pins with silicone grease and refit twice. Ribbon connectors require special attention and great care.

All line output and chopper transformers, also wirewound resistors, should be resoldered using high melting-point solder.

Reassemble the set properly, with all wires correctly dressed, and switch on. After cleaning all potentiometers, check all major voltages carefully. Give the set a good thumping on the bench, by lifting one end and dropping it about four inches. If there is anything intermittent, this action should make it show up.

When I'm really satisfied with the set I wash and clean the back then attend to the cabinet. After washing and cleaning and minor application of scratch polish the cabinet should look pretty good. Customer controls can be easily cleaned with some methylated spirit on a clean cloth. By adding a hacksaw blade you can clean all the little grooves etc. I like to hear the customer say "it must have come from a very clean home – it looks like new". Remote control units should also be cleaned. If one is too grotty, replace it with a nice, shiny new one – they are not expensive.

When all is finished, and after a thorough soak test, get your wife to cast her eye over it. If it passes this crucial test, make a good mark-up on your purchase price and sell it. If you've done the job properly it will draw the customers.

In the case of VCRs clean as with a TV set but pay particular attention to dusty air vents and channels. Remove the front panel and, if it's without any electronic parts, wash it by total immersion in warm soapy water, using an old toothbrush. When you've finished doing this the water will usually look like tea.

Replace all belts and clean the drum. If necessary replace the drum – they are cheap enough nowadays. Thoroughly check and clean all the numerous plugs and connectors. Remove and clean any pluggable i.c.s – most are soldered in however.

Check the power supply and replace any obviously hot regulators with a higher rated type – this is well worth the trouble.

As with a TV set, make the VCR look good. Give it a very long test in both record and play. Clean the mains lead and fit a new 13A plug. When all is finished you'll wonder why you didn't do this years ago! Finally, give a twelve-month guarantee on everything, supply a new three-hour tape and a new connector lead.

Hugh MacMullen,
Newquay, Cornwall.

IMPROVED G8 CHASSIS BLANKING

Many sets fitted with the Philips G8 chassis continue to give sterling service. I have however noticed that many of them suffer from teletext interference at the top of the screen, some more than others.

One particular example had six or seven lines running at least two inches down from the top of its 22in. screen, so I decided to do something about it. I first tried the usual modification, which is to add a resistor of about 220-270Ω in series with the base of the flyback blanking transistor T488 on the timebase panel in order to adjust the width of the blanking pulse. This approach was tried until the point was reached where the top of the picture started to darken, but the teletext lines were still there. Suspecting that there was a fault I checked with a scope at the junction of R214/R215 (see Fig. 1) on the decoder panel. Healthy 15V field and line blanking pulses were present. I then checked the components around the first luminance buffer amplifier transistor T221. They all proved to be o.k. The waveform at the emitter of T221 showed that the blanking action was ineffectual however, with teletext lines present only some twenty per cent down on peak video. I came to the conclusion that the circuit had been designed before the advent of teletext and was unable to cope.

After some experimenting I found a "belt and braces" solution by adding a diode, 1N4148 or equivalent, across R214 (cathode to the junction of R214/5) to increase the cut-off effect of the negative-going field blanking pulse on T221. The value of C213 was increased from 1μF to 4·7μF to compensate for the reduced load impedance present at the junction of R212/4 and thus prevent shading. These alterations, along with slight adjustment of the RGB background controls because of a brightness level change, provided a complete cure.

I hope that this will be of help to anyone else who finds a stubborn case of teletext interference with the G8.

D.R. Bracknell,
Farnborough, Hants.

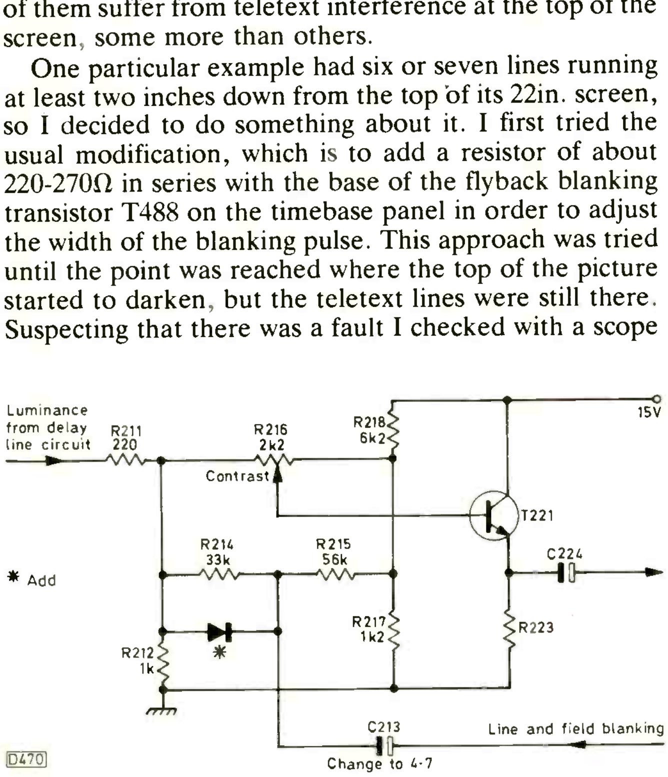


Fig. 1: Blanking modification for the Philips G8 chassis to cure teletext-line interference. The components shown are on the decoder panel

LP PLAYBACK ON THE NV7200

When a friend recorded the appearance of Garret Smythe, a director of the cryonic suspension company Alcor UK Ltd., on Sky Television he forgot to set his VCR to standard play. I found that my Panasonic NV7200 would play it all right at half speed, but there was no sound.

A look at the circuit showed that IC6002 on the system control board produces the half-speed and muting signals, and that the outputs are single-ended, i.e. they are pulled up to the supply rail voltage by 10kΩ resistors. The signals are positive true, the functions being enabled when the chip's outputs pass no current through the resistors. It was therefore a simple matter to add a transistor with a 100kΩ resistor between its base and the half-speed line (pin 15), its collector to the mute line (pin 10) and its emitter to chassis. By doing this the muting line is pulled down to 0V when the half-speed feature is selected, thus turning off the muting. There are already holes on the PCB for one end of the resistor and the transistor's collector. The other end of the resistor, connected to the transistor's base, is otherwise unsupported. I connected the emitter to the nearest chassis point via a stiff wire.

The resultant ability to play long-play tapes provides perfectly watchable results, though doubtless not as good as with a VCR designed for the purpose. The picture is slightly off-track at the top and the sound lacks h.f., due to the incorrect audio playback equalisation. It should not be difficult to get the half-speed line to switch in extra equalisation capacitors if the feature is to be used regularly. It's possible that the facility for half-speed playback with sound had been considered but was abandoned for reasons of picture quality. Hence the convenient holes in the PCB.

I also noticed that the main timer chip IC8005 on the luminance/chroma/audio board, the one that sets all the sync frequencies etc., not the clock, has jumpers between pins 9 and 10 to chassis. There's a hole in the PCB so that the presence of these jumpers can be observed even when the main board is screwed down. The output of this AN6353 chip is a 25Hz squarewave,

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presumably the field frequency. Would altering these links reset it to 30Hz for US frequencies? Would this automatically set the whole machine to play NTSC tapes in black and white (with NTSC line and field frequencies of course)? The links must be there for some purpose. But as this is presumably a CMOS chip it would not simply be a matter of opening the links. The pins may need to be connected to the supply rail instead, as with pin 11. Pin 12 seems to be the actual power input pin. If anyone has the circuit of the NTSC version of this machine and can look up these points I would be grateful for the information.

Finally I had a problem in that when cue or review was selected via the remote control system the machine would switch itself back to normal running after a short while, despite the fact that the remote control system still requested cue/review. This was cured by adjusting R6504 which is under the screening can that surrounds the IR remote control receiver diode.

John de Rivaz, West Towan House,
Porthtowan, Truro, Cornwall TR4 8AX.

HELP WANTED

Can anyone supply a set of scan coils for the Matsui CTV Model 2060 – the tube is a 510RJB22-IC09 PY. All expenses will be paid.

D. Jennings TVs, 59 Gainsford Road,
Bitterne, Southampton SO2 7AW.
Telephone 0703 442 110.

I have a chart recorder that was manufactured by Babcock of Bristol. Does anyone have further details of the manufacturer and/or know where charts can be obtained?

Tom Hession, 2 Church Lane,
Ballinrobe, Co. Mayo, Ireland.

I need a service manual or circuit diagram for the Waltham (made by Orion) W130 14in. portable TV set. Can anyone out there help?

Michael Harris, 13 Westfield Road,
Cheadle Hulme, Cheadle, Cheshire SK8 6EH.
Telephone 061 485 1621.

Can anyone help me to obtain the Philips part number for Rayfoc units as fitted to the Hinari DSK9 (CMD-4/31) and Hinari DK100. The Rayfoc model is not known.

R. Findlay, J.H. Donald (Darvel) Ltd.,
6 Riccarton Road, Hurlford, Kilmarnock.
Telephone 0563 26 477.

Can anyone supply a circuit diagram for the Cossor Model 3100 oscilloscope?

Ron Chaleck, 110 Cross House Road,
Gronoside, Sheffield S30 3RX.
Telephone 0742 455 897.

TELETEXT LINE PROBLEM

The Thorn 1400 chassis is now over twenty years old. These sets have coped with the increasing number of teletext lines over the years very well. Quite recently however a single line, sloping from centre right to left, appeared on the Channel 4 picture produced by my set. It subsequently put in an appearance on BBC-1 and ITV, and BBC-2 will doubtless be affected in due course. It will probably affect many other sets – I reckon that by now about half the picture will be obscured with these lines on some sets fitted with the Rank A823 chassis!

With the 1400 a solution is to adjust the field linearity controls when the receiver has fully warmed up, using a test pattern. A video recorded one is useful if you don't want to stay up till Channel 4 closes. Slight but not significant non-linearity may occur, but this is not noticeable with a normal picture. I've compromised so that the line is at the very top with direct viewing and is thus not distracting: I decided against modifying the field timebase as it's very reliable – in eight years I've had to change only the PCL805 valve.

Incidentally, does anyone know why some modern valves light up brightly at initial switch-on, then fade down to normal brightness? This doesn't cause any problems but it would be interesting to know why it happens. It's a very smooth build-up and down, nothing like the distracting "light-bulb" effect you get with the PCF80 in some Decca sets fitted with the Bradford chassis.

Brian Renforth,
Newcastle-upon-Tyne.

MONITOR LINE OUTPUT TRANSFORMER

I recently had to replace the line output transformer in a Commodore monitor, Model 1084S. The price quoted seems exhorbitant, some £54·57 plus VAT bringing a bill of £62·75. This is the trade price. Even with no other component failure and a reasonable labour charge, with no percentage added to the spare part price, the customer is faced with having to pay some £80 which is ridiculous for such a repair. Commodore didn't seem at all concerned at this situation. Fortunately for my customer I realised that it was a Philips transformer. When I quoted the part number to Willow Vale I was supplied with the transformer and was able to carry out the repair for under £45.

R.A. Simmons,
West Ham TV and Video, London.

RESTORING VALVE RADIO SETS

I read with interest David Tilley's letter on the Bush Model DAC90A in the March issue. These sets were certainly very well made and have proved to be extremely durable. I've had great pleasure repairing and overhauling them over the years.

Whilst I've no experience of cabinet repairs, I can offer the following comments on overhauling valve receivers. I like to replace all valves (keeping the old ones as spares), all electrolytic capacitors, all paper-tubular capacitors (use 400V polyester capacitors as replacements), the output valve's cathode bias resistor and all resistors of 100kΩ or higher value. The performance improvement is usually very marked.

With the DAC90A there are one or two additional points to note. First the frame aerial is directional, so

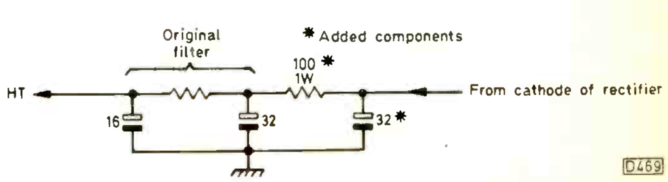


Fig. 2: Extra h.t. filtering to cure hum problems with the Bush Model DAC90A.

rotating the set can improve the signal pick-up and reduce interference. This is rather obvious but is sometimes overlooked. It's also important to ensure that the mains plug is connected to the set so that the chassis is at neutral potential (see also safety below). The capacitor across the mains input, originally a paper-tubular type, should be replaced with an X-rated 0·1μF 250V a.c. capacitor.

The hum level at low volume settings can be quite high. It can be considerably reduced by adding an extra capacitor and resistor to the smoothing circuit as shown in Fig. 2. The added 100Ω resistor also acts as an h.t. fuse, though not if the 32μF capacitor goes short-circuit. The voltage drop across this resistor produces no noticeable fall in performance.

The sound normally has a rather muffled quality. If you wish you can "clean" it up by carrying out the following simple modifications. First, fit an 0·001μF 1kV d.c. polyester capacitor across the primary of the output transformer in place of the 0·01μF capacitor. Secondly add a 1MΩ 0·5W resistor between the anode of the UL41 output valve and the UBC41 double-diode-triode to apply a little feedback.

Now to the safety aspects. These sets are of the live-chassis type, so it's very important to ensure:

(1) That the chassis is connected to the neutral side of the mains supply (try connecting it the other way and waving a neon screwdriver about in front of the speaker grill!).

(2) That the insulation of the output transformer is checked with an insulation tester, both primary-to-secondary and secondary-to-chassis. If significant leakage is detected there's a real danger of the speaker's frame becoming live should the chassis be connected to the live side of the mains supply. Since the metal speaker grill can easily make contact with the speaker frame it too could become live. The output transformer should therefore be beyond reproach and should be checked at least once a year.

(3) That the insulation of the rubber speaker wires, which can touch the chassis, is sound. If perished, replace with plastic-covered leads, keeping them well away from the mains dropper. It's wise to replace the dial lamp wiring for similar reasons.

Finally three miscellaneous points.

(1) The original output valve was a UL41, not a UL46. The UL46 is however an ideal replacement for the UL41 (my valve data suggests that the UL46 is a beam tetrode rather than a pentode but I'm not sure).

(2) One fault that sometimes occurs is that the volume fails to reduce to zero when the control is turned right down. This is due to the UBC41 being faulty. Replacing it will provide the cure.

(3) The correct dial bulbs are 3·5V 0·15A MES types which are available from The Vintage Wireless Company Ltd., Tudor House, Cossham Street, Mangotsfield, Bristol BS17 3EN. They can almost certainly supply a circuit diagram as well.

Geoff Davies,
Rugby, Warwickshire.

Long-distance Television

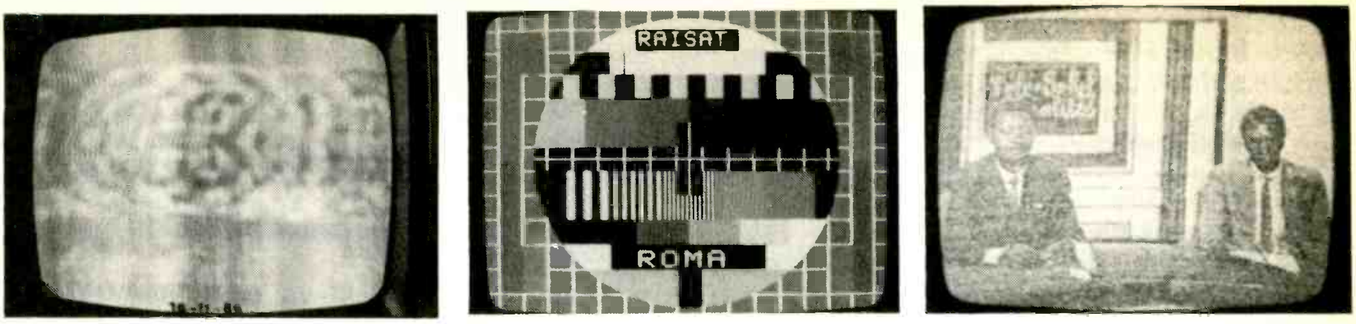
Roger Bunney

May was a more cheerful month with several good Sporadic E openings. This despite the expectation that the present high sunspot activity would result in poor conditions. It doesn't look as if we're going to get a really good season this year, but we must make the most of what's available. Several DXers produced good logs for the period under review. This suggests that if you've got the time to spare there are signals about. So to the May SpE log, as follows:

5/5/90 An unidentified ch. E2 Arabic signal was seen at 1020.
10/5/90 SVT-1 (Sweden) ch. E2.
11/5/90 TVE (Spain) E2, 3; RTP (Portugal) E3; RAI (Italy) IA; MTV (Hungary) R1; ARD (West Germany) E2; TSS (USSR) R1, 2; TVP (Poland) R2; +PTT (Switzerland) E2.
12/5/90 RAI IA, B; TVE E2, 3, 4.
13/5/90 TSS R1, 2.
14/5/90 RAI IA, B; TVA (Italian private station) IA; C+ (France) L4; JRT (Yugoslavia) E3, 4; TVE E2, 3, 4; TVE-2 E2; RTP E3, 4.
15/5/90 SVT E2, 3, 4; RUV (Iceland) E4; TSS R1, 2, 3; CST (Czechoslovakia) R2; TVRL (Romania) R2; TVRL-2 R2; MTV R1, 2; JRT E3, 4; +PTT E2; C + L2, 3, 4; ARD. E2, 3, 4; ORF (Austria) E2a; ERT (Greece) E3; RAI IA, B; TVA IA.
16/5/90 RAI IA; TVE E2, 3, 4.
17/5/90 TSS R1, 2; TVRL R2; C + L3.
18/5/90 RAI IA, B; TVA IA; Telemarket (Italian private station) E2; JRT E3; SVT E2.
19/5/90 TSS R1, 2; NRK (Norway) E2, 3; SVT E2, 4; ARD E2; RAI IA, B; TVRL R2.
20/5/90 RAI IA, B; NRK E2; SVT E3, 4; CST R1; MTV R1; DR (Denmark) E3, 4.
21/5/90 SVT E2, 3, 4; NRK E2, 3 ,4; TSS R1, 2; TVP R2; TVE E2.
22/5/90 TVE E2; JRT E3.
23/5/90 TVE E2, 3; TVP R1; RAI IA; ERT E3.
24/5/90 TVE E3; RAI IA, B; ERT E3; TSS R1, 2; CST R1; C+ L2.
25/5/90 RAI IA, B; TVE E2, 3, 4; RTP E3; TVE-2; C+ L2.
26/5/90 JRT E3, 4; ERT E3; RAI IA, B; TVE E2, 3, 4; CST R1; RTP E3; TVE-2 E2; RTM (Morocco) E4; unidentified Italian private station with vision carrier at 47·605 MHz.
27/5/90 TVE E2, 3.
28/5/90 RAI IA, B: TVA IA; RTP E3; JRT E3, 4; +PTT E2; ORF E2a; TVRL R2; unidentified 47MHz Italian private station.
29/5/90 RAI IA, B; TVE E2, 3, 4; TVE-2 E2; JRT E3, 4; CST R1; TVP R1, 2; TSS R1, 2;
31/5/90 TVRL R2; TVP R1, 2; TSS R1, 2, 3; NRK E2; SVT E2, 3, 4; C+ L2; TVE E3.
1/6/90 TSS R1-5, also R6 and 7 (Band III); CST R4; TVP R1, 2, 3; RAI IA, B, C; RTSH (Albania) IC; ARD E2; C + L2.

An aurora in Scotland on the 22nd gave identifiable reception from NRK on chs. E2, 3 and 4 from 2230 onwards (local time).

There were several tropospheric openings during the month. The period around the 14th produced signals from much of West Germany, the Benelux countries and France in southern and central UK. From the 24th through to the 30th high-pressure systems again produced tropospheric propagation in Band III and at



Left: Malaysia ch. E2 received via F2 layer propagation by Ryn Muntjewerff in Holland last November, with "3" logo. Centre: RAISAT test pattern received by Ian Waller via the Olympus satellite at 19°W. Right: Exotic satellite reception in the C band at 3·915GHz. A studio discussion from the Tele Sahel Actualities programme, Niger. As reception with an offset 1·5m dish was only marginal i.f. bandwidth reduction and sync insertion were necessary.

u.h.f., with reception over most of the UK from much of Western Europe. Conditions were such that BBC-TV gave announcements of probable interference.

Several enthusiasts have received ch. E3 and 4 pictures with the corner log "TVZ". This has been identified as indicating origin from TV Zagreb, Yugoslavia.

My thanks to the following for sending in their logs and reception reports: Tim Anderson (St. Leonards), Roger Fussell (Torpoint), Peter Schubert (Rainham), Iain Menzies (Aberdeen), Bill Cotterill (Tipton), David Glenday (Angus) and Simon Hamer (Powys).

I'm currently busy making major changes to the aerial system here, for both TV-DXing and satellite work. The lattice mast has been stripped for a complete change of aerials. Ones to go up will include the new TV-DXer's aerial mentioned last month. The dish is to be upgraded with the new Chaparrel OMT/polariser for 11/12GHz and new LNBs. Modifications have been made to allow for a C band fitting as well, giving the dish triband operation.

News Items

Belgium: The Wavre transmitter is back in operation on ch. E28 at 500kW e.r.p. horizontal, with the programme Tele 21.

Italy: A broadcasting bill has been passed by the Senate. It would remove much of the deregulated freedom enjoyed by Italian broadcasters over the last fifteen years and also the right of media owners to operate in both the publishing and broadcasting fields.

Switzerland: The local Montreux station "8 Mont Blanc" now reaches the Geneva area on ch. E57 at 0·25kW e.r.p. using SECAM L. Lausanne suffers interference on ch. E57 from the local SSR ch. E58 transmitter. As a result there's been a growth industry in peaked ch. 57 aerials and preamplifiers. La 5 and M6 are to start soon from the GEX site. Telecine's main office is moving to Fribourg but the losses being made mean that the service is likely to close down. Transmissions are on ch. E69.

Czechoslovakia: The third programme which was previously used exclusively for relaying Russian services and is radiated from sixteen transmitter sites now carries the following material: 1400-1600 CNN; 1600-1700 Screensport; 1700-1740 the Russian first programme; 1740-2000 La 7; 2000-2030 TV5; 2030 to closedown Screensport.

A satellite derived service is now being broadcast via the former CTI Kosice/Slovakia ch. R27 transmitter, timing being as follows: 0500-1100 CNN; 1100-1400 World Net; 1400-1700 TV5; 1700-1740 Russian Vremja news; 1740-2300 TV5. These are typical times, GMT.

Poland: The Echo TV station broadcasts from Wroclaw on ch. R28 from 1500-1700 GMT, using system K PAL. Power is due to rise from 200W to 1kW e.r.p.

Denmark: Teletext is being tested on TV-2, with page 100 as the menu. A new TV-2 transmitter has opened at Ostjylland.

New Zealand: The Sky Network has started operations in the Auckland area. It's expected to be available in the rest of the North Island by the end of this year and in the South Island next year. So far the scrambled u.h.f. service has been received with little enthusiasm. Decoders sell for around £130 and can be rented for £4.50 a month. The three channels consist of 24-hour news (CNN plus local news and BBC inserts), a sports service and a twelve-hour till midnight movie channel.

Correction: In the March column I mentioned the time-shifted TV services via the Orbita network. Unfortunately the regional time zones were numbered in reverse. Regions farthest from Moscow receive the I version while those nearest receive the IV version. My thanks to Bernd Trutenau for pointing this out.

Satellite TV

Teletext captions from RTL-V via Astra indicate that RTL is to undertake a phased series of tests with D2-MAC and PAL later this year. A point to note if you are considering the purchase of an RTL-V decoder.

Atlantic Satellite Communications Inc. has been granted a licence enabling it to provide a two-way video conferencing service between Europe and Central/South America via the PanAMSat satellite PAS-1 at 45°W.

The French Bouygues group which runs the TF-1 service has joined forces with the Swedish firm Kinnevik which runs the Scandinavian TV3/TV1000 networks to buy the Swedish Esselte Entertainment group that operates Filmnet.

Morocco is to carry out a six-month test of its 2M programme via the ECS satelite F4 at 13°E, sharing transponder time with TV5 on 11·472GHz (horizontal).

Intelsat has announced plans for the next decade. The World's largest commercial satellite Intelsat VI will have up to 38 C band and 10 Ku band TV transponders and three global TV channels in addition to its 30,000 simultaneous telephone circuits. From 1992 Intelsat VII will carry 26 C band and 10 Ku band TV transponders with steerable beams for each band. There are to be five satellites in this series and there are options for more should traffic be sufficient. Intelsat K up late next year will have an e.i.r.p. of up to 50dBW and capacity for satellite news gathering with up to 32 Ku band transponders. The eastern beams will cover all of Western and much of Eastern Europe while the western beam coverage will include the Eastern seaboard of the USA down to Central America and the north of South America.

The Russian Gorizont 15 at 14°W has been carrying much more traffic recently. The BBC has occasionally been seen via this craft.

As Eutelsat-1 F1 at 16°E slowly loses its station keeping stability and transponder capacity so Eutelsat-1 F2 at 7°E is being used more. Magic Box on Eutelsat-1 F5 at 10°E should be on full programme by the time that this is read.

Nordisk Television TV4 is a newcomer to Intelsat F12 at 1°W. It's another cable feed and uses the former NRK 11·66GHz (horizontal) transponder.

Dual Satellite Dish

A Chesham company, SMD, has developed a dish assembly with separate sections for receiving the Sky and BSB services. SMD recently gave a demonstration showing that a suitably constructed 70cm dish will provide excellent reception quality from both satellites. The company is seeking a development partner to market the system. Anyone able to provide financial backing can contact Dr. Michael Bell on 0494 725 244 for further information. The dish would avoid planning permission problems and cost about £15 more than a conventional dish.

Book Review

World Satellite TV and Scrambling Methods by Frank Baylin, Richard Maddox and John McCormac makes truly interesting reading. It covers basics, system design, construction, installation and fault-finding with lots of diagrams, photographs and circuits. Of particular relevance nowadays is the extensive section on the theory and practice of scrambling. Basic circuit information on most scrambling techniques other than Sky's VideoCrypt system is given. The book is up-to-date, covering events up to April 1990. Though US sourced it covers a great deal of UK practice and I can thoroughly recommend it. The price of the soft card covered book, which has over 340 pages 11 by 8½in., is £23. Enquiries to Baylin Publications, 24 River Garden, Purley, Reading, Berks RG8 8BA.

The Way We Were. . .

How time flies! At a local country fair I recently bought for £5 35 copies of *Practical Television* dated before 1959. Browsing through the yellowing pages proved to be absorbing reading. The July 1956 issue commented on the close down of the Alexandra Palace transmitter, known as Ally Pally, some twenty years after its opening in 1936. Close down was on March 28th. An article in the February 1958 issue described the development of TV in the UK since the start of the first regular transmissions from Ally Pally on November 2nd, 1936 at 1530. At that time two systems were in use, the Marconi/EMI electronic one and the Baird mechanical system, and it's thought that some 300 receivers were then in private ownership. Thoughts that the geographical coverage would be limited were dispelled when reports were received of regular reception at up to 50 miles and "good pictures" at up to 200 miles. Dual-standard operation continued until February 1937 when the Marconi/EMI 405-line system was adopted.

By 1939 when the service abruptly ceased on September 1st, as a war precaution, some 20,000 sets were in use. During the war years half a dozen BBC maintenance staff cared for the studios while the RAF took charge of the transmitters. The service resumed with an outside broadcast of the Victory Parade on June 8th, 1946, at 1500 – test transmissions had started on the previous day.

Trade news in one issue mentioned that the Antiference Antex X aerial insulator had been introduced in a modified form for clamping to masts up to 2in. and to aid Band III (ITA) installation work. We find reader H. Baines of Nottingham commenting on unusual reception – American police calls and other TV signals being received with ghosts (multiple imaging), the signals breaking up if an aircraft passed overhead! That was during the peak all-time record sunspot count in April 1957.

Fascinating reading. I'd recommend that any readers who come across vintage copies of this magazine going back to 1951 grab them.

For Sale

TV-DXing equipment: Fernseh Band I/III gold anodised combined aerial £30; wideband Antiference XG14W u.h.f. aerial £20. Phone Steve Saville (Verwood, Dorset) daytime 0202 678 719 ext. 4240 or 0202 825 654 after 1800.

VCR Clinic

Reports from Eugene Trundle, Alfred Damp, Philip Blundell, AMIEIE, Bob McClenning, Colin McCormick and S. Da Costa

Pioneer VR727/Philips/etc

This range of VCRs uses a switch-mode power supply. The one in this machine fluttered audibly all the time the machine was on. We found that the outputs were low and fluttered in sympathy with the sound coming from the chopper transfomer – there was a huge, triangular ripple voltage. If the load on the power supply was disconnected by withdrawing P023 the fluttering stopped and the output voltages settled down at the correct levels. Despite this the trouble was within the power supply, where C211 had gone low in value. It says $10\mu F$ on the circuit diagram but was actually $33\mu F$. Good old Philips! **E.T.**

JVC HR7200/Ferguson 3V29

This machine was fitted with the later PU21235A motor-drive amplifier panel. The problem was with the capstan speed – it was slow. We found that Q210's emitter-base junction was open-circuit while its collector-emitter path was leaky. **E.T.**

Philips VR6730/Finlux VR2030/etc

If you get one of these or their several clones with the complaint that it doesn't work but flashes all its function LEDs in sequence, together with the programme indicator and clock displays, look no further than crystal 1001 on the front PCB. It's the 6MHz clock for IC7050 and may be dry-jointed or faulty. **E.T.**

Ferguson FV30

If the off-air (E-E) signals go weak or are lost in a snowstorm, check for dry-joints at the pins of the modulator/booster module. It's mounted on the main PCB and it seems that the pins can be strained by plugging and unplugging aerial cables. **E.T.**

Hitachi VT11/33/etc

This problem cropped up on a Bang and Olufsen clone, Model VHS80, that uses the same deck. It was the very common one of loss of reel traction. This time replacing the reel idler didn't provide a cure: the reel drive clutch assembly beneath the deck was very stiff on its shaft. Removal, cleaning and a spot of lubrication got things going again and we added another chewed tape to our collection. **E.T.**

JVC HRD520

The symptom with this machine was failure to complete the tape-loading cycle. As soon as the guides had gone fully home the loading belt at the top right-hand side of the deck would slip and squeal loudly for some seconds until the machine shut down in standby.

In this half-loading deck design the pinch roller is lowered into place at a late point in the loading cycle, when a peg on the underside of the pinch roller pressure lever drops into a groove on the control cam. This one was getting stuck in the tight double-bend there. We cured the problem by easing the profile of the inner groove and lubricating the groove and peg with white Molykote grease. **E.T.**

Philips VR6485/6585/6880/etc

Intermittent no record colour is beginning to be a common problem with these machines. So far the cause has been a faulty TDA4710 chip. If you do have to change it, don't forget to read the note that comes in the box. This time it's not telling you to remove your nylon pullover before touching the pins but is a modification.

Look at the number beginning with DSD. If it ends with 2Y (the new chip's number ends in 3Y) the following changes will have to be made: increase the value of C2416 from 180pF to 330pF (part no. 4822 122 31353), reduce the value of R3418 from 82kΩ to 47kΩ (4822 116 52857) and increase the value of R3459 from 47kΩ to 470kΩ (4822 050 14704). **P.B.**

Philips VR6585

After about ten seconds the sound would become weak and distorted. The signal was o.k. at the P127 front-end module but faulty at the audio output sockets and of course the modulator. The cause turned out to be on the P524 f.m. audio board where decoupling capacitor C2211 was dry-jointed. For no sound at all check that the 80mA Wickman fuse on this module hasn't blown. **P.B.**

Philips VR6462

When play was selected the tape threaded but the head rotated much too fast. So the machine immediately unthreaded. This is usually due to an open-circuit head position sensing optocoupler, but not this time. The opto LED is in series with the tower LED (IR cassette bulb) and it was this that was open-circuit. The clue is that the head optocoupler LED voltages are normally around 3V but in this case were at 12V. **P.B.**

Philips VR6362

The E-E picture was smeary but was o.k. on playback. By substitution we narrowed the cause down to the P607 mother board. Voltage checks around the 4053 video switching chip showed that the EXT switching line was at 2V when it should have been at 0V. The chip itself was leaky, a new one (IC7951) restoring normal service. **P.B.**

No Picture

Two machines came in with no picture in the E-E or play modes. In both cases I first blamed the modulator then had to start serious fault finding. I'd no circuit diagrams for the first machine, a **Sharp VC7300**, but managed to track down the fault to the HA11703 chip.

The second machine was a **Panasonic NV730** where the chip that carries out the same functions, i.e. head signal amplifier and E-E/video switching, is an AN6337S. It's on the folded luminance-2 panel. Unfortunately this chip seems to be unavailable – and the board is hideously expensive. Worse still my meter probe slipped whilst I was monitoring the power supply lines. This damaged the tuner and the BN5115 on the demodulator panel, the result being low gain. I was able to replace these items with parts from a scrap NV366, with some modifications. Note that the manual may not correspond with the actual demodulator PCB or the aerial booster/modulator unit. **C.McC.**

Panasonic NV2010

This machine had noisy drum bearings. They can be changed in the same way as described for the NV333/366 on page 595 of the July 1989 issue. With the NV2010 don't remove the whole drum before dismantling: the stator with most of the wiring can stay in the machine. Fine adjustment of the head switching point can be carried out by means of the slotted screw holes at the back of the drum flywheel, by trial and error if necessary. I actually salvaged the bearings from an NV366. **C.McC.**

Amstrad VCR4600

No servo action was fixed by replacing the BA718 chip IC302. It's a dual operational amplifier that drives the main servo chip. Note that there's a fault in the information given in the item on page 364 of the March 1988 issue. This seems to be a stock fault. **C.McC.**

Panasonic NV7000

The customer's complaint was "poor picture – video heads?". On test the playback showed that the CTL pulses, with both its own recordings and pre-recorded tapes, were missing. All checks pointed to the audio/control head but this proved to be innocent when fitting a replacement left the symptoms as before. We then changed the i.c. that contains the CTL amplifier, but again there was no difference. Replacing C2039 and C2040 provided the cure. **A.D.**

Panasonic FS100

The complaint was no hi-fi audio monitor output and no audio when a signal was applied to the audio input. Both faults were due to the absence of the −27V supply to the input/output pack. I found that a safety resistor in the feed was open-circuit – it's not shown on the circuit diagram. **A.D.**

Sony SL301

The capstan motor was running at full speed. I found that the capstan frequency generator signal was missing at pin 62 of IC501. Making checks farther back in the circuit I found that there was a sinewave input at the capstan FG amplifier IC404 but no output. Replacing this chip restored normal operation. **A.D.**

Pye DV291

This machine was new stock and we were told that the problem was no results. So, expecting a dead set, I was surprised to find that the display lit up when it was powered. The VCR accepted a cassette and then sat there, refusing to play, wind, rewind, record etc. It also refused to give us back the cassette. On trying the remote control unit all functions worked normally. IC101 on the display/timer/operate board accepts the instructions from the IR preamplifier and from the on-board controls. The scan outputs from this chip were all correct, and were being correctly returned to its input port. Replacing IC101 restored normal operation. **A.D.**

Akai VS35

This VCR refused to accept a cassette. Checks were made on the mechanism timing, which was found to be correct. I then looked for "cassette detect" switches in the cassette housing but couldn't find any. In these machines the cassette is detected by the end-sensing phototransistors. The one on the supply side was open-circuit. **A.D.**

Panasonic NV-MC30

There was no drum rotation with this camcorder. The drum motor-on signal was correct but the "CYL VM" supply to the servo was at only 1·4V instead of 5V. Replacing IC1004 in the power supply restored normal operation. **A.D.**

Amstrad VCR4600

The complaint was of two thin lines approximately a third and two thirds of the way down the screen. It affected both record and playback. The fault persisted when a known good recording was tried, but improved as the machine warmed up. In addition varying the back tension changed the look of the fault. After a long search we discovered that a small 10μF, 16V electrolytic on the drum motor assembly was the cause. But how did the effect get into the signal circuits? Who knows with an Amstrad. . . **B.McC.**

Panasonic NV366/777/etc/Hitachi VT17

If any of these machines appears to have a faulty head, before condemning it check that the relay clicks in the pause mode. If it fails to click the fault is either in the relay (dirty contacts) or its control circuit. It's a good bet that the head is o.k. **S.DaC.**

Panasonic NV830

The problem with this machine was no colour. We found that the switched 12V line read 10V. The switching transistor Q6013 in the syscon was leaky. **S.DaC.**

Panasonic D1 deck (NV430)

Here's another fault to add to the list of electronic faults given on page 521 of the May 1990 issue. No clock display but the machine comes on, no cassette functions, the cassette will go in but not come out and no deck functions, Model NV430. IC7502 (AN5033) faulty – the 5V reset missing at pin 12. **S.DaC.**

Sharp VC7300/7800

White bleeps were visible on all tapes, increasing in number with weaker prints. We tried just about everything, including the entire head assembly. The cause of the fault lay in the drum motor holder unit – there was leakage in the plastic insulating washers. Replacing the unit put matters right. **S.DaC.**

Ferguson's BSB Receiving System

Ian Bowden

The Ferguson BSB receiving system is available in two forms, the difference between them being that one comes with the famous Squarial while the other one has a small "compact" dish. You pay £20 more for the Squarial version.

The Squarial is manufactured by Matsushita and sports the BSB logo. It's supplied with a wall-mounting bracket and cast aluminium adjustable arm assembly. The Squarial measures 41cm (40cm active area) across flats: when mounted its overall width and height is 54cm. Depth from the front of the slightly convex face to the back of the LNB cover is less than 5cm, but a stand-off distance of around 25cm is required from a wall as the Squarial is inclined like a prime-focus dish, with elevations of between 20° and 16° depending on the site latitude – a guide to elevation is cast into the aluminium support arm.

The dish is of the offset type and measures 37cm wide by 43cm high (active area 35 × 42cm). Overall depth from the LNB to the mounting bracket is 33cm. When mounted the dish is virtually upright: in fact it appears to look slightly downwards.

Both aerials gave similar results.

The SRB1 Receiver

The receiver and its remote control handset are something of a contrast, the former being quite large at 43·6cm wide, 23·5cm deep and 9·2cm high including the aluminium trimmed dummy round feet while the handset is tiny, just 15cm long, 3·8cm wide and 1·6cm deep. This means that the 18 handset buttons are rather small.

The receiver has no mains switch since it needs to receive updated authorisation data which may be sent at any time over the air. When the receiver is switched to standby only the r.f. modulator, the PAL encoder and the RGB output buffers are switched off, everything else remaining always on. There are only four buttons on the unit, a set-up button that produces horizontal and vertical bars for tuning the associated TV set – this button is at the back – and at the front the three "emergency controls". These give programme up, programme down and standby and are situated below the two-digit LED programme displays.

At the rear of the receiver there's a standard coaxial socket for the aerial input and a male and female pair for the r.f. output and u.h.f. input respectively. The frequency of the r.f. output can be adjusted through a small hole in the top face of the top cover, to the right of the BSB logo. An 8-pin DIN socket marked "DATA" is connected to the central control chip via a buffer stage. A phono socket allows for later connection of an external access control unit. Finally there's a scart socket which provides stereo audio, composite video and RGB outputs plus fast blanking and switching voltages. There's no separate Y/C output though there's an option to enable this facility via one of the on-screen menus: I'm told that Ferguson is working on some modifications/additional circuitry to give users this option. So at the moment to see just how good the D-MAC picture is you have to connect the receiver to a TV set with RGB inputs.

On-screen displays are extensively used. For example when a channel change is made or "view" is pressed on the handset the channel name is displayed across the top of the screen while a box near the bottom gives the current programme's name and the time left to run. When the "next" handset button is pressed this lower box displays the name of the next programme and its rating, together with the length of time before it starts. Other operations bring up on-screen menus to display settings and allow changing of the operation modes.

The most important display is the equipment authorisation number – the number that the user must register with BSB so that the receiver can be switched on via the satellite. The very useful parential control setting can be undertaken from the same main menu option. This bars access to any programme above the rating set (U to 18). In addition a second selection can be made to stop viewing of any programme that has either sex, violence or bad language, no matter which rating level is selected. For example one programme I saw had a rating of 15L: 15 is the normal rating and the L indicates bad language. So even if the rating had been set for 18, if bad language exclusion had been selected the programme would be blanked out, an on-screen message indicating that the performance was under parental control and couldn't be viewed (or heard) without entering the control number.

The contrast and colour level of all the vision outputs can be altered together by digital means on the D-MAC PCB. This would affect the input to a VCR of course, whether it's fed with composite video or r.f. If the record-lock mode is used however not only are all the receiver and handset buttons (except the view button which is needed to deselect the lock mode) locked out but the contrast and colour levels are reset to the mid-positions until this mode is released.

A couple of connected options should be interesting when they come into use in the future. These are the aspect ratio settings (4:3 and 16:9 for widescreen MAC) and the choice of automatic or manual panning for the viewer with a 4:3 aspect ratio TV set so that the 4:3 window can be moved from side to side with 16:9 material, using the handset – in the same manner that this is done when some films are shown on TV without reducing the height.

The aerial installation option displays on the screen the programme (or just noise if the aerial is not aligned) together with a bar and numeric display to indicate signal strength and noise level. It's obviously best to use a signal-strength meter to align the aerial, but for my temporary review installation I used the on-screen method for both the Squarial and the dish. This worked fine – but then so too was the weather!

Another useful menu relates to setting the RGB outputs and the previously mentioned non-functioning Y/C operation. The receiver defaults to the RGB enabled mode, which provides a fast-blanking output at pin 16 of the scart socket. This is used to switch the connected TV set to the RGB mode. If this causes problems you can switch it off by selecting the RGB disabled option or, temporarily, by pressing the standby button once to remove the fast-blanking signal and the 12V supply at pin 8 of the socket. This also occurs when you select the record-lock mode. To go back to the RGB mode you can select another channel or press the handset's view button. I used this facility to toggle between RGB and composite video so that I could compare the results obtained. It could be of use for demonstrating the superior picture quality with D-MAC.

Performance

In use the first thing I noticed was that the quality is very dependent on the programme. For example Hill Street Blues came on just as I completed the Squarial alignment. There was noticeable grain and a fairly strong vertical line pattern that was more prominent in the RGB mode – I've noticed a similar effect with US material terrestrially transmitted. When viewed in the composite video mode or at r.f. the display was similar to an ordinary transmission – no better. A change of channel brought up a studio shot on the Sports Channel. This was quite different. Very good in both the composite video and r.f. modes and even better in the RGB mode. The most noticeable improvement with this mode is the loss of the moving-rope pattering in coloured areas, particularly where two strong colours meet. A clear example is with computer-generated captions, where the border between characters and the background is no longer noisy but very sharp. A good way to demonstrate this is to display one of the test patterns and toggle, as previously suggested, between composite video and RGB by pressing standby once to select composite video and then view to go back to RGB. There's a tremendous difference in the resolution bars across the lower area and the rope pattern between adjacent colours disappears. One thing that's noticeable when you do this comparison is a slight picture shift to the left when RGB is selected, but with a normal transmission this should be no problem. The cause of this shift is presumably the delay in the PAL encoder circuitry.

The sound quality is excellent, as you'd expect with a digital transmission. There's no background noise and no complication of having mono and stereo sound carriers, as with Astra. This makes it much simpler for the user, and we've noticed that there are fewer calls from customers reporting poor sound because they've selected the wrong sound carrier or detuned it.

Internal Construction

Dismantling the receiver is very straightforward. Once you've removed the three screws along the underside of the rear rim it's just a matter of lifting the top half of the cover upwards at the rear and then backwards to detach it from the front. This reveals the separate mains input fuse panel and the mains transformer, which is connected to the main PCB via a six-way lead and plug/socket. The main panel (PC1450) is secured to the lower case section by five screws. With these removed the complete receiver PCB assembly can be taken out as a single block.

The main PCB is double-sided, with most of the discrete components mounted on the lower side. The input and output connectors are along the rear of the board while the vertical display/IR receiver and the emergency control button PCB are connected at the front. The D-MAC decoder PCB, which is supported by the seven separate plug-and-socket connectors that link it to the main panel, is towards the front beneath the

rectangular screening can. The access control module is towards the rear left. It's hidden inside a square screening can which is supported by four plastic stand-off posts and the 22-way gold-plated plug-and-socket strip. The tuner can, which contains the i.f. preamplifier circuitry on its underside and the "tuner heartpiece" on its upper side, is at the right rear corner. The 68-pin central control chip IR01 is to the left of the D-MAC decoder can, with the associated ROM at its rear.

Overall Impressions

I feel that it's a good system that works well but is perhaps spoilt by the external appearance of the tuner. The relatively small Squarial and dish should be more acceptable environmentally than the larger Astra system: they've been welcomed here by installers because of their ease of assembly and mounting.

Despite the delayed start of the BSB services equipment is at present still in very short supply, with in our case systems pre-booked well before they arrive. In this area public interest seems to be on a par with the launch of the Astra services – with these there was an initial burst of interest that then died back. We've found that Astra customers here seem to fall into two groups, the well-off who tend to buy the latest thing out and those towards the other end of the earnings league living in council houses. It would perhaps be unwise to draw any conclusion from the few BSB sales we've had to date, but it does seem that BSB is attracting customers from the middle ground.

We'll be taking a closer look at the chips and circuitry used in this receiver in a later article.

Servicing the Panasonic U4 Chassis

Nick Beer

The Panasonic U4 chassis was a successor to the U3 which we covered in the October 1989 issue of *Television.* It was used in a wide variety of models with screen sizes from 16 to 26in. Model numbers include the TC1631, TC1641, TX1632, TX1642, TC2031, TC2033, TC2043, TX2034, TC2232, TC2233, TX2200, TX2230, TX2231, TX2234, TX2244, TX2636, TX2646, TX3300 and TX-C21. The TC1631 and TC1641 were the first 16in. Panasonic sets to use a large-screen chassis while the TX1632 and TX1642 were the company's first teletext portables. The TC2232 was a teletext adaptable set, a very rare thing from Panasonic. The TC2031 was a specially priced "Anniversary" set. With the TX2230/1 you got "stereo" sound, the earlier TX2230 providing 10W per channel audio output. The TX-C21 took Panasonic into monitor styling and had a host of input and output sockets for audio and video, also a plate glass anit-glare filter – the latter was a feature of the TX2244 and TX2646 as well. The TX3300 was a 22in. budget teletext set that originally sold for £399. Its price was subsequently increased slightly. The choice of model number was unfortunate – Panasonic now produce 33in. sets! Every model in the range had remote control.

The main chassis, i.e. the power supplies, timebases and signals circuits, has proved to be extremely reliable, as one has come to expect from Panasonic. There were however problems with the microcomputer tuning and control system used with teletext models, which employ frequency-synthesis tuning. We'll deal with this first.

Tuning and Control Problems

The M board houses the tuning and control arrangements and there are different versions. The one used in teletext models employs a parallel data system and this proved to be its downfall. Symptoms can be varied but basically the problem is that the memory can be lost. Thus the preset sound and picture levels can revert to zero as can the stored channel frequencies. So the user might switch on to find that there is no sound, no picture and a very weak raster. With early cases engineers and the brighter customers assumed that it was a one-off occurrence or that someone had been fiddling, and resetting invariably restored normal operation. The set might then run for another year without a recurrence. More and more cases occurred and then some couldn't be reset. Thus out came the first of several modification kits from Panasonic.

The first couple of kits provided varying degrees of success, but some sets started to give continual problems. The fault pattern extended to being stuck on standby to starting up on channel 99 which doesn't exist. Many hours could be spent checking and replacing components without success because it was a design problem. Eventually a modification kit was produced to update the microcomputer circuit to the one used in the subsequent U5 chassis, with a serial data line.

Fitting this kit involves removing three chips and a number of associated components, replacing the chips with two others – the microcomputer and memory chips used in the U5 chassis. This of course calls for some wire links and a bit of what you might call bodging, but it does end the problems.

Instructions come with each kit, so I won't bore you with the details here. As a guide to what's involved, the MAB8440P/D032 microcomputer chip IC1203 is changed to type MAB8441P/T063, IC1202 is removed completely and the memory chip IC1201 is changed to type PCD8572. Since the PCD8572 has eight pins it uses only half the holes in the IC1201 position: wire links are required to link the 5V, clock and data lines to it. Three transistors, two capacitors, a coil and two diodes have to be removed. Two capacitors and a resistor have to be added on the back of the board. To avoid making the job look like a bodge, take care to cut the links required to the correct length and cut the component leads short, sleaving them and inserting beneath them a cushion of double-sided foam. It's very easy for shorts to occur where these components are fitted, so take care.

Teletext/frequency-synthesis tuning models have an SAB3035 CITAC chip (IC171) on board B (the signals panel). Faults here can give the impression that the microcomputer chip is defective. Checks on this chip and its associated crystal X171 (type TSS120M2) will usually reveal the cause of such faults as: very slow to scan the tuning; no signal when a channel number is dialled straight in using the CS feature; intermittent noise on the picture (splashing etc.); and drifting off tune – usually comes back on tune when the channel is reselected.

Thus in the event of problems with this side of the set the approach should be to establish whether you have a microcomputer/memory fault, then if necessary modify the circuit by using the kit – part no. XFMK606001. When fitting the modification kit to "stereo" Models TX2230/1 you must also replace L1208 with a shorting link. This is extra to the details provided with the kit. Failure to take this step can lead to intermittent faults such as the standby and either channel balance LED coming on when the set is switched on from cold. But don't rush into fitting the kit: check out the circuit first, otherwise you might make your problems ten times worse!

Power Supply System

Probably the most common of the small number of faults that afflict these sets is "no go". The symptom usually includes a high-pitched whine from the power supply.

Fig. 1 shows the main chopper power supply circuit – there's also a mains transformer fed low-voltage power supply circuit on panel M. The chopper transistor Q803 is used in a self-oscillating circuit – in fact a classic blocking oscillator arrangement. Forward bias is applied to the base of Q803 via R803. When it begins to conduct, positive feedback via a secondary winding on the chopper tranformer T801, C809 and R812 rapidly drives it into saturation. Since there is no further change in the current flowing through T801 the field collapses and Q803 is cut off. At this point C809 will have been charged by Q803's base current. R812 and Q802 provide a discharge path, and when the voltage at the base of

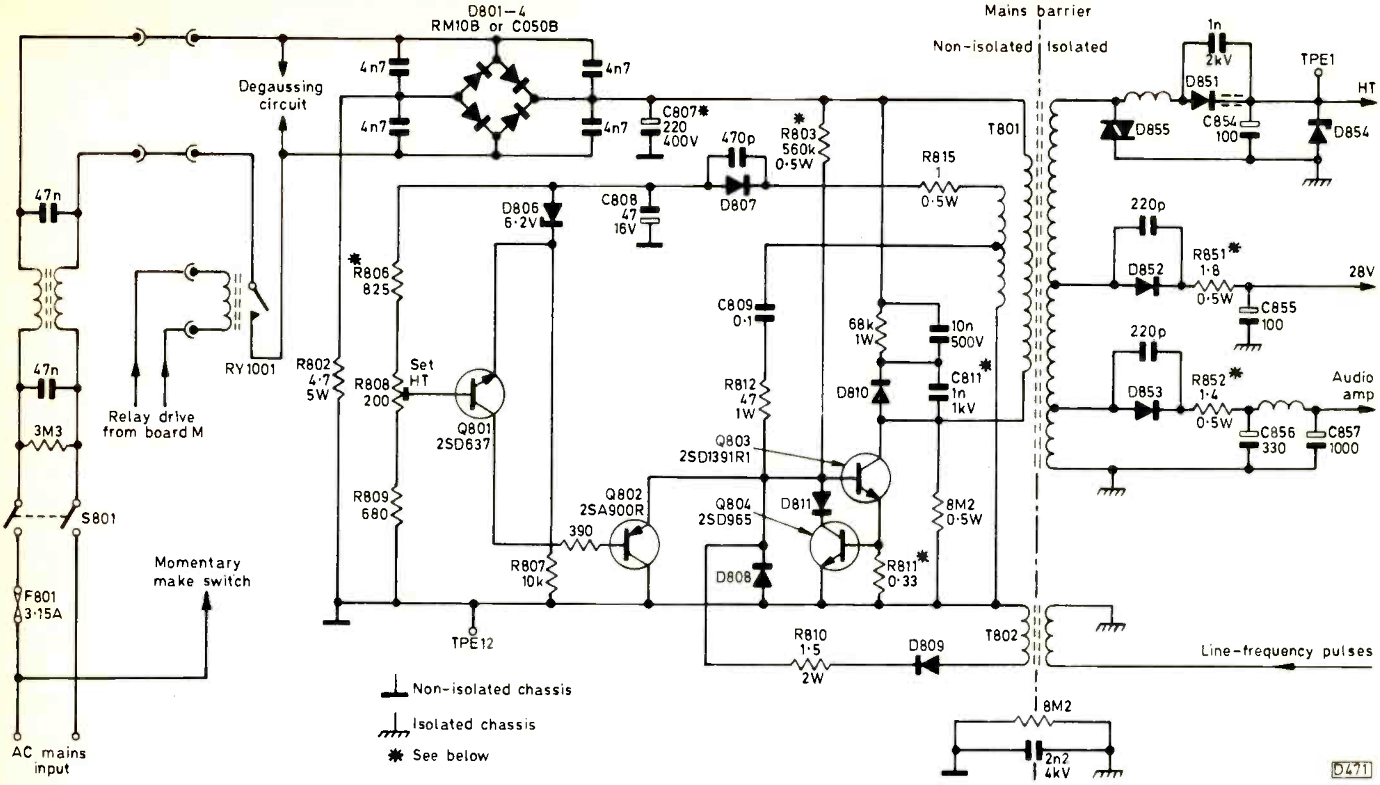


Fig. 1: The switch-mode power supply circuit used in the Panasonic U4 chassis. Depending on tube size there are various component value differences. For example R803 may be 560kΩ or 330kΩ, R806 825Ω or 680Ω, R810 1·5Ω or 6·8Ω, R811 0·33Ω or 1Ω with R817 (1Ω) in parallel, R851 1·8Ω or 3·9Ω, R852 1·4Ω or 0·82Ω, C807 220μF or 100μF, C811 1nF or 680pF. Check with the manual for the model concerned.

Q803 is once more sufficiently positive the cycle will be repeated. Pulses derived from the line output transformer are fed to the base of Q803 via T802, D809 and R810.

Regulation is effected by controlling the conduction of Q802 – and thus the discharge of C809. Q802 is controlled by Q801, which senses at its emitter (across R807) any changes in the voltage developed by D807 across C808. This voltage depends on the loading on the chopper transformer and the mains input. The circuit thus compensates for varying load/mains input conditions. Q804 provides a degree of circuit protection by conducting and thus shorting Q803's base in the event of excess current flowing via R811.

D855 and D854 provide protection on the secondary side of the circuit. T801 and T802 provide mains isolation.

A dead set with a whine coming from the power supply indicates an overload on the secondary side of the circuit. The first thing to do is to check the 2SD1439RL line output transistor Q551 for shorts or dry-joints, which are becoming fairly regular occurrences. Other items we've known fail are the h.t. rectifier D851 and the protective devices D854 and D855 – if the latter is responsible you'll usually find a pinhole burnt into its case.

If the set shuts down intermittently the probable cause is the 11V zener diode D501. This is linked to the protection circuit within the AN5435 sync/timebase generator chip IC501, at pin 5. The U3 chassis suffers from a similar problem.

A dead set with the fault on the primary side of the chopper circuit is a less common occurrence. Suspects here are the surge limiter resistor R802 and the bias resistor R803, both of which tend to go open-circuit, and a short-circuit in one or other of the transistors. A faulty transistor can cause intermittent power supply failure.

Faulty h.t. regulation is usually caused by failure of R806 or R809 in the h.t. control potential divider network. Check the values and replace as necessary – note that these are close-tolerance components.

The h.t. preset R808 should be set for 119V at TPE1 with a 16in. set, 121V with a 20in. set, 132V with a 22in. set and 158V with a 26in. set. When measuring voltages in the primary (non-isolated) section of the chopper circuit, use the non-isolated chassis test point TPE12.

Fault-finding Guide

As mentioned at the outset, in general these sets are very reliable. Luckily they don't suffer from varying sound, which was a problem with the U2 and U3 chassis. They do however, though to a lesser extent, suffer from the purple electrolytic syndrome.

Note that there are one or two important differences between the 90° (16 and 20in. tubes) and 110° (22 and 26in. tubes) versions of the chassis. Smaller-screen sets use an AN5521 field output chip (IC451) while larger-screen sets have a discrete component field output stage. There's an EW modulator circuit in 110° sets, and there are several important component value differences between the two versions in the power supply and line output stage.

The following is a list of the faults we've had other than those already mentioned.

(1) The tweeter used in some sets can go open-circuit, and when this happens the recommendation is to replace the AN7170 audio output chip IC251. This fault seems to occur only with non-text sets and you very often notice the absence of treble when repairing another fault, the user failing to complain about it. Waste of time really!

(2) Varying brightness. This is usually due to 180V rail

variations as C555 (10μF, 250V) is faulty.

(3) One side of the screen brighter than the other side. Check C356 (1μF, 250V) on the c.r.t. base panel.

(4) Raster present but no sound or vision. Fault due to absence of the 12V rail. Check whether R555 (1·5Ω, 0·5W) is open-circuit and D555 (EU2 or B4406) is possibly short-circuit.

(5) No picture as c.r.t. heaters out. R557 (2·7Ω, 2W) open-circuit. The value of R557 differs in some models and R564 may be fitted in parallel with it.

(6) No sound and vision, with the raster and channel display present, Model TX2230 only. R2420 open-circuit. Fit improved type, part no. ERQ12HJR82. I think I've had to do this with every one of these sets we've sold.

(7) Intermittent sound muting, Model TX2230 only. Modify the mute circuit as follows to prevent misoperation. Add a 470μF, 16V electrolytic in parallel with C2566, fit a shorting link in place of R2660 and remove any resistors strapped across R2633 on the print side of the panel (usually 3·9kΩ or 39kΩ). Adjust R2639 for a line-rate sawtooth at TPH1 with no signal, then connect and disconnect the signal several times to ensure that this waveform doesn't drift – readjust R2639 if it does.

(8) There's a tendency with TX2230/1 sets for the scan coils to slip back along the neck of the tube. The result can be anything from purity errors to a reduced and distorted raster. Relocate the yoke by twisting and locking it on the moulded glass tabs at the back of the c.r.t.

(9) Sides of picture bow in intermittently. This occurs with 110° sets. Check for dry-joints around the EW modulator driver transistor Q753 (2SD1265). If the fault is permanent Q753 is open-circuit.

(10) Overbright raster with flyback lines, teletext sets. Check whether R559 (1·2Ω fusible) is open-circuit due to IC5002 (5V regulator on the teletext panel) being short-circuit input-to-chassis. Alternatively you occasionally find that there's a dry-joint at pin 1 of the line output transformer.

(11) Set comes on in standby permanently or intermittently when the set's mains switch is used. The cause is carbonised contacts on relay RY1001. The contacts can be cleaned but it's better to replace the relay.

(12) Set stuck on standby. Line output transistor Q551 (2SD1439RL) short-circuit or IC501 (AN5435) giving a permanently high output at pin 5.

(13) The cause of random channel change, volume alteration etc. has on a number of these sets been found to be noise generated in the IR amplifier. Provided the fault is not especially intermittent you can easily prove this by disconnecting the IR amplifier from board M (disconnect plug M1). In earlier production the amplifier's gain was too high for some situations, particularly when there is strong sunlight in the room. This could usually be cured by adding a piece of infra-red filter material behind the filter at the front of the set. Nowadays the cause is much more likely to be noise generated in IC1101 (TDA3048B) or the sensor diode D1101 (PH302), or C1108 (10μF, 16V) being faulty. Some people might be tempted to change the panel, but it's no longer available from Panasonic.

(14) These sets are fitted with the same A56-540X series tubes as the U3 chassis. They don't, to date, seem to be failing to the same extent, though we've scrapped a couple of 20in. sets because of low emission and have had two cases of complaints about intermittent purity errors due to a faulty shadowmask.

Teletext

The teletext side has been pretty reliable. We've had one or two cases where the clock drifted. Replacing the crystal X5001 or adjusting trimmer C5008 put this right. Intermittent loss of one colour has been traced to dry-joints around the RGB amplifiers and interconnecting plugs/sockets.

Remote Control Handsets

Panasonic is well known for using standardised remote control units. The U4 series is no exception. Apart from the adaptable TC2232, non-text sets were supplied with a six-button black-box handset which now has the part number TNQ1419. This provides switching on and off to/from standby, sequential channel stepping fore and back, volume up/down and sound mute. The handsets are not particularly good looking but they are very reliable. Replacements used to cost only about £7 trade, so repair was seldom economic, especially with rental sets. Since the price has more than doubled repair is now more of a practical proposition. The two most common troubles are the battery cover and the rubber contact mat (part number TMM17573). The mat can be responsible for intermittent operation with certain functions.

Teletext sets use the TNQ1411-2 handset, which also has controls for Panasonic VCRs. You use a slide switch at the top right-hand corner to control either the TV set or the VCR. I only wish I'd a pound for every customer who complained about a dead handset after moving the switch to VCR. Faults are not common with these units. Panasonic supply only the battery cover (part number TEG37559-4) or the complete unit, at over £22 trade. If the unit is dead the likely causes are the crystal (type CSB420 – its legs rot off) or the MN6030B chip.

A point that applies to all Panasonic and many other remote control handsets, including Sony ones, is that Duracell type batteries can cause intermittent operation because their rounded terminals don't make good contact with the small surface area of the handset's contacts. I recommend the use of Panasonic or Ever Ready batteries.

As with some of the earlier U3 models the handsets usually slot into the front of the receiver. You encounter the same problem – they get stuck. The solution is to remove the screw in the bottom of the case, which clips together. Crayon on the handset's side runners will make it stick. Clean these while you are about it.

In Conclusion

To sum up, there are two areas where you are likely to get a fault, in the power supply or the microcomputer controlled tuning. In this article we've covered common faults and one or two nasties. Despite all this they are very reliable sets, though not as reliable as contemporary 14in. Panasonic sets such as the TC430G. The U4 was superseded by the U5, which brought with it innovations such as FS tubes and CCT. We'll be dealing with it in due course – don't go away!

CD-I Conference

George Cole

An international conference on the interactive compact disc (CD-I) format was co-hosted by Philips, Sony, Matsushita and Polygram in London on June 18-19th. Some 500 delegates from Europe, Japan and America attended the conference, which was designed to show publishing, hardware, software and media companies the commercial potential of CD-I.

In an earlier article (April 1990) I explained the technical background to CD-I. The CD-I disc looks like a conventional audio compact disc but holds a mix of sound, video, text, data and graphics, all of which can be interleaved and controlled by the user – hence "interactive". There are five video levels from full-screen, full-motion video to cartoon animation, and five audio levels ranging from CD PCM quality to a.m. quality. CD-I is seen as both a commercial and a domestic product. The players are designed to plug into existing TV sets and hi-fi systems and can play ordinary audio compact discs.

Philips' president-elect Jan Trimmer started the proceedings by outlining the success of audio CD. Over 74 million players have been sold worldwide since the system was launched in 1983 and sales of home, in-car and personal players are expected to reach 33 million this year. Jan Trimmer felt that CD-I would build on the success of the audio CD: it would be aimed at the professional, consumer and educational markets. Potential professional applications include travel, transport, financial services, government and retail. The French automobile manufacturer Renault is already using the system for training mechanics. For this application the disc contains information about engine and transmission systems. How long before TV and video service engineers get to use the discs?! Possible consumer applications include children's programmes, sports, how-to titles and electronic reference books.

Hardware

Several prototype CD-I players, along with Philips' three-module professional system, were shown at the CD-I arcade. The Philips system consists of the CDI180 player module, the CDI181 multi-media controller (MMC) and the CDI182 expansion module. The CDI180 is the CD-I drive which accepts the disc and reads it, under the control of the MMC. It feeds digital signals to the MMC.

Current CD-I discs are housed in a protective caddy. This is fed into the CDI180 which removes the caddy internally, the user pulling out the empty caddy. Re-inserting the caddy will extract the disc. Commercial discs won't have a caddy. They'll come in standard CD jewel boxes. The CDI180 has connections for digital output, control and clock signals. Its dimensions are 360 × 75 × 362mm (width, height and depth), the weight being 5·5kg.

The heart of the Philips system is the CDI181 MMC which controls operations and carries out signal processing. It has ports for digital, control and clock signals with r.f., composite video and RGB outputs. There's also a standard RS232 interface to allow the CDI181 to be linked to a keyboard or printer. Users control the CDI181 by means of a computer mouse or an infra-red remote handset. There's an interesting slot for a personal memory card that could be used to store additional data or as a device to restrict viewing. The CDI181 has the same dimensions as the CDI180, its weight being slightly greater at 6kg.

The CDI182, again with the same dimensions and weighing 8·5kg, allows users to connect floppy discs, hard discs, modems, midi systems etc. to the CD-I system.

Philips' domestic CD-I players will contain both the drive and the MMC and will be controlled by an infra-red handset.

Matsushita showed a prototype CD-I player that looked like an overgrown VCR but it was Sony that caused a stir with three personal CD-I players. The most interesting of these was the size of a conventional portable CD player and included a 4in. LCD screen, TV and radio tuners and a slot for a digital i.c. card.

Nimbus records showed a jukebox system that had been developed with Rediffusion. It provides over nine hours of background music and is intended to be used in restaurants, pubs and clubs, offering much longer playing times than current tape or disc systems – Nimbus has coined the marketing phrase "music that doesn't repeat on you before your food does" . . . The company also showed a talking book for the blind. It gives over 19 hours of sound.

Software

Philips' US subsidiary American Interactive Media (AIM) has joined forces with several large American publishers, such as Time Life and Groliers, to produce a number of CD-I titles. One of these is a golf disc that allows the user to play at a number of famous golf courses. One scene shows a golfer standing over the ball: users can alter his stance, select the type of club and control the strength of the shot. You are then shown the results of your shot. A photography disc lets you take pictures without using film. You can for example compose a shot by altering the camera's aperture, the shooting distance and the type of lens. Your finished photograph is displayed and critically analysed.

When?

CD-I is already available for professional applications. The first domestic players and discs are due to be launched in Japan and America next year. European versions are expected to arrive in 1992. Philips says that the discs will sell for $15 to $50. In the UK players are expected to sell for £500 to £700.

Companies that support the CD-I system are devising promotional plans. One of these includes the marketing of "CD-I ready" discs – normal music CD discs that contain additional "hidden" information such as pictures, lyrics or information on the artists. A sticker tells the consumer that use of a CD-I deck will enable the extra information to be seen. Philips has coined the slogan "Television with a mind of its own – yours".

Will CD-I be a success? It certainly has a lot going for it. It's a world standard that's backed by major hardware and software companies, it's easy to use and adds features to existing home TV and hi-fi systems. One delegate suggested that CD-I would face tough competition from the VCR, CD player and computer markets but others were very enthusiastic. For what it's worth my own hunch is that the system will be a big success, though its initial growth probably won't be as explosive as that of the original CD format.

TX9 SECAM Modification

Richard Edeson, G4FBA

I've been interested in everything French since first going on holiday there about nine years ago. We stayed at a camp site near Nice, about four hundred yards from the Mediterranean. It's a lovely place that I would recommend to anyone. I found it particularly interesting to look at the French TV sets being displayed in the shops. There's something about listening to foreign radio and watching foreign TV that intrigues me. It's like being there I suppose. In those days radio was the only French service you could receive in West Yorkshire. Before getting on the bus to return home I left my tranny tuned to Radio Monte Carlo on 218kHz. It was still there when we got back, though a bit weak – I found out later that the long-wave transmission is broadcast from farther inland, at Roumoules, to give coverage over a large part of France.

SECAM Programme Sources

Nowadays if you've a satellite dish and an LNB for the 12GHz band you can receive four of the French terrestrial channels, Antenne-2, M6, La Cinq and Canal Plus, also a cable children's channel, Canal J. In addition two Telecom satellites are used by France to distribute various video links and data/telephony as well as the full-time TV programmes. These satellites also have a 4GHz output to serve the Caribbean and other overseas French Departments. Telecom 1A is at 8° west of true south and 1C, which now carries the main services, is at 5° west of true south. With the exception of Canal J all the programmes are transmitted with SECAM colour. Canal J has PAL colour and is scrambled most of the time. Canal Plus has the same system and is also mostly scrambled but there are clear periods three times a day. The first is at 8 a.m. French time when a recording of the previous evening's CBS news is shown with French subtitles.

SECAM on a PAL Set

When you try to watch SECAM with a PAL receiver all you get is black-and-white pictures. I spent some time playing around with a second-hand module from a dual-standard TV set – I'd bought it for a fiver in order to try to make a transcoder – but I couldn't get it to work as a stand-alone module. Then my sister's TV set, which is fitted with the Ferguson TX9 chassis, went wrong – the problem was no colour. Although a few years old now these are nice little sets. It's one of the later versions of the TX9, with a TDA3560 PAL decoder chip. Eventually I found that the U/V balance potentiometer RV67 was open-circuit.

Dual-standard Decoder

While I was looking at the Mullard technical handbook on integrated circuits, Book 4 Part 2, bipolar chips for video equipment, in order to find out how the TDA3560 works I came across another chip, the TDA3591. This is a SECAM processor that's designed to work with the TDA3560 to form a PAL/SECAM decoder. It took a little while for the full possibilities to dawn on me, then I remembered seeing in a Sendz Components advertisement in *Television* reference to a "C.Cam Decoder with TDA3591." So I sent off for one. While waiting for it I studied the TX9 circuit and the Mullard application note on the two-chip decoder. The board eventually arrived, with no circuit diagram, but by

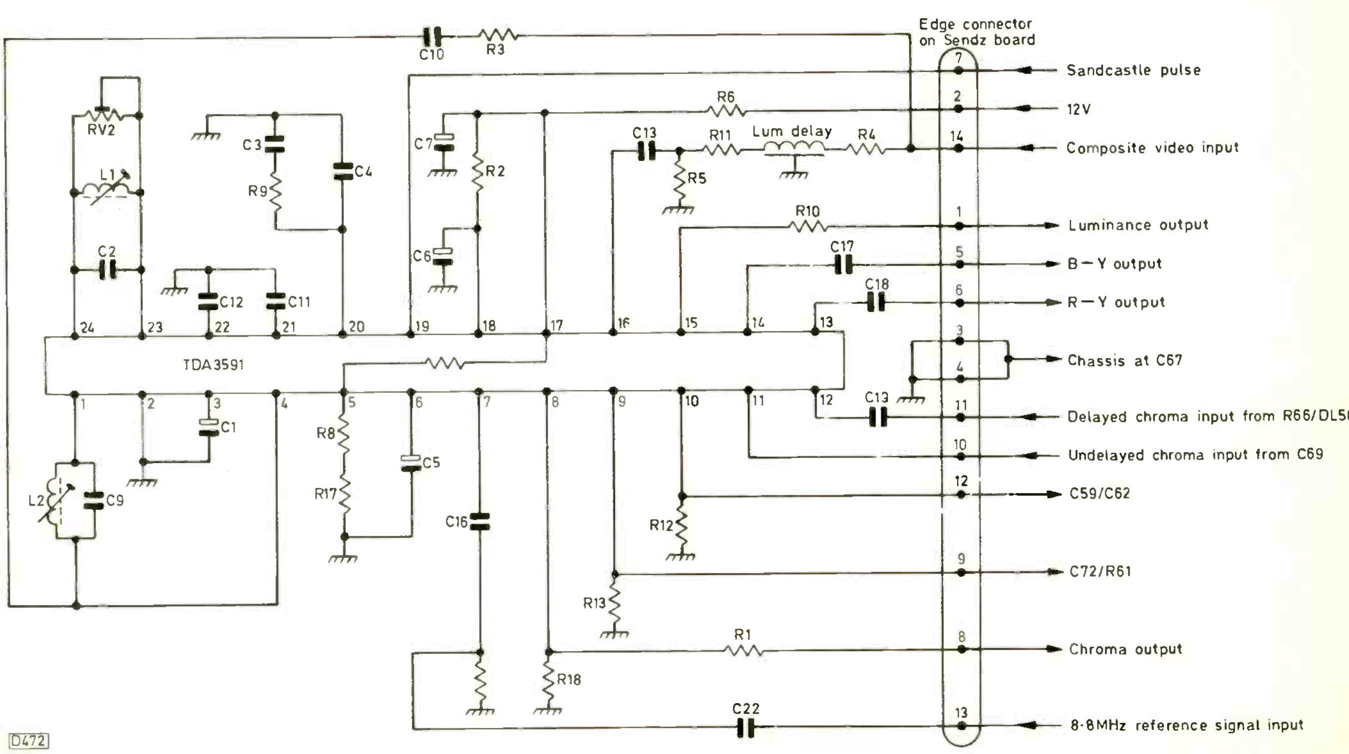


Fig. 1: Approximate circuit of the Sendz SECAM board.

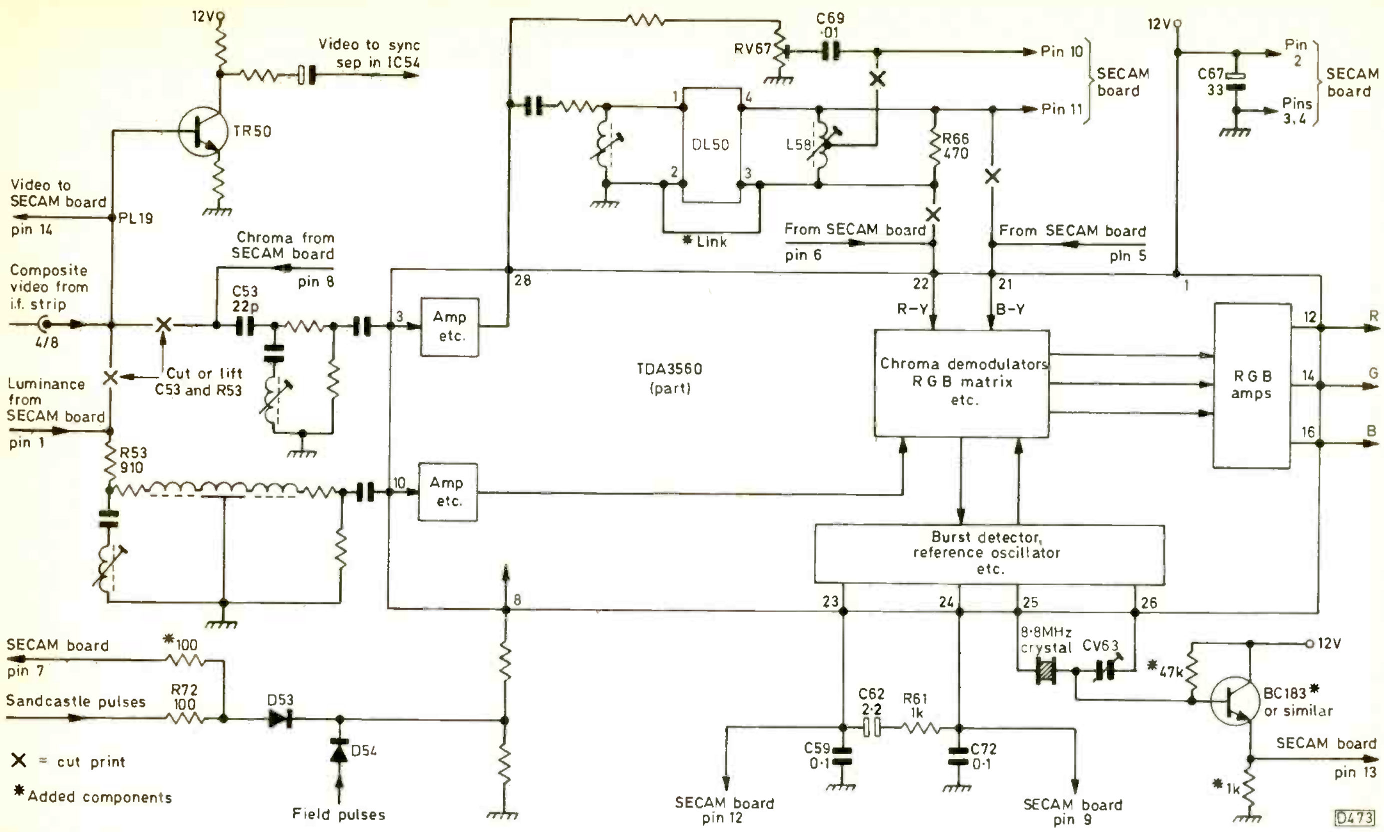


Fig. 2: Connections between the Sendz SECAM board and the TDA3560 PAL decoder circuitry in the Ferguson TX9 chassis.

this time I was sure that it would work. As the component count is not high it was not difficult to draw out the circuit. When I'd done this I found that it was virtually the same as the circuit in the application note.

Obtaining a TX9

Now we didn't have a TX9 in our house, so I looked through the ex-rental TV advertisements in *Television* and in due course found a dusty but working set with a good tube at a nearby supplier in Leeds. If you follow this course you'll have to ask if you can take the back off to check that the decoder chip is a TDA3560 – early versions of the chassis used a μPC1365, which won't work with the TDA3591. The firm at Copley Hill was very helpful in this respect.

Modification Details

Before you start to work on the TX9 note that the chassis is live, at approximately half mains potential. Don't hang your earthed soldering iron on the chassis, or a scope probe earth. If possible use an isolating transformer with a rating of at least 500VA while the back is removed. Next comes the tricky bit, cutting the print on the TX9 panel and finding enough different bits of coloured wire – thirteen to be exact.

There's a fourteen-pin plug on the SECAM decoder module – see Fig. 1. The pin connections are as follows:

(1) Luminance output from the TDA3591 to the TDA3560 – the composite video input goes to the TDA3591 first, where PAL/SECAM identification is carried out. Fig. 2 shows the TDA3560 circuitry involved in the TX9 chassis and the points at which to make connections to the SECAM decoder module. Connect pin 1 of the SECAM decoder module to the input side of R53, i.e. at the TR50 end. I found it easiest to unsolder this end of R53 and connect it directly to pin 1. This breaks the existing luminance input path to the TDA3560.

(2) 12V supply. Connect to the positive end of C67 in the TX9.

(3) and (4) These are chassis connections. Make the connection at the negative end of C67.

(5) B − Y output. Connect to pin 21 of the TDA3560. Cut the print to isolate pin 21 from the TX9's chroma delay line.

(6) R − Y output. Connect to pin 22 of the TDA3560. Cut the print from pin 22 to the chroma delay line.

(7) Sandcastle pulse input. Connect via a 100Ω resistor to the junction of R72 and D53 in the TX9.

(8) Chroma output to the TDA3560. Lift the leg of C53 at the TR50 end and make the connection direct to this leg of C53.

(9) Connect to the junction of C72 and R61 in the TX9. This link and the one to pin (12) give phase relationship information about the oscillators in the two chips.

(10) Undelayed chroma input to the TDA3591. Cut the TX9 PCB track to the centre tap of L58 and make the connection to this end of C69.

(11) Delayed chroma input to the TDA3591. Connect to the junction of R66/L58/DL50 pin 4 in the TX9 and cut the track to pin 21 of the TDA3560 – see (5) above.

(12) Connect to the junction of C59/C62/pin 23 of the TDA3560.

(13) 8·8MHz reference signal input to the TDA3591. Connect to the junction of the 8·8MHz crystal and CV63 in the TX9.

(14) Video input from the TX9. Connect to PL19 in the TX9.

Join pins 2 and 3 of the chroma delay line in the TX9 and that's it. Well almost. It depends on the lead lengths between the two boards. I had a problem with the 8·8MHz reference oscillator pulling. This was cured by adding a single transistor emitter-follower as a buffer between the crystal oscillator in the TX9 and the TDA3591, as shown in Fig. 2.

Setting Up

L1 on the Sendz board adjusts the SECAM reference oscillator frequency to approximately 4·33MHz. I found that this adjustment is very critical. When it's off frequency the picture has a red/sepia or blue cast. The best way to adjust it is to wait for a black-and-white film and tweak for minimum chroma. L2 is the bell-shaped SECAM filter and should not require adjustment. It affects the chroma noise. Note that the numbering of coils L1 and L2 differs in the Mullard book and on the Sendz board. SECAM noise appears as long streaks from the edge of saturated colours. I had to adjust RV67 on the TX9 board to remove slight Hanover bars on SECAM. PAL operation was not affected. Switching between systems is automatic and occurs instantaneously. In practice there's a slight saturation change between systems. If you require a source of SECAM colour bars tune to Telecom 1A at 8°W: there are normally some available.

VCR Operation with SECAM

It's possible to record SECAM on most domestic VCRs – we have a JVC HR7650. With VHS machines a bandpass system is used to separate the chroma and luminance signals, the chroma being downconverted to approximately 628kHz. The two SECAM chroma f.m. carriers (4·40625MHz for the V signal component and 4·25MHz for the U component) fall within the filter's bandwidth. SECAM broadcasts now have a line-rate colour identification signal like the PAL burst, also a field-rate identification for compatibility with older receivers. I suspect that this fools the VCR into thinking it's receiving a PAL colour signal. The results obtained are quite acceptable, though there are noticeable streaks on saturated colours. As most films have a low average chroma level this is a problem only with games show type programmes and digitally generated effects. In my opinion the resulting pictures are far more enjoyable than monochrome ones. I've tried playback and made dubs on Panasonic machines and found that these give similar results. I've not tried Beta recordings. The Beta system uses a different processing system for chroma crosstalk cancellation, but I suspect that it will still give colour pictures.

SECAM Colour Identification

The circuit used with the Sendz board is set up for vertical chroma identification – the voltage at pin 5 of the TDA3591 determines the identification system it uses. If the broadcasters do away with the vertical identification to make room for text it should be simply a matter of altering resistor and capacitor values to change over to horizontal identification.

Satellite TV Reception

The modification described in this article is designed to work with the signals obtained from a satellite TV tuner which provides a 6MHz intercarrier sound signal. It's not appropriate for terrestrial reception because the French system L uses a.m. sound spaced at 6·5MHz from the vision carrier to which positive-going modulation is applied. Those in the south of England living close enough to France to receive signals direct will need to invert the video polarity and build an a.m. sound demodulator – a short-wave receiver tuned to 6·5MHz might work.

The signals from the Telecom 1A and 1C satellites are very strong here in the north of England (Knottingly, West Yorkshire). Reception is good with a 90cm dish. I use a 1·2cm dish and an LNB with a noise figure of 2dB. This system provides a good picture on all channels except when there's heavy rain. The LNB is mounted to the side of the 11GHz one. I use two coaxial cables for the link to the house, with a TV switch to select the LNB in use. A cheap line amplifier from Micro-X, costing about five pounds, makes up for the losses in the plugs, switch and long cable runs.

It's now possible to buy a 1·4dB, 12GHz LNB for less than a hundred pounds, so it should be possible to obtain good pictures with a 65cm Astra dish. At their office here in Leeds Micro-X shows pictures from Eutelsat F4 using a 65cm dish and a 1·4dB LNB. On the strongest transponder, SAT-1, the pictures are almost noise free.

A bonus with Telecom is the large number of radio stations on separate carriers – too many to give an accurate list. I think the most entertaining one is Radio FM (RFM).

Other PAL Chips

I subsequently found that the TDA3561 and TDA3562 PAL decoder chips will also work with the TDA3591 as a PAL/SECAM decoder. Our Ferguson TX100 uses a TDA3562 which has feedback from the tube to maintain the black balance as the tube ages. It looks as though this chassis would be even easier to modify as the PCB has removable links to facilitate fitting a SECAM daughter board, but I've not worked out the pin relationship with the Sendz board. It should be possible to modify other sets that use these chips.

Triple Trouble

Les Lawry-Johns

I got up and stood to get dressed, as I've always done though some of you don't believe it. You see it's always best to do things the hard way, then when things get really hard it doesn't seem too bad.

The Grundig that went Bang

When I'd done the cleaning etc. I went out to pick up a TV set. After a bit of an effort I found the place. The old girl told me that her son had replaced the fuse in the set but that it had blown again straight away. It was a Grundig CV720KT/C7400GB, which I'd not come across before, so I carted it downstairs, bunged it in the car and told the owner I'd bring it back within the hour. This seemed to surprise her somewhat.

Back at the shop I took off the rear cover and looked at the chassis. It was a rather small, horizontal one with a few plugs and sockets. There was just one screw to the right of centre, the rest of the panel being held by clips. Having freed this lot and disconnected the plugs etc. I removed the panel and examined it closely. My meter showed a dead short, well almost, across the mains input. It was nothing to do with the degaussing. The meter led me to a bridge rectifier which when removed proved to be the offender.

I looked high and low for a suitable replacement but couldn't find one. So I popped along to Geoff's in Sun Lane and got one from him. As it was larger and the leadouts were different I had to insulate them and turn them over to fit into the right holes. After making sure that I'd fitted it properly I replaced the panel and plugs etc., switched on and plugged in the aerial. There was a good picture and sound. I put the back on and loaded the set into the car, which is easier said than done as it's a small one nowadays. The old girl was delighted when I carted it upstairs and fitted it where she wanted it to live. She paid up happily and in no time I was back home with the dogs and H.B.

"What have you been doing?" she asked.

"Well I've already seen to an old girl," I replied, "and left her very happy I might add."

"Really, after all these years?"

"Just a question of a bridge" I replied, wondering what she would think of next.

Fuzzy Picture then Smoke

For some reason this made me think of another lady I'd visited recently. She'd given her address as number 68 on a certain road and asked me to collect the keys from number 74. When I got there I was surprised to find number 74 next to number 68 and wondered what had happened when the houses had been built. Anyway the lady from number 74 let me into number 68 where I found an ITT CVC5 on the table. Apparently the picture had gone fuzzy then smoke had come from the set. So it was another case of taking the set to the car and the problem of getting it in. I told the lady I'd be back shortly and sped off to the shop. Getting the set in and on to the bench left me breathless, but with the back removed and the cover taken off the right-hand side line output transformer assembly I could see what had happened.

The line output transformer tag that's connected to the PL509's top cap is also connected to the tripler. The latter lead's insulation had broken down and was shorting to the focus assembly, hence the fuzziness complained about initially. Under the bench I found a stout lead which, after pulling out the three wires, proved to be an adequate cover for the faulty lead in the set. When I'd fitted the cover I arranged the lead clear of the focus assembly and resoldered it to the line output transformer. I then checked that there were no shorts across the h.t. line etc. As everything appeared to be in order I switched on. After the warm-up period a good picture appeared. I left the set on test for a while then returned it to the owner who was now back at number 68. She was happy to pay me my charges after seeing the picture and listening to my puffed voice.

Transport

If you wonder why I get puffed getting sets into and out of the car it's because of the layout. There are just the two front doors, and if a set is put on the passenger's seat it gets in the way of the gear change etc. So I have to move one of the seats forwards and plump the set in the back. H.B. sold the estate car to one of her relatives you see and got this miniature vehicle from another relative, thinking that I wouldn't be doing any more repairs. I keep my mouth shut and put up with it though I'm not happy with the situation despite the reduced petrol consumption.

Back at the Ranch

Having been in the navy you'd think that I would have a preference for rum. Well I did, for a time. After a spell on beer I got on to whisky, which is where the small amount I make on repairs tends to go, me drinking it neat and H.B. taking it in coffee – black with one spoonful of sugar – which I would have thought would water it down. Anyway, I decided to try it like this one night and ended up more sloshed than I did with the neat whisky. Strange that. Maybe it's something to do with my brain: I've not been able to think straight since I reached sixty five.

You might think that the reason this piece is called Triple Trouble is something to do with triplers. It really relates to the dogs however. They haunt me all day (and night). All Alsatians, Tess who's the oldest and largest, Zebardi and Gunga – he's the youngest and causes more trouble than the other two put together. The cat still won't come in. She lives outside, sleeping not in the house H.B. made for her but in a car that's been bunged in the space next to the bungalow. Then there's the bird that still has the grudge against whoever puts his finger in her cage. Possibly something to do with having keen kept in an army camp and jossled by the squaddies.

Liquorish Paper

I'll just stop a minute to roll myself a cigarette with liquorice paper. Hard way to have a smoke but I told you that I always take the hard way. Another thing is that hand-rolled fags go out quickly when left. So they don't cause fires like those packet ones. I should get a discount on my insurance but I don't. That's enough for now. Cheers to you all.

CD Player Casebook

Reports from Mike Leach, Philip Blundell, AMIEIE, Joe Cieszynski, Nick Beer, Ronald Aranha and Keith H.C. Parker

Pioneer PD4100

This machine would read the TOC all right but wouldn't play. When play was selected the sled moved the laser assembly to the approximate section of the track that had been selected. Then after several seconds the machine returned to the stop mode. There are various causes of this problem, as engineers will know, e.g. a poor laser, a misadjusted PLL, poor tracking etc. In this case I cleaned the laser lens and checked the grating adjustment which was found to be at the optimum point. So I ruled out the laser for the time being. I next checked the tracking drive waveform at pin 1 of the TA8410K tracking drive chip IC17. It was very low while the chip itself was very hot. Replacing the chip restored normal operation. **M.L.**

Pioneer PDX99M

This machine wouldn't play at all. The disc rotated but very little else happened. Fitting a new PWY006 laser got the machine working but for one problem – it wouldn't play track one of any disc. Subsequent tracks played all right, but not track one. I went through the set-up procedure a second time and found that the PLL adjustment was slightly out. Setting this up cured the problem. I can only assume that the PLL's pull-in range is critical when the disc is rotating fast, i.e. track one. There was only very slight misadjustment. **M.L.**

Hinari DSK14

Distorted left-hand channel sound was the complaint with this machine. Its decoder section incorporates an LC7860N postage-stamp 80-pin chip. Some of these multipin decoder chips have a built-in digital filter while some don't. With this chip the filter is internal. I've found that the digital filter is more prone to being faulty than the digital-to-analogue converter. Some engineers may disagree with this and say that the chances are fifty-fifty, but I've found that most DAC chips are reasonably reliable. A can of freezer worked wonders here, confirming that the LC7860N chip was the cause of the trouble. Replacement put matters right – and no broken print! **M.L.**

Marantz CD54

The disc rotated but the machine would no nothing else – there was no play and no TOC reading. Slight pressure on the servo board restored normal operation and I could see that there were dry-joints on the tracking drive transistors Q243/4. I mention this straightforward fault because the joints were so bad that it could become a common problem with these machines now that they've seen several years' use. Maybe one to watch out for. **M.L.**

Philips CD160

The right-hand channel sound was distorted. In this case I suspected the DAC chip as it was running rather warm. A replacement didn't provide a cure however. I knew it wouldn't. I'd had a bad fortnight – a JVC camcorder out of sync, three Philips rack sliders, a microwave oven that couldn't tell the time and our tea machine ran out of water. A bad scene.

Anyway I went farther back in the circuit and tried slapping in a new SAA7220P digital filter chip. Same results! D.C. checks were then carried out around this chip but everything appeared to be in order. I then found that when heat was applied to C2331 (0·22μF) the fault cleared for a minute or two. I took one off a scrap panel and carefully fitted it – it's a surface-mounted component. This cured the fault. C2331 is part of the current divider network in the right-hand channel section of the DAC circuit. It may have been just a dry-joint, but I changed the capacitor as a precaution. **M.L.**

Pye TR8829

Early versions of this model had a disc hold-down cover made of a hard material. If dirt gets sandwiched between the disc and the hold-down the result can be damage on the disc's label side, causing track jumping. A soft, self-adhesive cover is available, part no. 4822 529 10258. With later machines this cover was fitted during production. **P.B.**

Pye CST428/35

We've had several cases where the machine intermittently stops playing and won't restart unless the disc is ejected and the TOC is read again. Check for dry-joints on X102. It's by the SAA7210 chip. **P.B.**

Grundig Party Centre PC3100

Beware of faults in the servos damaging the d.c.-d.c. converter. The problem with this player was that the disc wouldn't spin at all. There was the usual dim red glow in the lens, indicating that the laser was lit, but a laser power meter check showed that its output was very low. There was a break next to the laser power control. Attending to this cured the problem of failure to start up, but the disc took off at great speed as soon as the tray was closed. Attention was therefore turned to the focus and tracking servos. It was then that smoke signals started to emerge from the d.c.-d.c. converter.

To cut a long story short, when the disc motor runs at full speed TR4 in the d.c.-d.c. converter cannot sustain the current for any length of time and begins to burn up. A BD132 in this position lasted a little longer, but in the end I had to resort to replacing the +9V rail with an external power supply while carrying out the repair. Normal operation was obtained when the tracking offset had been reset. **J.C.**

Sony Discman D20

This machine came in with the complaints that the disc wouldn't spin and there was track jumping. On opening up the player we found that the laser assembly wasn't in its home position (centre). So we moved the sled mechanism manually to the centre. While doing this we found that there were broken teeth in one of the sled mechanism drive gears. You can't order this gear separately: it comes along with the sled motor/chassis assembly. When the new assembly arrived we mounted the spindle motor and optical block on it. The disc then started to spin, the TOC was read out but the skipping fault persisted. So we checked the laser emission by measuring the voltage across R511 (10Ω). The reading was 0·8V, suggesting a laser current of 80mA. A label stuck on the laser unit indicated that the current should have been 49mA. After fitting a new KSS-162A laser unit and carrying out the necessary adjustments the machine worked perfectly. **R.A.**

Sony CDP-205ESD

Even though the player was usually able to read the TOC there was severe skipping. We connected the scope to test point TP(RF) to check the eye pattern which was just 0·35V peak-to-peak. According to the manual it should have been 1·2V ± 0·2V p-p. We suspected the KSS-150A laser assembly and after fitting a replacement and doing the E-F balance adjustment the player worked perfectly. A check on the r.f. waveform showed that the eye pattern was 1·1V p-p. **R.A.**

Sony CDP-S37

This new machine wouldn't read the TOC. On inspection we found that there was a problem with the focus search – the lens assenbly didn't come upwards sufficiently. When we compared the search voltage swing across the focus coil with the swing in a correctly working player it was very poor. As the search voltage is generated by IC3 we replaced this chip, but the symptoms remained the same. Checks around IC3 then revealed that C215 (3·3μF, 50V) had been inserted with reversed polarity. Taking it out and putting it back the right way round restored normal operation. **R.A.**

Sony CDP-S37

This machine was under guarantee. There was a "cur-cur" sound from both channels. All other functions, such as display, track jumps and search, worked perfectly. We thought that the RAM might be at fault, then suspected the digital filter chip, but the fault was still present after replacing them. We then brought out the scope to check the address and data in/out lines from the RAM chips, using another machine as a guide. Not much difference could be seen. The CXD1125 digital signal processor/CLV servo chip IC7 was then suspected, though with only 50 per cent expectation that we were right. One was ordered and fitted and after that the sound came up. **R.A.**

Sony Discman D55T

The complaint was that this player didn't work – the LCD didn't come on. We found that there was a 9V input to the d.c.-d.c. converter but there were no ±5V outputs. Pin 30 of the CXP-5024H-003Q system control chip IC801 is the power on/off control output to the d.c.-d.c. converter. It was permanently high. We checked IC801's supply and found that it was 9V instead of 5V. The cause was that the 2SA412 transistor Q412 had gone short-circuit. Replacing it restored the 5V supply to IC801 but there were still no results. We had to replace IC801 – presumably the 9V had killed it. **R.A.**

Yamaha CDX810/910

If the reported fault is a "loud crunching sound over the signal" the usual cause is excessive voltage on the +5A power line. Changing zener diode D31 to a tighter-tolerance type so that the +5A regulator's output is less than 5V usually provides a cure, but Yamaha now advise that in addition to changing the zener diode L14 is changed from 60μH to 40μH (part no. VB817900). These players also suffer from a switch-on thump caused by movement of the screening material over the mains transformer. This can be cured by inserting a spacer to trap the screen between the transformer and the case. **K.H.C.P**

Panasonic RX-DS30

This ghetto-blaster incorporates a CD player. The complaint was that the disc would speed up after about track eight or nine, but only if it had been played from the start. What the customer meant of course was that the machine skipped, giving the impression of playing too fast.

With a portable CD mechanism stability is obviously crucial. With this fault it would therefore be logical to direct attention to the mechanical components. Experience has shown me that there's a common problem with portable units. It can occur with non-portable machines, but is less common with them. The problem is poor playability at the outer tracks because of the greater tangential and tracking error possible due to the warping factor of the disc. In this case, as in many others, the cause of the trouble was misalignment of the optical unit's tangential or mechanical adjustment. I suspect that after an initial period of use the suspension components bed-in and the tangent shifts slightly – the fault usually occurs within the guarantee period. **N.B.**

Technics SLP770

This elaborate machine was accused of skipping but didn't unless it was asked to play the error discs. A check was carried out on the setting up. This revealed a reluctant tracking servo due to a faulty laser unit. Replacement and realignment put matters right. **N.B.**

Pioneer PD6050

The customer had had a few problems with this machine from new. Apparently it had been repaired on two or three occasions previously because of skipping and sticking, but as the problem was intermittent it hadn't been rectified. A check on the r.f. waveform showed that it was poor and that the alignment was all slightly off. Resetting this produced little improvement however. The famous PWY1003 laser unit was at fault, a replacement providing a terrific improvement. I was still not happy however as its traverse seemed to be erratic. This is common when a d.c. brush motor is worn. A new motor finally gave us excellent performance. **N.B.**

Pioneer PDM500

This six-disc multiplayer was accused of skipping. Even the customer admitted that it didn't happen very often. Combined with the fact that it lived on a farm I thought that maybe dirty discs would have something to do with it. On test it played our badly scratched Fleetwood Mac and Belinda Carlisle discs faultlessly. The faithful check with the Technics "spotty" disc revealed very poor performance however. The tracking servo couldn't be set up to perform satisfactorily because the PWY1008 laser unit was faulty. **N.B.**

Test Report: Muter CRT Tester-Reactivator

Eugene Trundle

When you have a set with a suspect picture tube it's essential to be sure of your diagnosis. Despite appearances, the cause of many symptoms that suggest a defective tube can lie outside the tube – this works both ways of course. The problem is that these days a set is very often a write-off when its tube fails. That's why you have to be sure. For test purposes the ideal is an instrument that incorporates as many check functions as possible, with a simultaneous readout for all three guns so that direct comparisons can be made.

Tube Reactivation

After many years' use a tube's emission deteriorates, leading to low brightness, a poor grey scale, defocusing, excessive warm-up time or various combinations of these symptoms. The tube may not be worn out however. What can happen is that the emissive surfaces become choked. When this occurs the use of a regenerator ("jacker") often provides a new lease of life.

A tube's active cathode surface is made of a mixture of barium, strontium and calcium. These are all low melting-point alkaline metals that emit electrons prolifically when heated to almost their melting point. In use the metal cathode "pill" gradually becomes polluted with oxygen and carbon. This blocks the pores of the emissive surface and increases the cathode's electrical resistance. As a result, efficiency and emission deteriorate.

The reactivation process is relatively simple. First, the heater is overrun to the point where the soft emissive cathode substances melt, separating the metal, oxygen and carbon atoms. Once separated, the next process is to remove the intruders. This is done by drawing a heavy current via the control grid. The impurities are thus drawn out and, with the BMR90, they are then driven by an alternating anode current into the tube's bowl where they are absorbed by the getter system. During this process the heater current is cut off so that the cathode melt progressively solidifies into its original crystalline form, with a rough and open pore structure on the surface, ready again for full emission.

Features of the BMR90

The Muter BMR90 is a German–made instrument that provides a sophisticated rejuvenation process and also facilities for repairing various internal faults to which picture tubes are subject. It requires an a.c. mains supply and comes with tube base sockets for the seven most common arrangements, covering about 700 types of tube. There are another 130-odd adaptors for use with rarer types of tube. They are all listed in a booklet that covers over 8,000 different types of tube. The main intended use is with the monochrome and colour tubes in domestic TV sets, but other tubes such as radar, oscilloscope, camera, projection and flying-spot scanning tubes can also be dealt with.

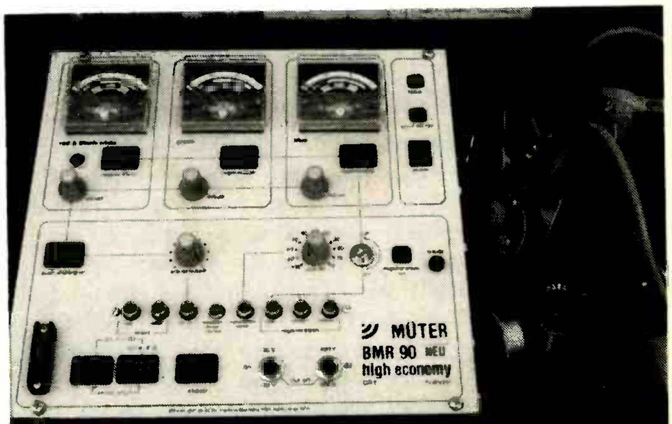
The characteristics and parameters of each of the three guns in a colour tube are displayed simultaneously on separate, large meters. Functions are selected by means of push-buttons. They are short-circuit measuring and repair, emission testing, beam current measurement, focus check, life expectancy test, characteristic curve plotting and rejuvenation. To prevent unauthorised use the on-off switch is controlled by means of a key. Dimensions are 420mm width, 320mm depth and 120mm height, and weight 75kg. The unit is housed in a suitcase-style case made of tough black plastic.

On Test

My appraisal of this machine consisted of going through all its functions with two widely different types of tube, then working my way through a selection of old and new sets, repairing, jacking and assessing tubes as necessary. This has given me a good idea of the BMR90's capabilities.

The instruction book is comprehensive and easy to follow, being written in that courteous and formal style that's characteristic of many translations. Operation is helped by the logical layout of the controls – I soon found that I knew the routine by heart. No adjustment is required for heater voltage – it's set automatically by the base adaptor in use. The other unusual feature of this machine is the requirement for a connection to the tube's final anode, at the bowl of the tube. A flower and flylead are supplied for this purpose, the need for this connection ensuring that the high voltage stored in the tube's glass capacitance is discharged. A similar but older instrument that lives in our workshop, of a different make, has twice been blown up by idiots hooking it to a charged tube.

Leakage or shorts between any two electrodes are indicated on the appropriate meter. At length I found two tubes with internal leakage. The first had intermittent grid-cathode problems in the green gun. It was repaired using the BMR90's spark-zapping process, in which a capacitor is discharged through the leakage path (this usually consists of a tiny flake of cathode material). The second case was an old 12in. monochrome tube with heater-cathode leakage, probably due to "brewer's droop" in the filament. This was also cured, though the fault reappeared later. In some tubes the BMR90's



The Muter BMR90 c.r.t. tester-reactivator which is available from Blendown Ltd., 34 Glan-y-Mor Road, Penrhyn Bay, Llandudno, Gwynedd in the UK and from Donberg Electronics, Schoolmasters House, Rannafast, Co. Donegal in Ireland.

rejuvenation process actually introduced cathode-grid or heater-cathode leakage, but in all cases this was removed by further jacking or one of the blow-clear processes.

There are three stages in the reactivation process: clean/resinter, restore I and restore II. Each is progressively stronger. The idea is that with each gun being treated you go as far as required in accordance with the emission test results provided by the machine. In practice you can tell how the process is going by watching the action of the meters during the rejuvenation process. Generally speaking, the older the tube the higher the order of treatment required.

When reactivating tubes this instrument's special characteristics are two. First the use of an a.c. anode voltage to assist in getting the cathode impurities away from the cathode and into the getter. And secondly the automatic monitoring that enables the cathode "blasting" current to be tailored to suit the many sizes, shapes and conditions of emitter encountered.

By testing many tubes I found that the BMR90 is effective in most cases, with four to six year old tubes being the most amenable to the process and showing the most spectacular improvement, both on the meter and afterwards with the picture display. With youngish tubes the clean/sinter mode enabled the grey scale to be balanced. Setting I or II in most cases restored the brightness and sparkle with older tubes. Very old tubes – some had seen fifteen or more winters – seldom came up appreciably at any setting or with any amount of jacking: plainly these were well and truly worn out, and no amount of cleaning, tickling or boiling can bring such a tube back to life.

At the two ends of the success scale, a sixteen year old Mullard 20in. delta-gun tube used in an ITT set fitted with the CVC8 chassis came up like new, while a 26in. Hitachi tube doggedly refused to cheer up in its red section, running steadily at 600μA or so beam current compared to the 1mA or so flowing in the other guns. In no case did the machine wreck a tube, as some cruder machines can – though I suppose it may be possible to kill a cathode if the restore II process is applied for long enough.

The life test is interesting. At the prescribed setting it reduces the tube drive, the drop in emission current providing the prognosis. I couldn't prove the findings of course but have no reason to doubt them from the condition and age of the tubes I used it to quiz.

There's a final and unique feature of this machine. Unfortunately I don't fully understand it and had no suitable tube to test it on. It's for use with tubes that suffer from flashover. The process, Muter Flash-Ex (patent pending), links gas molecules and free particles to the internal metal parts of the tube. In this mode the machine itself isn't used – the base adaptor is plugged into a jig that earths the cold gun assemblies. After a half-hour run with the set working, generating e.h.t. but with this disconnected as far as the base is concerned, the treatment is complete and the tube is cured of flashovers. It's a pity that I was unable to test and prove this intriguing process, but flash-prone tubes can't be produced to order.

Construction

On inspecting the interior of the machine I was a little surprised to find that it was almost entirely electrical rather than electronic! The sole active device is a BU208 transistor. There are also sixteen diodes, five electrolytic capacitors, two meaty transformers and three pygmy bulbs, plus five potentiometers and lots of switches mounted on a fibreglass board. It's well made and will no doubt last, but in comparison with a colour TV set, a VCR or a satellite receiver there's not a lot in there for the money! Even though the economies of mass production don't apply much with this sort of equipment, at £446 plus VAT it's not exactly cheap.

Conclusions

I believe that this machine is equal to or better than anything at present available for the purpose, and that if a tube can be repaired or restored at all this instrument will do it. It's rather over-priced, but I suppose that you buy it for what it does rather than what it is. If it goes into a large, busy workshop, or one that's involved with refurbishing second-hand and ex-rental TV sets, it should pay for itself in the fullness of time. For a smaller outfit the present tight economic situation makes purchase of the instrument a more doubtful proposition. For economic reasons if I already had a three-meter tube tester/reactivator which worked well I wouldn't update to this one, better though it probably is.

The build quality is good, though I reserve judgement on the longevity of the plastic-web cabinet lid hinge. Otherwise I see no reason by, if looked after, the machine shouldn't last for many years. Whether it's a good buy and a potential profit generator depends entirely on the size and throughput of your workshop, the type of equipment you service, and whether you already have an adequate (though not comparable) means of checking and rejuvenating tubes.

ECONOMIC DEVICES PO BOX 15, WOLVERHAMPTON, WV2 4AZ

Part	Price
15/80H	2.72
15/85R	3.28
17052	4.58
17053	5.61
17074	9.30
17089	3.45
17127	2.50
17376	1.58
1N4001	0.04
1N4002	0.06
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	0.10
1N5408	0.15
1N914	0.04
1S1555	0.18
1S44	0.10
1S921	0.10
2N2219A	0.37
2N3053	0.35
2N3054	0.99
2N3055	0.66
2N3442	1.16
2N3702	0.14
2N3703	0.18
2N3705	0.15
2N3706	0.14
2N3707	0.16
2N3711	0.11
2N3771	1.56
2N3772	1.55
2N3773	1.61
2N3819	0.40
2N3823	1.17
2N3904	0.50
2N3908	0.62
2N4101	1.33
2N4240	2.68
2N4444	1.66
2N5293	0.50
2N5294	0.50
2N5296	0.50
2N5297	0.50
2N5298	0.61
2N6109	1.58
2N6130	0.85
2N6133	1.25
2N6180	0.73
2N6292	1.60
2SA1006	1.50
2SA1011	1.65
2SA1015	0.20
2SA1012	0.80
2SA1020Y	0.99
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
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2SA493	2.25
2SA562	0.57
2SA564	0.97
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
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2SB511	2.65
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2SC1096	1.16
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2SC1195	6.09
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2SC1383	1.20
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2SC1398	0.41
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2SC174L	1.25
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2SC2028	2.11
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2SC2233	1.20
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2SC2278	1.14
2SC2314	0.87
2SC2335+Kit	7.00
2SC2551	1.26
2SC2565	4.10
2SC2570	1.85
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2SC2671	0.91
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2SC3153	6.50
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2SC495	0.92
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2SC537	0.54
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2SD1453	1.33
2SD152K	2.64
2SD198	3.87
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AD145	1.60
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AN115	3.98
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AY106	2.80
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BAX16	0.08
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BC113	0.14
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BC182	0.09
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BC204	0.35
BC207	0.19
BC212B	0.26
BC213L	0.10
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BC225	0.40
BC237	0.10
BC238	0.10
BC238B	0.10
BC239B	0.25
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BC294	0.50
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BC337	0.09
BC338	0.12
BC368	0.19
BC440	0.69
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BC454	0.36
BC460	0.42
BC461	0.47
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BC463	0.30
BC478	0.32
BC479	0.41
BC532	0.28
BC546	0.08
BC547	0.10
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BC637	0.24
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BD116	0.70
BD124	1.31
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BD879	0.74
BD895	2.18
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BF173	0.34
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BF200	0.37
BF218	0.36
BF224	0.17
BF237	0.65
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BF241	0.17
BF245	0.50
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BF246A	2.52
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BF256	0.15
BF257	0.34
BF258	0.33
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BF262	0.57
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BF271	0.34
BF273	0.20
BF274	0.20
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BF337	0.31
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BF371	0.50
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BF423	0.33
BF450	0.35
BF451	0.29
BF457	0.41
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BF459	0.26
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BF469	0.33
BF470	0.26
BF471	0.25
BF472	0.33
BF479	0.61
BF480	0.89
BF491	0.50
BF506	0.43
BF532	0.24
BF596	0.18
BF597	0.27
BF694	0.22
BF757	0.59
BF759	0.47
BF761	1.05
BF762	0.34
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BFR39	0.44
BFR61	0.92
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BFR86	1.08
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BFX29	0.34
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BFX88	0.34
BFX89	0.44
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BFY51	0.33
BFY52	0.27
BFY79	0.49
BFY90	0.89
BLY49	2.20
BR100	0.23
BR101	0.78
BR103	0.87
BR303	1.15
BRC84	2.08
BRX44	0.60
BRX49	0.46
BRY39	0.65
BSS38	0.70
BSTB0140G	4.93
BSTC0246	5.99
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BSTD1043	2.85
BSV57B	3.91
BSW68	0.60
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BT108	1.45
BT119	1.76
BT120	2.17
BT121	2.48
BT123	1.98
BT151-800R	0.85
BTT6018	2.42
BU106	2.48
BU108	1.50
BU109	2.25
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BU125	2.48
BU126	1.10
BU137	6.53
BU205	1.15
BU206	1.27
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BU208	1.12
BU208/02	2.36
BU208A	1.12
BU208D	1.43
BU209	1.75
BU226	2.55
BU326A	0.99
BU406	1.24
BU406D	1.24
BU407	0.54
BU412	5.29
BU426A	1.67
BU500	1.53
BU508A	1.50
BU536	1.55
BU608	1.65
BU705	2.50
BU806	0.98
BU807	1.40
BU826A	1.95
BUW84	0.66
BUX84	0.50
BUX85	0.69
BY126	0.13
BY127	0.13
BY133	0.10
BY164	0.44
BY176	0.93
BY179	1.42
BY182	1.05
BY187	0.77
BY189	1.76
BY198	1.62
BY207	0.22
BY208	1.15
BY210-400	0.18
BY210-600	0.31
BY210-800	0.19
BY223	1.25
BY224-600	2.60
BY226	0.15
BY227	0.20
BY228	0.60
BY229-1000	1.12
BY229-600	1.20
BY255	0.13
BY295-600	1.23
BY298	0.20
BY299	0.60
BY407	0.90
BY409	1.49
BY448	1.40
BY713	1.12
BYW56	0.29
BYX55-600	0.23
BYX71-600	0.85
BYX71-350	0.88
BYY56	1.48
BZY93C30	1.86
C106D	0.37
C106M	0.76
CA3046	1.55
CA3089	0.83
CA3090AQ	3.25
CA3094	1.72
CA3131EM	2.95
CD4001	0.24
CD4002	0.27
CD4008	1.35
CD4011	0.20
CD4012	0.24
CD4013	0.33
CD4016	0.25
CD4017	0.30
CD4020	0.75
CD4021	0.39
CD4023	0.28
CD4025	0.64
CD4028	0.84
CD4040B	0.45
CD4047	1.06
CD4049	0.24
CD4052	0.33
CD4066	0.23
CD4069	0.29
CD4070	0.25
CD4081	0.14
CD4093	0.40
CD4511	0.44
CD4528	0.52
CD4556	1.47
CR02AM-8	1.70
CV12E	4.19
CX095D	3.14
CX104	8.77
CX108	12.48
CX109	7.20
CX130	8.76
CX134	4.50
CX136	11.49
CX139	11.83
CX157	5.52
CX158	10.45
CX177	8.00
CX187	5.26
CX755	12.95
CX885A	6.85
E1222	0.40
E5024	0.28
E5386	0.25
GD243	1.95
GF758	0.84
HA11215	1.75
HA11211	2.53
HA11225	4.29
HA11229	3.46
HA11235	1.95
HA11124	5.25
HA1125	4.29
HA1137W	1.38
HA1138	3.75
HA11414	4.20
HA1156	1.16
HA1160	5.79
HA1166X	6.60
HA1167	6.60
HA11706	3.61
HA11705	8.00
HA11703	3.46
HA11701	3.57
HA11710	3.45
HA11713	2.90
HA11711	9.40
HA11715	9.99
HA11714	7.76
HA11716	13.10
HA11725	18.26
HA11725MP	16.00
HA117555P	6.23
HA11781	21.15
HA1180	5.15
HA1196	7.43
HA13001	1.73
HA1306	2.26
HA13402	7.06
HA13342	2.65
HA13365	4.02
HA1366WR	2.88
HA1367	2.75
HA1368R	1.95
HA1368	2.65
HA1370	3.71
HA1374	1.80
AA117	9
HA1377	1.95
HA1389R	2.05
HA1389	2.39
HA1392	2.22
HA1394	2.65
HA1397	2.75
HA1398	2.75
HA1406	2.07
HA1452	0.85
HD14538	2.07
HD38702-A2	7.95
HD38750A53	5.77
HD38750A-7	7.25
HD38800A50	14.09
HD44801A05	14.07
HISH1010	14.60
HISH1004	6.00
HISH1002	9.50
HM6231	12.24
HM6232	7.20
HM6251	5.69
HM7103	4.85
HM9032	4.00
HM9012	3.22
HM9015	3.24
HT4207	13.25
HT4208	20.65
KA2101	1.00
KC581C	7.75
KC582C	4.85
L200CV	1.69
LA1201	0.75
LA1210	1.56
LA1230	1.18
LA1320	2.87
LA1357N	9.00
LA1363	1.05
LA1364	3.02
LA1365J	1.45
LA1385	1.53
LA1387	4.75
LA3350	1.43
LA3361	1.60
LA3390	5.52
LA4032P	2.35
LA4100	1.25
LA4101	1.30
LA4102	0.75
LA4112	1.35
LA4125	2.25
LA4138	4.98
LA4140	0.70
LA4192	1.50
LA4220	1.25
LA4420	1.72
LA4422	1.00
LA4430	2.88
LA4440	2.55
LA4445	1.80
LA4460	1.50
LA4461	1.60
LA5112N	1.18
LA7020	13.86
LA7025	11.97
LA7027	10.92
LA7040	9.20
LA7042	3.90
LA7800	1.30
LA7801	3.21
LB1274	1.90
LC7800	9.20
LD3120	1.13
LD3150	2.75
LM1017N	1.81
LM1877	2.95
LM2808	5.94
LM2877	7.45
LM317CKC	1.08
LM324N	0.98
LM339N	0.43
LM340K	11.85
LM348N	2.15
LM380N	1.50
LM567CN	1.71
LM6402/011	10.23
LM6402A093	10.15
LM748	0.69
LM8360	3.87
LM8361	2.95
LR3419	9.37
LR3471	9.37
LU1141	7.27
LU52012	20.62
LU52011	14.95
LU03112	12.37
M193	6.83
M21C	1.10
M23C	1.98
M293	6.71
M51102L	2.77
M5115P	5.24
M51203L	3.15
M51231P	0.95
M5134-9341	4.13
M51353P	5.25
M51381P	5.98
M51393AP	4.50
M51394P	14.50
M5142P	6.85
M5144P	4.27
M51513L	2.55
M515158L	2.75
M51517L	2.90
M5192	3.13
M5194AP	5.74
M5231L	1.58
M53274P	1.33
M54532P	1.45
M54544L	2.97
M58478P	6.75
M58485P	14.05
MA06	1.07
MA8001	0.82
MA8003	1.16
MB3705	1.98
MB3712	1.85
MB3713	1.69
MB3730	1.75
MC13002	2.99
MC1310P	1.95
MC1327P	1.33
MC1330P	1.98
MC1350P	0.45
MC1351P	1.25
MC1352P	1.40
MC1357P	2.15
MC1358P	1.48
MC14493P	5.50
MC14494P	2.15
MC14497	7.10
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	1.25
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	3.30
MJE3055	1.25
MJE340	0.49
MJE520	0.49
ML231	0.99
ML232B	3.01
ML237B	1.95
ML238	5.65
ML923	3.10
ML926	3.58
MM5314N	8.95
MM5316N	3.50
MM5318N	3.11
MM5369N	2.01
MM5387AA/N	6.20
MM5841N	6.93
MN1400VL	13.65
MN1405	7.92
MN1435VX	8.81
MP1192	5.07
MP2794	4.00
MP2812	5.07
MP8512	1.57
MPC596	2.13
MPF256C	0.60
MPS6570	0.48
MPSA42	0.15
MPSA56	0.08
MPSA92	0.15
MPSU05	0.86
MPSU10	2.31
MPSU56	0.65
MPSU60	1.33
MR818	0.33
MR854	0.50
MR914	1.20
MSM5816RS	17.35
MSM5840H	12.26
MVS460-02	0.34
NE542	2.75
NE555	0.35
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	1.95
OC45	0.18
OC72	0.44
OC75	0.44
DN236	1.06
DN782	1.65
DT121	1.45
PT6042	3.25
PT8504	5.13
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	1.65
R2540X	3.30
R2615	0.67
RCA2060	2.00
RGP01-15	0.70
RGP10	0.23
RGP30M	0.28
RT402	1.58
RT905A	3.28
S1299	5.34
S2800D	1.50
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	2.50
SAA1075	4.25
SAA1121	7.44
SAA1124	2.60
SAA1130	6.69
SAA1174	7.77
SAA1250	3.95
SAA1251	3.20
SAA1351	8.11
SAA3027P	2.71
SAA5000	3.25
SAA5010	3.50
SAA5012	5.50
SAA5020	5.78
SAA5030	6.33
SAA5050	4.90
SAB1009B	5.98
SAB3011	7.34
SAB3013	4.69
SAB3021	3.95
SAB3024	6.36
SAB3209	5.82
SAB3210	3.21
SAF1032P	5.13
SAF1039	1.95
SAS5010	8.39
SAS560S	1.91
SAS560T	5.42
SAS570T	5.42
SAS570S	1.95
SAS580	2.85
SAS6600	1.33
SAS660	1.33
SAS6700	1.33
SAS670	1.33
SAS6710	2.21
SBA750	1.61
SC84203	19.35
SC9504P	1.95
SDA2006	17.10
SDA2112/2	9.20
SG264A	5.26
SG613	10.70
SG629	8.27
SG6533	9.00
SI1125H	7.50
SI1630HD	20.62
SKE2F1/04	1.25
SKF2G3/04	0.73
SKE4F1/06	0.30
SKE4F2/08	1.07
SKE4F2/06	0.80
SKE4F2/10	1.56
SKE4G2/02	0.96
SKE5F3/10	1.36
SKS1/10	2.15
SL1310	3.14
SL1430T	2.31
SL414	3.69
SL432A	3.44
SL439	2.48
SL471	2.13
SL480	7.24
SL490	2.37
SL901B	8.32
SL918A	9.07
SN16861AN0	0.82
SN16862AN	2.98
SN16966N	10.25
SN29717N	7.19
SN29716N	3.66
SN29715N	6.04
SN29722	11.95
SN29723AN	8.77
SN29764AN	2.60
SN29767	3.90
SN29770BN	3.69
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SN29771BN	5.59
SN29791	1.67
SN29798N	5.56
SN2709	0.44
SN7400N	0.61
SN7401N	0.36
SN7402N	0.65
SN7404N	0.52
SN7408N	0.27
SN7410N	0.27
SN74121	1.60
SN7413N	0.37
SN74141N	2.65
SN74151AN	1.51
SN74154N	1.27
SN74190	1.35
SN7420N	0.34
SN7430	0.49
SN7440N	0.27
SN7472	1.54
SN7474N	0.44
SN7490AN	0.75
SN74LS26N	1.45
SN76001N	1.65
SN76013ND	7.45
SN76023N	2.97
SN76023ND	3.91
SN76033N	5.54
SN76110N	0.90
SN76115AN	1.61
SN76131	0.82
SN76227N	2.45
SN76226DN	2.98
SN76228N	3.27
SN76242	5.23
SN76243	5.23
SN76396	2.90
SN76533N	2.47
SN76532N	0.91
SN76545	4.87
SN76546N	3.47
SN76549	2.45
SN76570	3.08
SN76611	2.59
SN76620	2.59
SN76660N	2.48
SN76666N	1.20
SN76708	4.86
SN76709N	9.63
SN76707N	1.23
SN76705N	2.97
SN76730	5.54
SN76810N	0.60
SN76832N	1.35
SN94041	5.54
SN94042	4.35
SPS5384	1.98
ST1702L	0.99
STA401	2.49
STA441C	2.70
STA471C	8.70
STK0029	9.55
STK0050	7.85
STK016	11.23
STK022	8.95
STK031	12.95
STK040	13.34
STK054	9.35
STK058	27.50
STK077	9.28
STK1039	5.75
STK2110	7.33
STK2145	16.95
STK2240	16.65
STK2250	18.95
STK3042	6.08
STK3044	5.75
STK4019	9.29
STK433	6.18
STK4332	4.75
STK435	7.12
STK4352	1.95
STK436	5.95
STK437	6.91
STK4372	13.13
STK460	9.36
STK466	10.10
STK4833	9.52
STK501	6.32
STK502	7.25
STK5314	9.48
STK5730	3.20
STK7216	14.90
STK772	3.71
STR1096	11.20
STR4090	6.43
STR440	6.18
STR451	6.18
STR453	8.16
STR454	5.52
STR6020	6.96
T6029V	7.98
T6035V	0.73
T6036	0.67
T6037	2.11
T6044V	0.97
T6045	1.20
T6049	1.45
T6052V	0.87
T6058	3.08
T6059	4.22
T9003V	1.25
T9005V	2.38
T9011V	1.40
T9013V	4.95
T9014V	2.42
T9016	1.82
T9019W	1.98
T9034V	1.34
T9035V	6.65
T9051	7.70
T9054V	5.98
T9057V	3.44
T9062V	0.49
T9064	4.20
TA7027	4.80
TA7050	1.74
TA7051	1.74
TA7054	2.55
TA7060AP	0.71
TA7061AP	1.27
TA7069	3.13
TA7070P	1.83
TA7072P	2.57
TA7074P	1.98
TA7076P	7.50
TA7089P	3.10
TA7092P	9.94
TA7093P	3.99
TA7102P	5.88
TA7108P	1.61
TA7109	3.71
TA7122B/P	0.87
TA7124P	2.34
TA7129P	1.90
TA7130P	1.27
TA7136AP	1.89
TA7137P	0.98
TA7141AP	3.87
TA7146P	4.85
TA7148P	1.67
TA7149P	3.26
TA7152P	3.16
TA7161P	4.50
TA7162P	3.61
TA7172P	1.41
TA7176P	1.75
TA7193P	4.80
TA7204P	1.95
TA7206P	12.49
TA7207P	1.48
TA7208P	2.15
TA7210P	1.45
TA7214P	3.63
TA7215P	2.58
TA7217AP	1.45
TA7222	1.95
TA7226	3.57
TA7229P	4.66
TA7230P	1.35
TA7233P	3.61
TA7240AP	2.55
TA7245P	1.95
TA7310P	2.15
TA7313AP	0.65
TA7314	3.50
TA7323P	3.15
TA7325P	1.15
TA7339P	1.85
TA7340P	5.95
TA7607AP	1.30
TA7609	2.35
TA7611AP	2.32
TA7616P	5.25
TA7622AP	8.94
TA7628P	1.40
TA7629P	7.50
TA7630P	0.95
TA7640AP	2.40
TA7672P	2.75
TA7676P	2.81
TA7726P	10.25
TAA320A	1.27
TAA350A	6.59
TAA570	1.85
TAA621AX1	4.85
TAA661B	0.95
TAA691	8.58
TAA700	2.37
TAA930	4.36
TAA970	2.83
TAG626-600	1.20
TBA120AS	1.45
TBA120SB	0.40
TBA120T	0.57
TBA120U	2.50
TBA120A	1.05
TBA1440	1.94
TBA1441	1.95
TBA395	1.10
TBA396	1.20
TBA400	2.39
TBA440C	2.34
TBA480Q	1.30
TBA510	1.37
TBA520	1.20
TBA530	1.30
TBA540	1.72
TBA560C	1.40
TBA570Q	1.60
TBA570A	1.71
TBA673	2.60
TBA700	1.85
TBA720	4.32
TBA730	3.55
TBA750Q	2.50
TBA760	1.71
TBA800	1.08
TBA810S	1.61
TBA810T	1.75
TBA820	0.66
TBA820M	0.82
TBA890	3.50
TBA920	1.65
TBA940	1.87
TBA950	1.55
TBA970	3.60
TBA990	1.98
TCA270S	2.15
TCA270SQ	1.05
TCA290A	2.39
TCA420A	2.16
TCA440	2.25
TCA530	2.24
TCA640	2.25
TCA650	3.05
TCA660B	2.60
TCA730	2.75
TCA750	2.25
TCA800Q	5.95
TCA830S	2.38
TCA890	5.44
TCA900	2.04
TCA910	1.65
TCA940	0.82
TCA940E	2.93
TD3F800R	4.78
TD3F900H	5.50
TDA1001B	2.31
TDA1003A	1.47
TDA1005A	2.22
TDA1006A	7.00
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TDA1011	1.14
TDA1010	1.05
TDA1011A	1.51
TDA1028	2.45
TDA1034B	2.42
TDA1035S	2.95
TDA1035T	1.70
TDA1037	1.79
TDA1037D	2.05
TDA1044	2.10
TDA1047	2.25
TDA1059B	0.80
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TDA1082	3.25
TDA1151	0.95
TDA1190	1.27
TDA1190Z	2.48
TDA1200	1.51
TDA1235	3.88
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TDA1270	3.74
TDA1327A	6.93
TDA1412	1.08
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TDA1470	2.90
TDA1470P	4.25
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TDA1510	4.60
TDA1512	2.57
TDA1515	2.55
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TDA1770	2.88
TDA1905	1.27
TDA1908	2.55
TDA1940	3.26
TDA1950	2.50
TDA2005	1.76
TDA2006	1.35
TDA2004	0.99
TDA2002	0.90
TDA2003	1.00
TDA2030	1.05
TDA2140	4.77
TDA2150	4.48
TDA2151	2.47
TDA2160	4.01
TDA2161	5.11
TDA2170	4.75
TDA2270	2.50
TDA2520	2.25
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TDA2524	4.50
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TDA2532	2.50
TDA2530	2.20
TDA2541	1.00
TDA2540	0.99
TDA2545Q	5.94
TDA2560	2.50
TDA2575A	0.50
TDA2578A	2.95
TDA2576A+Kit	12.35
TDA2581	1.60
TDA2582	1.35
TDA2591	2.15
TDA2594	2.45
TDA2593	1.99
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TDA2611AQ	2.80
TDA2612Q	4.68
TDA2611A	1.25
TDA2610	2.79
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TDA2652	8.62
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TDA2670	2.48
TDA2680	3.20
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TDA2791	1.81
TDA2910	13.25
TDA3300B	7.24
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TDA3506	4.40
TDA3501	5.50
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TDA3510	5.95
TDA3520	9.71
TDA3540	2.20
TDA3541	2.22
TDA3560	5.83
TDA3571D	3.63
TDA3576	7.48
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TDA3591	6.45
TDA3650	5.90
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TDA3651AQ	3.95
TDA3651	2.45
TDA3651A	2.50
TDA3950	4.50
TDA4050B	3.40
TDA4280	7.20
TDA4290	1.95
TDA4400	4.90
TDA4420	2.30
TDA4422	8.32
TDA4427S	9.00
TDA4431	2.27
TDA4440	1.95
TDA4442	4.15
TDA4500	4.75
TDA4600-2	1.75
TDA4610	6.84
TDA4620	7.75
TDA5500	14.20
TDA5700	2.75
TDA7270S	2.25
TDA8190	4.30
TDA9403	3.70
TDA9503	2.92
TDA9513	3.15
TDB1033	2.68
TDE1081	7.24
TEA1002	4.93
TEA1009	0.80
TEA1014	3.00
TEA1020SP	4.93
TIC106C	0.61
TIC106M	0.65
TIC44	0.72
TIC45	0.55
TIC47	0.77
TIP120	1.55
TIP110	0.35
TIP112	0.45
TIP117	0.95
TIP121	0.40
TIP126	0.38
TIP132	0.99
TIP137	0.96
TIP29	0.84
TIP2955	0.86
TIP29A	0.46
TIP29B	0.63
TIP29C	0.40
TIP29D	0.75
TIP3055	0.66
TIP30A	0.41
TIP30C	0.40
TIP31A	0.34
TIP31B	0.38
TIP31C	0.30
TIP32A	0.35
TIP32B	0.46
TIP32C	0.28
TIP33	0.82
TIP33A	1.02
TIP33C	0.95
TIP34	0.75
TIP41A	0.36
TIP41B	0.31
TIP41C	0.51
TIP42A	0.29
TIP42B	0.79
TIP42C	0.50
TIP47	0.65
TIS43	1.43
TIS90	0.21
TL011CP	1.65
TL494CN	8.77
TL072CP	1.45
TMP4320	15.00
TMS1024NLL	6.50
TMS1025N	11.95
TMS3720ANS	5.25
TMS3748NS	10.95
TMS3755	9.66
TMS3894NL	19.25
TMS5102NLL	6.25
TUA2000	8.98
TY6010B	2.97
ULN2204	8.50
UPA53C	4.94
UPC1003	5.95
UPC1009C	6.32
UPC1025H	2.90
UPC1028H	2.00
UPC1032H	0.82
UPC1042C	8.95
UPC1156H	3.94
UPC1161C	4.98
UPC1182H	1.38
UPC1186H	1.05
UPC1181H	1.35
UPC1185H	2.10
UPC1188	8.77
UPC1212C	0.80
UPC1225H	2.82
UPC1230	1.88
UPC1238	2.10
UPC1278H	5.95
UPC1351C	1.81
UPC1350C	1.40
UPC1353	1.63
UPC1355C	2.13
UPC1363	4.20
UPC1362	1.80
UPC1365C	2.50
UPC1366	1.65
UPC1360C	2.30
UPC1378H	1.95
UPC141C	4.95
UPC1458	2.00
UPC151C	2.95
UPC2002	1.40
UPC30C	2.51
UPC324C	4.70
UPC32C	4.95
UPC339C	4.35
UPC41C	2.99
UPC4558C	1.24
UPC474	5.11
UPC554C	1.85
UPC575C2	1.55
UPC580C	6.60
UPC587C2	1.34
UPC592H	2.15
UPC595	2.95
UPC596	1.98
UPD1514C	4.76
UPD2819C	4.98
UPD553-164	19.52
UPD8049C-1	11.50
X0022CE	5.75
X0029CE	7.09
X0031CE	6.32
X0035TA	6.18
X0040TA	4.50
X0042CE	4.35
X0043CE	2.75
X0056CE	6.25
X0057GE	6.00
X0065CE	5.77
X0074GE	15.29
X0077GE	14.80
X0079CE	4.95
X0092CE	4.95
X0096CE	6.20
X0109CE	11.25
X0113CE	9.48
X0195CE	9.60
X0204CE	8.74
X0261CE	8.98
ZPY120	3.25

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TV Fault Finding

Reports from Philip Blundell, AMIEIE, Sergio Roncella, Stephen Leatherbarrow, Hugh MacMullen, Joe Cieszynski, Chris Avis, Roger Burchett and A.P. Farnborough

Pioneer SV2101/2501/2801

The U4606B chip in these sets can be responsible for various symptoms as follows: (1) loss of red; (2) green screen; (3) channels 1, 2, 3 and 4 o.k. but teletext is green; (4) vertical rolling, would not lock with adjustment of the potentiometer; (5) wavy ripples from side to side; (6) colour flashing in and out. Replacing it provides a cure, the snag being that it costs about £20 a time trade. **S.R.**

Philips CP90 Chassis

This set was brought into the workshop during a cold spell – back in February. Its owner was in the habit of putting it into standby before switching off at the mains. The result with this chassis is that at power on the set comes on in standby. If the room was cold the set gave a loud humming noise in standby. The hum disappeared when the set was in use.

With the set on the bench, in the standby mode, we found that cooling transistor 7727 and thyristor 6726 increased the h.t. voltage and produced the noise. Replacing 2703, 6726, 3726, 2726, 6727 and 7727 in turn had no effect. The control voltage from the microcomputer chip was o.k. Time for a change of plan! The shop still had a new set in stock, so comparisons were carried out. Cooling had the same effect! Then I noticed a supplement to the manual. This showed that the circuit around T7727 had been altered after serial number PM03 and BA03. Updating the circuit to the later specification cured the problem. Change R3727 from 180 to 120Ω, and 3729 to a BZX79F4V3 zener diode with an 820Ω resistor in series, cathode of the zener diode to T7727. **P.B.**

Philips NC3 Chassis

If you have an i.f. fault with one of these sets – weak and buzzing sound or low gain and a ringing picture – it's a good idea to start by changing the i.f. filters. I've had examples of faulty SAWFs and ceramic filters – one set even had 5·5MHz filters fitted! **P.B.**

Philips 14GR1212 (GR1-AX Chassis)

As a postscript to the store lock problem (see May issue) Philips has now introduced a production change to prevent the set inadvertently going into the store-lock mode when coming out of standby. It's fitted to sets with factory codes starting from SV9001 or PM8928. The changes are too involved to list here – they are available on Tech Tips 216. **P.B.**

Philips 24CE7570 (3A Chassis)

This set was dead – there was just a faint noise from the power supply. With most sets a check on the fuses is a good starting point. But on this chassis they are Wickman types and the copper side of the PCB is obstructed by a plastic frame. So plan B was called for! Resistance checks at the outputs of the rectifier diodes in the power supply showed that there were shorts across D6704 and D6707. They disappeared when the audio module was removed. One of the TDA1514 audio output chips was short-circuit. **P.B.**

Philips KT3/K40 Chassis

Sets fitted with these chassis are prone to line oscillator chip failure after an e.h.t. flashover. There had been arcing in this particular set but a new cap and chip didn't restore oscillation. There was no voltage at pin 16 of the TDA3576B sync/line oscillator chip as C2204 (3·9nF) was short-circuit. **P.B.**

Decca/Tatung 140 Chassis

Intermittent no go turned out to be due to R805 which had risen in value from 390kΩ to about 600kΩ. It supplies pin 5 of the TDA4600 chopper control chip. The voltage at this pin was very low and there was very low drive at the base of the chopper transistor Q801. Watch out for R802 (10kΩ) being dry-jointed. **H.MacM.**

Sony KV2096

This was a panic job – I was called to the house on the eve of a holiday and had no service information and didn't know the set. The firm that supplied it was shut for the duration. When I found out how to slide out the chassis I discovered a classic dry-joint. There are three wire-wound resistors mounted on end next to each other near the fuses, just asking for overheated joints. I resoldered them all and the set worked. Phew! The cabinet is frighteningly unstable when the chassis is slid out but the main thing to watch if you meet one of these beasts is those wire-wounds. **R.B.**

Philips G11 Chassis

This set lives in a caravan and is left during the winter when its owner retreats to London. After some nasty e.h.t. flashovers she now allows the poor old thing to reach a safe, dry state before switching on. This year the set started up but produced no sound or vision. The 12V stabiliser you say? Close! In fact repeated hingeing out of the left-hand panels had broken the pins in sockets 5C1 and 5C2 (LT1 input and inter-panel earth), so the effect was the same. The wiring loom is pulled very tight at some of these sockets and I cannot help but think that many other baffling faults can be caused by this sort of damage. **R.B.**

Toshiba 261T4B

This set had a curious bending of the verticals: the degree of bending varied with picture content and contrast changes. I was about to start checking the power supply rails when I noticed that there was very slight lack of width. Adjusting the width control increased the width, but pincushion distortion began to appear. After checks on the semiconductor devices on the EW board failed to reveal anything amiss I tested the d.c. resistance of the EW coils L361 and L362. L361 is quoted as having a resistance of 3·3Ω and the reading was slightly low. To be on the safe side I ordered them both. Replacing the coils one at a time proved that L361 was at fault, with short-circuit turns. **J.C.**

Philips KT3 Chassis

Maximum uncontrollable brightness was caused by R587, the 160V h.t. feed to the RGB output stages, being high in value. It had risen from 100Ω to 5kΩ. Initial checks at the c.r.t. cathodes were misleading because the 50V or so recorded here suggested that the RGB output stages were being driven hard on. It was only when we checked the 160V supply that we found it was down to about 50V. **J.C.**

Decca 70 Chassis

Low h.t., intermittent tripping and field cramping were the symptoms with this set. C637 (22μF) had lost capacitance. **S.L.**

Panasonic U4 (90°) Chassis

This set was dead with the 8·2Ω resistor that feeds the line output stage open-circuit. As with many Panasonic sets, a quick look round for faulty electrolytics can be fruitful. In this case C555 was found to have a leg missing due to corrosion. This wasn't the end of the story however. When we switched on there was a normal picture but no sound. The intercarrier sound chip, an SN76622AN in this case, was hot enough to fry eggs on. A replacement restored the sound. **S.L.**

Fidelity CTV14/20

A fault that's becoming increasingly common with these sets is that C21 (2,700pF) goes open-circuit or intermittently open-circuit. Since it's the line oscillator capacitor, associated with the TDA4503 chip, the result is a dead or intermittently dead set. It's of the now rarely seen polystyrene type. Replacements are available from SEME and RS Components. Whilst on the subject of these sets it's worth knowing that a TDA4500 will replace the TDA4503. Simply interchange the connections to pins 16 and 17 and ensure that R19 is 180kΩ. **S.L.**

Solavox CML14

The chassis used in this set is actually of the Hinari CT4/5 variety. The front panel display didn't work and there were no signals or front panel functions. Obviously loss of a supply somewhere we thought. As we'd no manual we had to delve into the front panel circuitry, a task not to be taken lightly. There was no output from the 5V regulator on this panel – and no input either. Tracing the print and leads back brought us to the line output transformer on the main board. Here we discovered that the BA157 rectifier D426 was short-circuit. **S.L.**

Tashiko 14F841

This was a good one, highlighting the need to check voltages both at source and destination. The basic fault seemed to be simple enough – field collapse and no sound. A colleague had changed the field output chip as it was visibly damaged. When I came to look at the set the problem seemed to be lack of field drive from the TDA4501 chip. A scope check confirmed this. The chip was obviously muting the sound as there was a healthy buzz from the audio output stages. A check on the 12V rail provided by regulator IC103 proved that the supply for the TDA4501 chip was present – or so I thought. So replacing the TDA4501 was considered to be a logical step to take. It didn't cure the fault however. A few more careful checks would obviously have to be made.

On checking the voltages at the pins of the TDA4501 chip, in particular at the supply and field drive pins, I found that the supply pin voltage was 10·5V. It measured 12V at source and this is the figure it should have been at the TDA4501. The penny then dropped: the 3·3Ω series resistor R104 was reducing the voltage, a replacement providing the cure. It's a tiny component. This confirms what we all know but tend to forget – that modern multi-function chips are very sensitive to supply voltage variation. **S.L.**

Bush 2020

This set appeared to have a tuning problem. After a few minutes of normal operation, during which search tune and channel selection and display were fine, the display would stick on one channel – usually AV – and the set would refuse to perform any other function. After a check on the supply to IC1 and its clock a new SAA1293 was quickly plugged in. This cured all the symptoms. **S.L.**

Ferguson TX9 Chassis (Panel PC1044)

The T9062V line driver transistor TR67 was short-circuit and the safety resistor R222 in its collector circuit had made the supreme sacrifice. Replacements produced a picture which was out of line lock, adjustment of the line hold control RV206 putting this right. Each time the set was switched off and on however lock was again lost. C158 (10nF) in the timing circuit was the culprit. No prizes for guessing that it's of the radial polystyrene type. **C.A.**

Mitsubishi CT2554TX

On two occasions recently the no sound and vision symptoms accompanied by an audible whistle have been due to failure of the line output transformer. A resistance check between the collector of the line output transistor and chassis will reveal short-circuit conditions: closer investigation shows that the transformer is at fault, not the transistor.

Establishing whether the short-circuit is in the power supply or the line timebase is helped by the inclusion of R556 (10Ω) which enables the line output stage to be isolated from the h.t. supply. If you compare the line output transistor collector with TP91 in the power supply, the line will be found to be much the lower of the two readings. The problem you get is that the primary winding, connected between tags 1 and 2, which is normally at h.t. potential, goes short-circuit to the field timebase supply winding between pins 3, 5 and 7 – this is earthy at one point.

Removal of the transformer from the PCB is a tedious and tiresome job as the socket into which the transformer is fitted is very reluctant to be relieved of its solder. You therefore need a very hot iron plus considerable time and patience. **A.P.F.**

Could Some Japanese Gent Explain?

Steve Beeching, T.Eng.

I recently had a bit of bother with a Panasonic camcorder, Model NV-M5. It came to me from a dealer because of a loading mechanism fault. All the loading drive gears were jammed and mistimed and there was a note to the effect that the owner had experienced threading problems from new.

Bias Pressure Spring

There's a bias pressure spring that stabilises the exit guide post when it arrives back at its rest position during unthreading. It's shown as item 228 in the service manual parts list, but there's no part number. The pressure spring is positioned below the threading rings, and for whatever reason the guide can sometimes foul it during the threading operation. I can only speculate on how this happens, but the spring lever gets bent back and prevents threading. The loading mechanism then jams and the drive gears are frequently damaged as there's insufficient protection. In this particular case no damage occurred to the drive gears, so the spring lever was replaced, the mechanism was retimed and, after testing, the camcorder was returned to the dealer.

Back it Comes

Unfortunately when his customer inserted a cassette it again jammed. So the machine came back to me. Initially the tape was suspected. The pressure spring was intact however and was thus not involved this time. So was this a different fault?

Further inspection revealed that this time the loading cam (148), the retaining arm (154), the quadrant gear (157) and the loading gear (153) were damaged and would have to be replaced. Something had held the tape guides back during the threading, and as the drive motor continued the intermediate parts just mentioned had suffered. In addition the quadrant gear had been forced out of its cam slot, damaging the main drive cam slot wall. The only course of action would be to replace the above parts, retime the mechanism, and start again.

The loading mechanism was tested first, on a dry run by powering the motor via an external voltage. It was then tested self-powered but without a cassette. Everything was fine. Testing with a cassette in place was rather different. The quadrant gear could be seen to rise upwards with stress as the threading guides were held back. The reason why was not at first obvious.

After some time had been spent playing with the loading mechanism, both with and without a tape, I was able to deduce that the tape around the loading guide was being stretched and damaged every time during tape loading.

The Anomaly

Now for the anomaly. With no tape inserted I could see that during the threading process the supply spool turntable rotated in reverse for a second or two. Thus while the loading guide system was pulling the tape out of the cassette the supply spool was trying to wind it back in again. No wonder that the loading mechanism and tape were under quite a lot of stress!

I decided to cross-check this with other models to see if the supply turntable did the same. I checked an NV-M1. No reverse rotation. The same with an NV-M7 and an NV-MS1. So why should the NV-M5 be different? I rang Nick Beer who later called back to say that his NV-M5s had no supply turntable reverse rotation during threading.

I next found that the system control microcomputer chip's R/S/F (reverse/stop/forward) signal goes high for reverse for about one second when the capstan power is 2V. Close inspection of the capstan timing waveforms confirmed this. So the spool idler drives the supply spool in reverse under these conditions. Why shouldn't it? But none of the others do. Nick's don't.

Panic, and as a last resort ring Panasonic. The man there had no idea. They'd not come across this problem.

As I had an NV-MS1 (Super VHS) to hand I decided to cross-check the capstan drive level during threading. Electrical measurements showed that sure enough there was a one-second drive pulse. But the supply spool didn't rotate in the reverse direction, because the idler seemed to be prevented from contacting the supply spool turntable. At last a clue.

Further inspection of the NV-MS1 revealed a thin, flat lever (item 155, the arm kick lever) that's moved slightly during threading and holds the idler assembly off the supply spool turntable, thus preventing reverse rotation. Back to the NV-M5. The arm kick lever had slipped and stuck and was not being operated by the loading mechanism cam lever, thus allowing the idler to drive the supply turntable. Once the arm kick lever had been correctly repositioned perfect operation was obtained.

Maybe some Japanese engineer could let me know why a one-second reverse drive is programmed into the microcomputer and then mechanically inhibited? Incidentally the same pulse is present in the NV-M1 through to the NV-MS1.

Another Funny

Another funny problem that led me a merry dance occurred with the NV-MC10 chassis. After replacing some parts in one that had been dropped the deck unit was tested. It recorded and played back fine, but threading, fast forward and rewind were not smooth. To put it mildly, the capstan motor was very lumpy. It rewound in massive jerks for a short period, then shut off.

Considerable time was spent checking through the main PCB which I thought might have suffered damage, but I couldn't find anything amiss. The only clue was that the servo drive output was abnormally high and was over-driving the d.c./d.c. converter chips. Hence the lumpy drive, as the d.c./d.c. converter was switching on and off.

Previous MC10s had not acted like this. Nick Beer confirmed that he had run the deck section of an NV-MC10 on its own without problems. A man at Panasonic said that the only time he'd had this fault was when the servo reference oscillator signal was missing, and that this was in playthrough. Anyway the machine was shelved for a while so that we could check whether a new main PCB could be afforded.

Some time later another MC10 came in for intermittent something or other, which meant that the deck had to be removed, and blow me if it didn't have the same lumpy rewind. But half a minute. This machine worked all right didn't it? The deck section was quickly reconnected to the camera and it ran fine. A nice smooth rewind. But when the camera section was disconnected the rewind was once more erratic. Needless to say back to the shelved unit for a retest. The results were the same. If the camera was connected the rewind was smooth. If not the rewind was lumpy.

The key was the colour signal. If it was present all the capstan functions were smooth. If it was absent, play and record were fine but the unthreading, fast forward and rewind drive was lumpy.

The cause was the colour VXO from which the servo obtains a 4·43MHz carrier as its reference signal. It runs in play and record but not during rewind, fast forward and unthreading unless the chroma signal from the camera is present. It then became apparent from the manual that this happens only in later versions with a modified Y/C PCB.

Perhaps that Japanese engineer could explain the design criteria of this circuit to me?!

TEST CASE

332

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.

The first recipients of the BSB satellite receivers were the members of the Launch Club, of whom one was Mr. Burnham. He retired to this neck of the woods about six months ago, and bought his TV set from us then. His BSB receiver finally arrived and he made his own arrangements for its installation.

Soon after this was done he came on the phone to us to book a service call to his Mitsubishi TV set. He said that on ITV the colour was bad and sometimes non-existent. The set was still under guarantee, and when could we come? Tomorrow, he was told. This sort of call was David the Downtrodden's speciality, but David has now left us and been replaced by Dylan. So it was Dylan who was briefed by the service manager next morning. He was told that it was bound to be a quickie. Probably the dish installers (Wild West Satellite Co. as it turned out) had upset the tuning or somehow interfered with the terrestrial aerial lead or its connections.

Dylan found Mr. Burnham's bungalow and glanced at the aerial arrangements briefly on his way to the front door. There was a 14-element group C/D aerial attached to the chimney, with a crank arm to stand it off. The BSB aerial, a 35cm offset dish, was just below it, slightly to one side. Its new mounting bolts gleamed in the sunshine. Once indoors, Dylan selected ITV on the Mitsubishi set. The colour was very grainy. During a few minutes' viewing it disappeared altogether once or twice, leaving a black-and-white picture that was somehow not quite right. When the tuning control was operated the effect was similar to that when the alignment of an older type of TV set with adjustable coil cores has been disturbed. Even the sound was affected, with a degree of hiss and buzz. When Dylan selected the other channels the strange symptoms disappeared like magic – the result was bright, clear pictures with good colour, perfect sound, and tuning control behaviour that was right for a set using the modern approach, a SAW i.f. filter and varicap tuner. Since the ITV channel lay between two of the others there seemed little point in investigating the TV set at this stage. It was unlikely that this would be any sort of guarantee claim job. Even so, a small portable TV set was brought in from the van to try it out. The results were similar of course, with poor, grainy ITV colour.

On its way to the TV set the signal from the terrestrial TV aerial was looped through the new BSB box and then through the VCR. Perhaps the trouble lay here? As a check Dylan plugged the u.h.f. aerial's downlead into the TV set's aerial socket directly. This had little effect on the symptoms – if anything the colour was worse, with more frequent drop-outs. Whatever the cause of the trouble then it was external to the set, indeed to the house. Dylan inspected the cable run, which was undamaged and appeared to be undisturbed. He borrowed Mr. Burnham's binoculars and focused them on the chimney and the aerials. The satellite cable was routed alongside the u.h.f. one, but nowhere could he see any problem. The terrestrial aerial was pointing in the correct direction and the boom was horizontal. How Dylan wished that he had one of those spectrum analysers he'd seen at the Cable and Satellite Show! As it was he could only phone the aerial erectors and ask them to call and check.

In the event the problem was caused by the aerial arrangements but neither Wild West Satellite who'd put up the dish nor Stick-Em-Up Ltd. who'd installed the u.h.f. aerial wanted to know. What was the cause of the trouble, and how was it cured?

ANSWER TO TEST CASE 331
– page 707 last month –

Our story last month involved two puzzled technicians, an exasperated customer (who decided on Portugal after all) and a recalcitrant TV set who's teletext display was full of errors. Two more teletext sets had proved that the signal from the aerial was all right, and the troublesome TV set had produced the same garbled display when fitted with a known good decoder. Clearly the trouble lay either in the power supply to the decoder panel or somewhere in the signal circuits between the aerial input and the video feed to the text decoder section. Dave knew when he was beaten: he loaded the set into the van and hastened back to the workshop.

Now the workshop's off-air signals are rather better than those at Mr. Hayes' house. Thus the results were better, but less than perfect. Very careful study of the picture (not the text display) showed that reproduction was not as good as it might have been. With the a.f.c. turned off, the set's vision demodulator coil (39·5MHz "tank" coil) was carefully tuned. The a.f.c. coil was then trimmed to give spot-on tuning. Both of these operations were carried out while watching an oscilloscope that displayed the teletext pulses in the field blanking period.

After that the text display was very good and error free, both in the workshop and back at site.

De Luxe Component Tester

Part 2: Uses

David Botto

Last month we described the design and construction of the de luxe component tester. This month we'll describe the wide number of tests for which it can be used.

Zener Diode Tests

In addition to measuring the voltage rating of a zener diode, using the ZV scale, good/bad tests can be made. Waveforms produced by good zener diodes are shown in Fig. 1.

Testing Transistors

For transistor testing set the voltage selector switch SW4 to position 2 or, for large power transistors, position 3.

The base-emitter junction of a transistor can be checked by connecting test lead Ch to its base and test lead T to its emitter. With a good silicon npn transistor the waveform will be as shown in Fig 2(a), with the longer vertical line at the top. Moving test lead T to the collector will produce the waveform shown in Fig. 2(b). With test lead Ch connected to the emitter and test lead T to the collector the waveform is as shown in Fig. 2(c). Emitter-collector tests need not usually be made. The waveforms should be sharp-angled and clear. If you are using an old a.c.-coupled oscilloscope you may get the displays shown in Fig. 2(d) and (e).

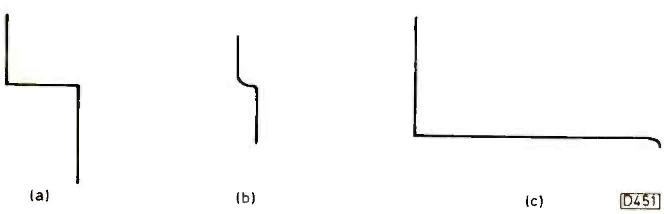


Fig. 1: Zener diode waveforms: (a) 14V zener diode, (b) 1·6V zener diode, (c) 47V zener diode.

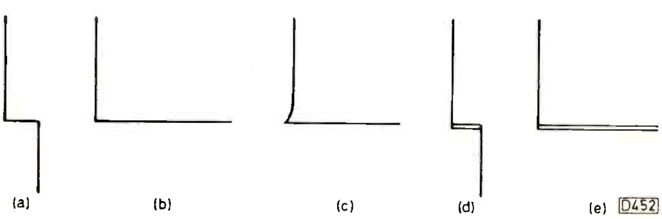


Fig. 2: Silicon npn transistor waveforms: (a) base-emitter, (b) base-collector, (c) emitter-collector. An a.c. coupled scope may produce the waveforms shown in (d) and (e).

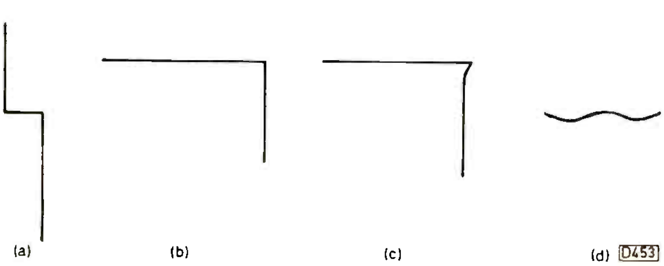


Fig. 3: Silicon pnp transistor waveforms: (a) base-emitter, (b) base-collector, (c) emitter-collector. The centre pin-base waveform with an STR450 is shown at (c).

Fig. 3 shows the waveforms produced by pnp transistors. With a pnp transistor the longer vertical line is at the bottom and the base-collector waveform is inverted. Thus it's possible to establish whether an unknown transistor is an npn or a pnp type.

Fig. 4 shows fault conditions with silicon transistors. Leakage in a transistor's base-emitter junction, or in a zener diode, gives the display shown at (a). This is an in or out of circuit check. An out of circuit leakage check is shown at (b). Another out of circuit check is shown at (c). Diode or base-collector leakage out of circuit is shown at (d).

A germanium transistor produces waveforms of the type shown in Fig. 5. An STR450 produces the waveforms shown in Fig. 3(a), (b) and (d).

Small transistors can be plugged into test sockets Q1 and Q2. Set SW4 to position 2. Switch T3 to its B position and SW3 to its C1 position. You'll then see the base-collector waveform of the transistor fitted into socket Q1. Turn SW3 to its E1 position and you'll see the base-emitter waveform. Turn SW3 to the C2 and E2 positions to view the test waveforms for a transistor in socket Q2.

Large power transistors often have an internal diode inside the encapsulation, across the base-emitter junction. At first glance there may appear to be a base-emitter short. Turn SW4 to position 3 and increase the scope's X amplifier gain. You'll also need to turn up the brightness. The base-emitter waveform you obtain must be compared with that of a known good transistor of the same type.

An interesting effect that you may encounter on rare occasions is when a small-signal transistor tests open-circuit then suddenly tests o.k. It may work in the

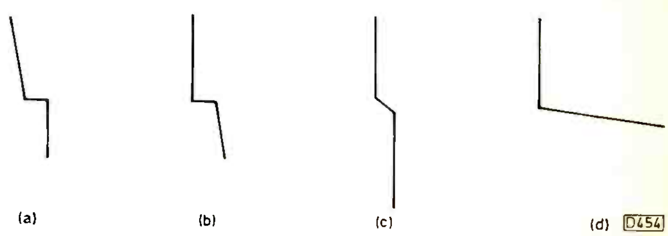


Fig. 4: Displays produced by faulty transistors.

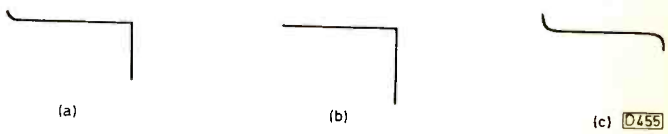


Fig. 5: Germanium transistor waveforms: (a) base-emitter, (b) base-collector, (c) emitter-collector.

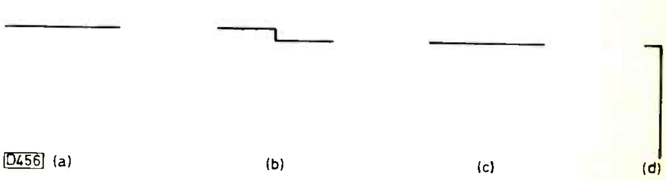
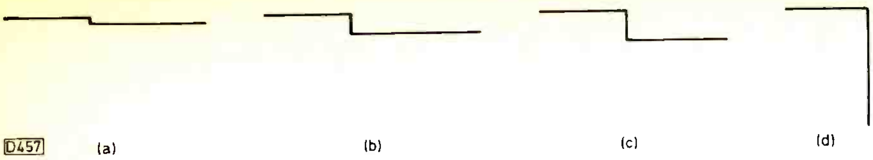


Fig. 6: Waveforms produced by a BT106 thyristor: (a) thyristor off, (b) just starting to conduct, (c) thyristor on, (d) the saturated state.



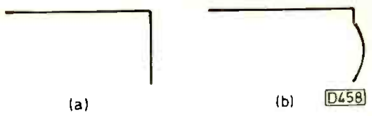


Fig. 7 (left): Waveforms obtained with a Sony SG264A device: (a) the SG264A barely conducting, (b) starting to conduct, (c) conduction increasing, (d) device on.

Fig. 8 (right): Thyristor with an integrated diode: (a) diode test, (b) thyristor turned on.

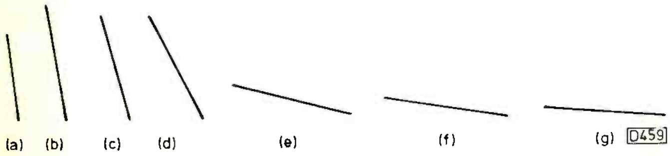


Fig. 9: Waveforms produced by various resistors: (a) 50Ω, (b) 100Ω, (c) 470Ω, (d) 1kΩ, (e) 2·2kΩ, (f) 10kΩ and (g) 22kΩ.

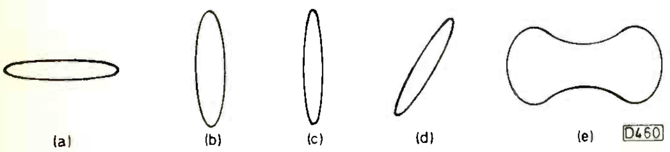


Fig. 10: Capacitor test waveforms: (a) 0·22μF capacitor, (b) 10μF capacitor, (c) 100μF capacitor, (d) leaky capacitor, (e) 0·01μF capacitor with high Y gain.

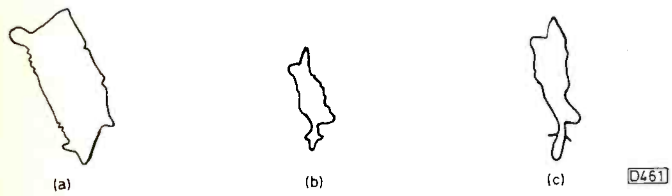


Fig. 11: Displays produced by large-value capacitors: (a) 800μF, (b) 8,000μF, (c) 10,000μF. See text for the scope X and Y settings.

receiver for some hours, months or even years. It's sound policy to replace the transistor however.

Junction f.e.t.s can be checked for shorts. Before checking one of these transistors switch SW4 to position 1 and add a 1kΩ resistor in series with test lead T. MOS field-effect transistors cannot be checked and could be damaged if you try.

Checking a Thyristor

To check a thyristor connect test lead Ch to its cathode and test lead T to its anode. Set SW4 to position 2. Turn the gate voltage control VR3 fully anti-clockwise and connect test lead G to the thyristor's gate. Slowly turn VR3 clockwise and the thyristor should conduct. Fig. 6 shows the waveforms obtained with a BT106 thyristor while Fig. 7 shows the waveforms obtained with a Sony SG264A. On disconnecting test lead G a good thyristor will stop conducting and a horizontal line will appear. Small thyristors can be plugged into socket T on the PCB. Very little gate voltage is required to turn one of these on.

This thyristor test is useful if you suspect that a thyristor is turning on too late or too early. You can compare the results obtained with a known good thyristor of the same type.

Thyristors used in applications such as the line output stage of a TV set often have an internal diode connected across the anode and cathode. With test lead Ch connected to the cathode and test lead T to the anode you should get the waveform shown in Fig. 8(a). This shows that the diode is in order. Connect test lead G to the thyristor's gate and, as you advance VR3, the thyristor should turn on, producing the waveform shown in Fig. 8(b).

Resistor Checks

With SW4 in position 2 resistors with values from about 50Ω to 22kΩ can be checked. Fig. 9 shows the waveforms produced by an assortment of resistors. By increasing the scope's Y gain resistors with values up to about 2·2MΩ can be checked. This test won't replace the ohms ranges on your digital multimeter, but you'll find that it saves time when you make in-circuit tests.

Continuity Testing

A handy function of the tester is its use as a continuity tester. It's ideal for locating breaks in printed circuit tracks. Looking at your scope's large display is far easier than peering at a meter needle or the relatively small display on your digital multimeter. Set SW4 to position 1.

Capacitor Checks

For capacitance measurement adjust the scope's horizontal (X) gain until the horizontal scanning line nicely scans the screen and set SW4 to position 2. Capacitance over a range of about 0·22μF to 100μF can now be measured, see Fig. 10.

With the capacitor under test connected between test leads T and Ch a circle or an ellipse will be seen, the size and shape depending on the capacitor's value. If an electrolytic is leaky the ellipse will be tilted as shown in Fig. 10(d).

Provided the oscilloscope being used is a dual-channel type its X gain can be increased to 0·01V/cm and its Y gain set at 5V/cm. This enables capacitors with values up to 10,000μF to be checked. To make such tests you may need to turn up the brightness. Fig. 11 shows the waveforms produced by capacitors with values of 800, 8,000 and 10,000μF. The waveforms are not exact ellipses because the capacitors don't charge fully.

For capacitors with values between 100-800μF, set the X gain to a suitable level.

Keep a record showing the scope settings for various capacitor values. You can then check a wide range of capacitors quickly.

Use position 1 of SW4 for capacitors of over 250μF value. Use position 3 for capacitor values of less than 0·47μF and increase the Y gain – see Fig. 10(e).

Checking LEDs and VCR End Sensors

To test a LED connect its cathode, which is usually identified by a flat side or a notch, to the Ch lead and its

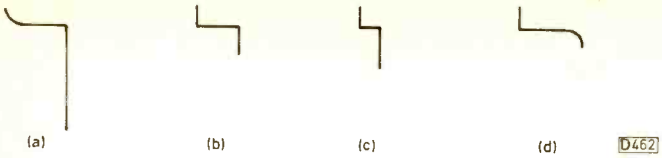


Fig. 12: LED waveforms: (a) small LED, (b-d) typical waveforms produced by the segments of a seven-segment display.

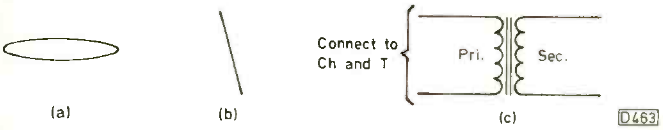


Fig. 13: Mains transformer tests: (a) waveform across the primary, (b) waveform obtained with a short across the secondary, (c) test lead connections.

anode to the T lead. A good LED will light and display the waveform shown in Fig. 12(a). Switching SW4 to position 3 will increase the LED's brightness.

If a seven-segment LED won't light, or one segment stays out, is the problem due to the LED itself or to the complex drive circuitry? Connect lead Ch to the common cathode (or anode) and the T lead to each segment in turn. The segments should light and waveforms similar to that in Fig. 12(b-d) should be seen. It's often possible to check LEDs in circuit: use position 1 of SW4 to do this.

Many types of VCR end sensor can be checked – usually in circuit, with the mains power disconnected of course. Connect test leads Ch and T across the sensor connections. The waveform should be as shown in Fig. 2(b). Shine a light on to the sensitive part of the sensor and, if it's o.k., you'll see the waveform change to that shown in Fig. 2(a).

Mains Transformer Test

A mains transformer or mains choke should show a waveform similar to that in Fig. 13(a). If the winding has shorted turn(s) or the secondary load has shorted the waveform will be as shown in Fig. 13(b).

Checking a Loudspeaker

To test a loudspeaker turn SW4 to position 1. Applying test leads Ch and T across a good loudspeaker's speech coil should produce a slightly angled upright line. It will also make the loudspeaker emit a soft buzz. Now turn SW4 to position 3. If the speech coil is scraping on its polepiece magnet you'll hear it.

Signature Waveform Tests

Connecting test leads Ch and T across almost any component or across any two points in the circuitry of a piece of equipment will produce a unique and distinctive waveform. This is known as a signature waveform.

The signature waveform shown in Fig. 14(a) was obtained by connecting leads Ch and T across the power

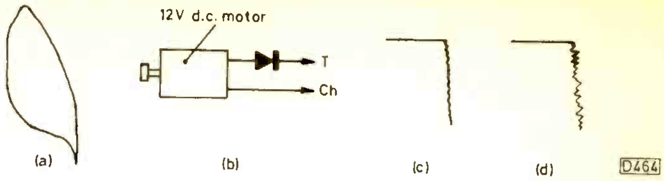


Fig. 14: The signature waveform produced by a 12V d.c. motor is shown at (a). Adding a diode in series as shown at (b) will produce waveform (c) with a good motor and waveform (d) with a faulty motor.

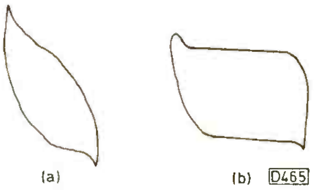


Fig. 15: Signature waveforms produced across the mains input lead of the Panasonic NV2000 VCR.

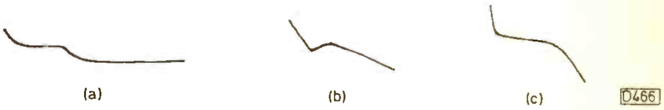


Fig. 16: Signature waveforms produced between various pins of a TDA4503 i.c.: (a) between pins 20 and 21, (b) between pins 22 and 23, (c) between pins 25 and 26.

input leads of a small 12V d.c. motor of the type used in many VCRs. SW4 was set to position 3, the scope's Y channel gain was set to a sensitivity of 5V/cm and the X channel to 1V/cm. With a diode in series with one lead, as shown in Fig. 14(b), the waveform shown in Fig. 14(c) was obtained. The power from the tester made the motor run. A good motor produces a steady waveform. A motor whose speed varies produces the waveform shown in Fig. 14(d).

Fig. 15(a) shows the signature waveform across the a.c. mains input lead of the Panasonic NV2000 VCR, with SW4 in position 2. Should fuse F1002 go open-circuit the waveform appears as shown in Fig. 15(b).

In-circuit Tests

A helpful feature of the tester is its use in making in-circuit tests. Before making such tests disconnect the equipment from the mains supply and make sure that the capacitors in the power supplies and, in the case of a TV set, the c.r.t.'s final anode capacitance are discharged. Many transistors, diodes, capacitors, transformers, LEDs etc. can be checked in-circuit – it's another form of signature testing. Compare the waveforms you obtain with those from a known good unit. If you regularly service particular TV and VCR models it pays to keep a record of key signature waveforms. Draw them in the service manual – you'll find that they can save you much time and frustration. But like everything else in life, you'll find that in-circuit signature testing skill requires practice.

If you need to isolate a transistor, unsolder only two of its three leads and keep them clear of the print. If the transistor tests o.k. you can then resolder the leads. This

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avoids the problem of removing a transistor then finding that the PCB is unmarked and that you have to waste time working out which way to reconnect it. Use the same method with diodes, capacitors and resistors, with only one lead being unsoldered of course.

Integrated Circuit Tests

Integrated circuits with up to 28 pins can be tested by checking the waveforms between adjacent pins. This is another form of signature testing. Check known good i.c.s and keep a record of the waveforms. Fig. 16 shows some typical signature waveforms obtained from an i.c. We can't claim that this is an infallible method of checking i.c.s, but it does reveal a surprising number of i.c. faults including short- and open-circuit failures.

Switch SW4 to position 1. The amber neon should then light. Set toggle switches T1 to T3 to their centre positions and T4 to its N position. Switches SW1-3 and T1-3 then enable the waveforms of an i.c. with up to 28 pins to be checked.

For checks between pins 1 and 12 of a 28-pin chip switch T4 to N and T1 and T2 to their A positions. Set SW4 to 1 and SW2 to 2. Then select 3 with SW1 then 4 with SW2. As you rotate the switches you'll see the signature waveforms on the scope.

To check between pins 12 and 13, return toggle switch T1 to its centre position and set T2 and T3 to their A positions. Use SW2 to select pin 12 and SW3 to select pin 13. Then view the waveform.

For checks between pins 14 and 24, set T1 to its B position, T3 to its A position and T2 to its centre position. Use SW1 and SW3 to select the i.c. pins.

To check between pins 24 and 25, set T1 and T2 to their B positions and select the pins with SW1 and SW2. For i.c. pins 25-28, set T2 and T3 to their B positions and T1 to its centre position.

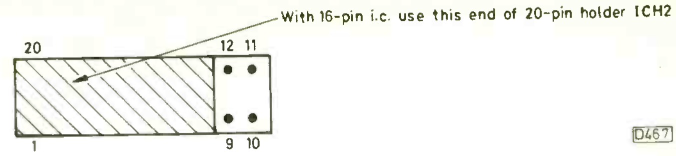

Fig. 17: Testing a 16-pin i.c. in the 20-pin holder ICH2. The same method is used with 8-pin and other small i.c.s.

Plug smaller chips with fewer pins into the 20-pin holder. Fig. 17 shows the idea. With an 8-pin chip you use the switches to select pins 1-4 and 17-20. With a 16-pin chip you check the waveforms produced by switch positions 1-8 and 13-20.

With a little practice you'll find that the switch settings for various i.c.s are quite straightforward.

Large, multipin memory and microcomputer chips cannot be tested. This is not a problem however as in-circuit checks with a logic probe and pulser are easy.

CMOS i.c.s are easily damaged so I wouldn't recommend that you check them with the tester. I have however checked a number of CMOS i.c.s, with toggle switch T4 in its R position, and have not so far damaged one. With T4 in position R resistor R6 is in circuit. The scope's Y gain must be increased when this is done.

By now you'll appreciate that this tester presents new approaches to measurement for the TV/video engineer. It also enables full use to be made of the oscilloscope. You'll probably find many other useful tests in addition to those described above.

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3HSSHB-VT11,33 etc	£19.00
10078-VT17 etc	£43.00
PANASONIC	
3HSSU1N-NV370,380,100/Philips VR6460	£16.00
3HSSU2N-NV230,470,480,G9,10, G11,G15PX	£30.60
3HSSU3N-NV430, 460	£21.50
3HSS3N-NV777,330	£21.50
3HSS4NB-NV730	£30.80
3HSS4NA-NV366	£30.80
NVG30,33,40,45,46,130 & most others Panasonics	POA
SANYO	
3HSSSY-VHR1100,1110,1300	£26.50
3HSS3SY-VHR1500	£30.80
SHARP	
3HSSSP-VC9300,9500,9700,381,481 482,483,486 etc	£21.00
3HSSSPB-VC581,583,651,750 etc	£21.00
VC7000,8000 series (Brass)	£42.00
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Fisher FVHP510,520,530,615,710 etc	£21.00
Fisher VBS7000,9000 etc	£33.75
Goldstar 8000	£23.00
Goldstar Universal	£23.00
Hinari VXL2,4,35	£23.00
Hinari VXL5,20H	£20.00
Hinari VXL20H	£23.00
Mitsubishi HS303,304,320,700,310	£35.00
Saisho VR100,605,705,805,905	£23.00
Samsung Universal 2 Head	£24.25
Toshiba V71,81, etc	£25.50
Toshiba V93	£25.50

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BC147A	£0.07	BU500	£0.95
BC172C	£0.07	BU508A	£0.90
BC214A	£0.07	BU508D	£0.95
BC214B	£0.07	BU536	£1.75
BC237	£0.07	BU806	£0.75
BC238	£0.07	BU807	£0.75
BC308B	£0.07	BUT11	£0.75
BC327-25	£0.07	BUX84	£0.60
BC328	£0.07	TIP29	£0.30
BC337	£0.07	TIP31	£0.30
BC547A	£0.07	TIP32	£0.30
BC548	£0.07	TIP41	£0.27
BC549	£0.07	TIP42	£0.25
BC559B	£0.07	TIP42C	£0.40
BD137	£0.30	TIP112	£0.45
BD237	£0.22	2SA1102	£1.90
BD238	£0.22	2SB1016	£1.50
BD243C	£0.30	2SC1413A	£2.50
BD244	£0.30	2SC2027	£4.50
BD244C	£0.30	2SC2331	£1.00
BF195	£0.07	2SC2577	£1.40
BF196	£0.15	2SC2958	£2.50
BF197	£0.15	2SC3153	£3.40
BF198	£0.07	2SC3678	£2.75
BF259	£0.22	2SD639	£0.35
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BF471	£0.25	2SD1265	£1.30
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BU208A	£0.90	2SD1497	£2.60
BU208D	£0.90	2SD1497-02	£5.95
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BU326A	£0.90	*Ask for Transistors not listed*	

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AN5900	£1.50	TBA560	£1.00
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AN6332	£4.40	TBA820M	£0.45
AN6341	£2.75	TBA920S	£1.00
AN6344	£6.50	TCA640	£3.75
AN6346	£4.50	TCA650	£3.95
AN6360	£3.75	TCA660B	£3.50
AN6362	£4.25	TDA1010A	£1.10
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AN6677	£5.25	TDA1022P	£4.50
AN7169	£3.50	TDA1035	£1.90
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BA5406	£2.50	TDA1057	£2.00
BA6109	£1.80	TDA1082	£3.50
BA6209	£3.20	TDA1170S	£1.20
BA6219	£1.95	TDA1180	£1.80
BA6238A	£1.95	TDA1190	£1.90
BA6301	£2.00	TDA1412	£1.00
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HA13008	£2.00	TDA1670A	£2.60
HA11714	£3.50	TDA1701	£3.00
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LA4460	£1.70	TDA2510	£4.30
LA4461	£1.80	TDA2521	£9.75
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STK7309	£5.50	UPC1361	£3.90
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Hitachi 8000,8300,8500	£8.50
Sanyo VTC5000,5150,5400,5300,6500	£7.50
Sharp VC9300,9500 etc, Original	£15.90
Panasonic NV333,366 Original	£13.20
All other Panasonics	POA
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Ferguson/JVC (Mechanical models)	£23.00
Sharp 7000 series Original	£24.63
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AN5732	£1.85	BA6328	£2.20	KA2261	£1.20	LA6358D	£1.20	STK2240	£9.50	STR1096	£4.95	TDA4501	£4.50	2SC2235	£0.40
AN5750	£3.75	BA6411	£2.20	KA2284	£1.20	LA7031	£2.60	STK2250	£9.50	STR2005	£5.95	TDA4503	£4.50	2SC2335	£1.20
AN5753	£1.95	BA7005	£2.20	LA1130	£2.50	LA7032	£2.95	STK3041	£6.50	STR2012	£6.20	TDA4505	£3.95	2SC2570	£0.50
AN5900	£1.40	BA7023L	£2.50	LA1135	£2.50	LA7042	£2.80	STK3042	£6.50	STR2013	£5.20	TDA4510	£3.95	2SC2580	£2.75
AN6130N	£2.50	BA7751AL	£1.95	LA1140	£2.20	LA7520	£3.25	STK3044	£5.75	STR3115	£5.95	TDA4600	£2.75	2SC2581	£2.95
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AN6250	£1.50	HA1197	£1.80	LA1185	£1.60	LA7806	£2.50	STK3102iii	£5.75	STR4211	£4.50	TDA7250	£4.95	2SC3156	£3.70
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AN6327	£3.50	HA1339A	£3.50	LA1320	£1.60	LA7830	£2.20	STK4025	£6.50	STR6020	£5.20	UPC1156H	£3.50	2SC3409	£2.75
AN6328	£3.50	HA1367	£3.50	LA1363	£1.20	LA7831	£2.50	STK4121ii	£6.95	STR50020	£6.20	UPC1185H	£2.50	2SC3466	£2.95
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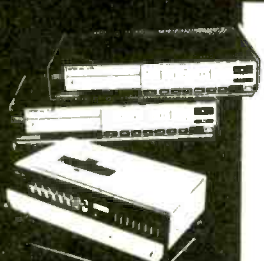

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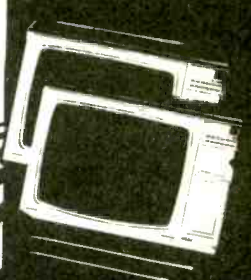

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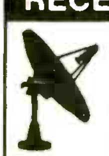

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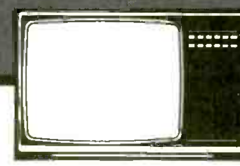

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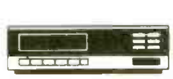

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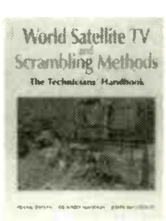

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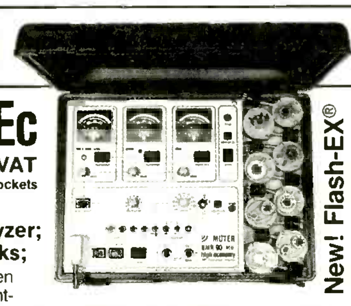

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