APRIL 1981 70p

TELEVISION

SERVICING·VIDEO·CONSTRUCTION·DEVELOPMENTS

ARROW GENERATOR
LOCATING INTERMITTENT FAULTS
THE THORN TX10 CHASSIS
plus
ALL THE REGULAR FEATURES

PHD COMPONENTS

RADIO & TV COMPONENT DISTRIBUTORS
UNIT 7 CENTENARY ESTATE
JEFFRIES RD ENFIELD MIDDX
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ALL COMPONENTS OFFERED SUBJECT TO AVAILABILITY. WE RESERVE THE RIGHT TO SUBSTITUTE REPLACEMENTS SHOULD THE ORIGINAL PART BE OUT OF STOCK OR UNAVAILABLE!

PLEASE ADD 50p per parcel post and packing.

SEMICONDUCTORS

AA113	0.16
AA116	0.16
AA117	0.16
AA119	0.16
OA91	0.12
OA95	0.12
OA202	0.18
BA100	0.18
BA102	0.10
BA130	0.15
BA154	0.10
BA155	0.20
BA164	0.12
BAX13	0.16
BAX16	0.08
BAY38	0.16
BY206	0.20
IN4148	0.04
BY126	0.20
BY127	0.15
BY133	0.22
BY164	0.50
SKB2/08	1.00
BY238	0.15
BYX10	0.18
IN4001	0.10
IN4002	0.10
IN4003	0.12
IN4004	0.12
IN4005	0.12
IN4006	0.14
IN4007	0.16
IN5407	0.33
BR100	0.30
BR101	0.60
BRY39	0.60
TIC1160N	1.50
BT119	2.00
BT120	2.00
BYX/71/600	0.80
2N444	1.50
TV106/2	1.50
BYX88 2V7	0.10
BZY88 3V0	0.10
BZY88 3V3	0.10
BZY88 3V6	0.10
BZY88 3V9	0.10
BZY88 4V3	0.10
BZY88 4V7	0.10
BZY88 5V1	0.10
BZY88 5V6	0.10
BZY88 6V2	0.10
BZY88 6V8	0.10
BZY88 7V5	0.10
BZY88 8V2	0.10
BZY88 9V1	0.10
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BZY88 13V	0.10
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BZY88 18V	0.10
BZY88 20V	0.10
BZY88 22V	0.10
BZY88 27V	0.10
BZY88 33V	0.10
BZX61 7V5	0.20
BZX61 8V2	0.20
BZX61 9V1	0.20
BZX61 10V	0.20
BZX61 11V	0.20
BZX61 12V	0.20
BZX61 13V	0.20
BZX61 15V	0.20
BZX61 16V	0.20
BZX61 18V	0.20
BZX61 20V	0.20
BZX61 22V	0.20
BZX61 24V	0.20
BZX61 27V	0.20
BZX61 30V	0.20
BZX61 33V	0.20
BZX61 36V	0.20
BZX61 39V	0.20
BZX61 47V	0.20
BZX61 72V	0.20
AC107	0.35
AC127	0.50
AC127/01	0.60
AC128	0.60
AC128/01	0.60
AC141	0.50
AC141K	0.60
AC142	0.40
AC142K	0.60
AC176	0.60
AC176/01	0.60
AC186	0.40
AC187	0.40
AC187K	0.60
AC188	0.40
AC188K	0.60
AD140	1.50
AD142	1.50
AD143	1.50
AD145	1.50
AD149	1.00
AD161/2	1.50
AD162	0.70
AD262	1.50
AF121	0.60
AF124	0.60
AF125	0.60
AF126	0.60
AF127	0.60
AF139	0.60
AF239	1.00
AL102	3.00
AU107	3.00
AU110	3.00
AU113	3.00
AL103	3.00
AY102	3.00
BC107	0.20
BC108	0.20
BC109	0.20
BC113	0.15
BC114	0.15
BC115	0.20
BC116	0.20
BC117	0.20
BC118	0.20
BC119	0.50
BC125	0.20
BC126	0.20
BC136	0.20
BC137	0.20
BC138	0.40
BC139	0.40
BC140	0.40
BC142	0.40
BC143	0.40
BC147	0.15
BC148	0.10
BC149	0.15
BC153	0.15
BC154	0.15
BC157	0.15
BC158	0.15
BC159	0.15
BC160	0.40
BC161	0.40
BC170	0.15
BC171	0.15
BC172	0.20
BC177	0.20
BC178	0.20
BC179	0.20
BC182L	0.15
BC183L	0.15
BC184L	0.15
BC184LC	0.15
BC186	0.30
BC187	0.30
BC203	0.15
BC204	0.15
BC205	0.15
BC206	0.15
BC207	0.15
BC208	0.15
BC209	0.15
BC212L	0.15
BC213L	0.15
BC214L	0.15
BC225	0.40
BC237	0.15
BC238	0.15
BC251A	0.15
BC301	0.40
BC303	0.40
BC307	0.15
BC308	0.15
BC327	0.15
BC328	0.15
BC337	0.15
BC338	0.15
BC547	0.15
BC141-10	0.80
BD115	0.50
BD124	1.80
BD131	0.70
BD132	0.60
BD133	0.70
BD134	0.70
BD144	2.50
BD159	0.80
BD238	0.50
BD380	0.70
BD441	0.70
BD537	0.70
BD538	0.70
BD507	0.70
BD508	0.75
16181	1.20
16182	1.20
BD709	1.00
BD710	1.00
BD442	0.70
BD379	0.50
BF115	0.60
BF118	0.60
BF152	0.40
BF154	0.20
BF157	0.70
BF158	0.40
BF160	0.60
BF163	0.60
BF167	0.50
BF173	0.50
BF177	0.50
BF179	0.50
BF180	0.50
BF181	0.60
BF182	0.50
BF183	0.50
BF184	0.50
BF185	0.50
BF194	0.20
BF195	0.20
BF196	0.20
BF197	0.20
BF198	0.15
BF199	0.15
BF200	0.15
BF224	0.15
BF240	0.45
BF241	0.20
BF256LC	0.50
BF257	0.50
BF258	0.50
BF271	0.60
BF273	0.20
BF274	0.25
BF336	0.50
BF337	0.50
BF338	0.50
BF355	0.80
BF458	1.00
BF459	1.00
BFT43	0.50
BFX29	0.50
BFX84	0.50
BFX88	0.50
BFX89	0.50
BFY50	0.50
BFY51	0.50
BFY52	0.50
BFY90	1.20
BF381	0.50
BFR39	0.30
BFR79	0.30
BFR81	0.30
BFR89	0.50
BF259	0.25
BDX32	2.50
BU206	1.60
BU208/02	2.80
BU326S	1.00
BU406	2.00
BU406D	2.50
BU407	1.70
BU407D	2.50
R2008B	2.50
R2010B	2.50
R2540	3.00
ME0402	0.20
ME0412	0.20
ME4003	0.15
ME6002	0.20
ME8001	0.20
MJE2955	1.50
MJE3005	1.30
MP8113	1.00
MPSU05	1.20
MPSU55	1.20
TIP2955	1.30
TIP3055	1.30
TIS90M	0.30
2N2904	0.50
2N2905A	0.50
2N2905	0.50
2N3053	0.50
2N3703	0.20
2N3075	0.20
2N3710	0.20
2N3055H	0.60
TAA350	0.80
TAA550	0.50
TAA570	1.80
TAA611	1.75
TAA630S	2.50
TAA661B	2.00
SN76540N	1.50
TAD100	2.00
TBA120AS	0.75
TBA231	1.20
TBA480Q	2.20
TBA520Q	2.00
TBA530	2.00
TBA530Q	2.00
TBA540	2.20
TBA540Q	2.20
TBA550	3.00
TBA550Q	3.00
TBA560C	2.20
TBA560CQ	2.20
TBA570	2.50
TBA570Q	2.50
TBA641BX	3.00
TBA641B11	4.00
TBA651	3.00
TBA720A	1.50
TBA730	1.50
TBA750	2.00
TBA750Q	2.00
TBA800	1.00
TBA810S	1.50
TBA820	1.50
TBA920	2.00
TBA920Q	2.00
TBA990	2.00
TBA990Q	2.00
TCA2205A	3.00
TCA900	1.00
TCA940	2.00
TDA1170	2.00
TDA1200	3.00
TDA1270	4.00
TDA1412	1.00
TDA2020	4.00
SN76115N	2.00
SN76227N	1.20
SN76530P	1.00
SN76651N	1.50
SN76003N	3.00
SN76013N	2.00
SN76013NO	2.00
SN76013ND	2.00
SN76023N	2.00
SN76023ND	1.00
SN76033N	2.00
SN76110N	2.00
SN76226DN	2.00
SN76227N	1.20
SN76532N	2.00
SN76533N	2.00
SN76544N	2.00
SN766504	1.00
SN76665N	1.50
SN76666N	1.20
SL901B	6.00
SL917B	8.00
TBA396Q	2.00
TDA440	2.50
SN76001N	1.50
TBA520	2.00
TBA120S	1.00
TBA396	2.00
TCA270SQ	2.00
TDA2030	8.00
TDA2140	6.00
TDA2150	6.00
TDA2160	6.00
TDA1230	3.00
TDA3089	2.00
TDA1054M	2.00
MC1349P	1.50
SAA661	0.60
SAS560S	2.00
SAS570S	2.00
SN7400N	0.40
SN7413N	0.90
SN74122N	1.00
SN74141N	1.00
TBA395	1.80
TBA395Q	1.80
TBA950	4.00
TCA800	4.00
TCA8000	4.00
TDA1180	3.00
TDA1190	3.30
TDA2002H	3.60
TDA2590Q	5.00
TDA2600	5.00
TDA2640	3.30
TDA3950	3.00
TAA621 AX1	3.30
TBA625X5	2.00
TCA830S	2.00
TDA2020/A2	5.00
TDA2020P	5.00
TDA2030V	3.60
TDA2010/BD2	4.50
TDA2002V	5.00
TCA940E	3.00

We can often supply equivalents to transistors & I.C's not listed. Free list on request with any order.

VALVES

DY/86/87	1.30
DY802	1.80
ECC82	1.40
ECC84	1.20
ECH83	1.10
ECH84	1.10
ECL80	1.10
ECL82	1.10
ECL86	1.10
EF80	1.10
EF95	1.50
EF183	1.70
EF184	1.60
EL34	3.00
EL84	2.00
GY501	3.00
PC97	1.50
PC900	1.50
PCF80	1.74
PCF802	1.60
PCF806	1.10
PCL82	1.70
PCL84	1.80
PCL85/805	1.90
PCL86	1.90
PD500/510	5.00
PFL200	2.60
PL36	2.60
PL81	1.50
PL504	2.50
PL508	2.50
PL509	4.00
PL519	5.00
PL802	3.00
PY88	1.70
PY500A	2.80
PY800/801	1.70
UCL82	1.10
30FL2/1	1.40
PCF805	1.20
PCF808	1.20
PL519 · PY500A	5.00

VALVES NOT SHOWN HERE MAY BE IN STOCK. PLEASE WRITE FOR QUOTE.

DIRECT REPLACEMENT PARTS

Decca 30 Series Lopt	8.00
173 Tuner (Repl Elc 1043/05)	8.00
4.443MHZ Crystals	2.00
Cut Out TCE 3500	2.50
Cut Out GEC	2.50
Cut Out TCE 8500	2.00
TV18 Rectifier Stick	2.00
TV20 Rectifier Stick	2.00
VA 1104 Thermister	0.80
Transductor TCE 3000	1.50
AEG Tuner (Repl Elc 1043/06)	9.00
Aeriel Isolator Kit	1.60
Philips G8 Lopt	12.00
PYE 691/697 Lopt	11.00
Bush A 774 Lopt	18.00
Bush 0823 Lopt	5.00
Pye 731 IF Gain	10.50
A823 Bush Power Panel	20.00
PL 802T Transistorised	4.00

BAHCO TOOLS. – Come and see the full range at our shop or send for full catalogue free, on request, with any order.

EHT MULTIPLIERS

TCE950 Doubler	2.00
TCE950/1400 Tripler	5.04
TCE1400 (Piped System Only)	4.56
TCE1500 Doubler	4.16
TCE1500 Tripler	4.64
TCE1600 1/2 Wave	3.95
DECCA CS 1730/1830 Doubler	4.23
DECCA CS 1910/2213 Tripler	6.67
DECCA 30 Series Tripler	6.01
DECCA 80 Series Tripler	6.43
DECCA 100 Series Tripler	6.68
GEC Hybrid 2028 Tripler	6.43
GEC 2110 Tripler Pre JAN77	7.21
GEC 2110 Tripler Post JAN77	6.43
ITT CVC 5/8/9 Tripler	6.51
ITT CVC 20/25/30	6.45
Philips 520 Tripler	6.51
Philips 550 Tripler	6.42
Philips G9 Tripler	6.63
PYE 691/693/697 Tripler	6.68
RRI 823 Tripler	5.48
RRI Z179/823	6.68
TCE 3000/3500 Tripler	5.51
TCE 4000 Tripler	8.00
TCE 8000 Doubler	3.53
TCE 8500 Tripler	5.60
TCE 9000 Tripler	7.28
TVK 76/13 Continental Sets	5.50
TVK 52 ITT Replacement	6.68
Korting 90% Tripler	6.50
Autovox Tripler	6.50
Rediffusion MK 1 Tripler	6.00
RRI TV 25 Quadrupler	4.00
RRI T20	7.04

MULTISECTION CAPACITORS

DECCA 400 400/350	3.72
DECCA 80/100 400/350 · 800/250	4.00
GEC 200 200 150 50/350	3.00
GEC 100 2000/35	1.10
GEC Philips G8 600/250	2.10
GEC Philips G8 600/300	2.50
ITT KB 200 200 75 25/350	3.00
ITT CVC 20 200/400	2.20
Philips G11 470/250	1.90
PYE 691 200 300/350	2.80
PYE 1000 1000/40	0.90
PYE 731 800/250	2.50
RRI 2500-2500/30	1.30
RRI 600/300	2.50
RRI 300 · 300/300	2.50
TCE 950 100 300 100 16	1.00
TCE 1400 150 100 100 100 150	3.70
TCE 1500 150 150 100	2.10
TCE 3000/3500 175/400 · 100 · 100/350	2.70
TCE 3000/3500 600/70	1.00
TCE 3000/3500 220/100	0.70
TCE 8000/8500 2500-2500/63	1.50
TCE 8000/8500 700/200	1.00
TCE 8000/8500 400/350	1.00
TCE 9000 400/400	3.00
TCE 9500 220/400	2.20

MAINS DROPPERS

TCE 140 12R · 16, IK7 · 116 · 462, 126	1.16
TCE 1500 350 · 20, 128, IK5, 317	1.10
TCE 1600 18 Thermal Link 320 · 70, 39	1.10
TCE 3000/3500	0.80
TCE 8000/8000A 56 · 1K, 47, 12 5R · 1R · 100R	1.00
Philips G8 2.2 · 68	0.90
Philips G8 47	0.80
Philips 210 30 · 125, 2K85	0.70
Philips 210 118 · 118 · 148 (Link)	0.65
RRI 154 · 50 · 16 94	0.60
RRI A640 250 · 14 · 156	0.80
GEC 27840 10 · 15 · 19 · 10 · 63 · 188	1.00
GEC 2000	0.80
PYE 731, 735 36 · 27	1.00
PYE 11009 60 · 70 · 173 · 26 · 16 · 17 · 19	1.00
RRI823 56R · 68R	0.80

CONNECTORS

Sets of AVO Leads	10.00
Plug 13A (Box of 20)	8.00
AL Coax Plugs Pack of Ten	1.80
6DB Attenuator	1.00
12DB Attenuator	1.00
18DB Attenuator	1.00
Back to Back Coax	0.40

SERVICE AIDS & TOOLS

Super Servisol	0.82
Foam Cleanser	0.82
Silicone Grease	0.82
Plastic Seal	0.82
Aeroklene	0.82
Freezit	0.82
Antistatic	0.82
Solder 18 SWG 60/40 5KGM	7.50
SR2 Desoldering Tool	9.70
SR3AS Mini Silver	7.00
SR3A Mini Orange	6.80
Replacement Nozzles	0.80
Replacement Washers	0.19
Solder Mop Red	0.60
Solder Mop Brown	0.60
Side Cutters ORYX	3.20
TVTY 80/80 Transistor EQV A-Z or 2N	5.00 each
Books PR	9.00 PF

TELEVISION

April 1981

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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., Lavington House, Lavington Street, London SE1 0PF.

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QUERIES
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Requests for advice in dealing with servicing problems should be directed to our Queries Service. For details see our regular feature "Service Bureau". Send to the address given above (see "correspondence").

this month

OUR NEXT ISSUE DATED MAY WILL BE PUBLISHED ON APRIL 22

TV scores with quality

WHY NOT TRY OUR EXPRESS MAIL ORDER ON ANY OF THE ITEMS LISTED

NEW SPARE SELECTION

TYPE	PRICE £
AC107	0.24
AC113	0.22
AC115	0.23
AC117	0.30
AC125	0.23
AC126	0.23
AC127	0.22
AC128	0.22
AC131	0.13
AC141	0.24
AC142	0.24
AC141K	0.31
AC142K	0.31
AC151	0.21
AC165	0.21
AC166	0.21
AC168	0.22
AC176	0.22
AC176K	0.28
AC178	0.23
AC186	0.26
AC187	0.23
AC188	0.23
AC187K	0.30
AC188K	0.30
AD130	0.58
AD140	0.68
AD142	0.80
AD143	0.70
AD145	0.70
AD149	0.64
AD161	0.42
AD162	0.42
AD161)	
AD162)	1.00
AF106	0.42
AF114	0.37
AF118	0.45
AF121	0.37
AF125	0.30
AF126	0.30
AF127	0.30
AF139	0.40
AF150	0.27
AF151	0.30
AF170	0.92
AF172	1.00
AF178	1.00
AF180	1.00

TYPE	PRICE £
AF181	1.00
AF186	0.90
AF239	0.46
AU113	1.40
BA130	0.08
BA145	0.14
BA148	0.21
BA155	0.08
BAX13	0.05
BAX16	0.08
BC107	0.11
BC108	0.11
BC109	0.11
BC113	0.11
BC114	0.11
BC115	0.11
BC116	0.11
BC117	0.12
BC119	0.24
BC125	0.15
BC126	0.15
BC136	0.15
BC137	0.17
BC137	0.23
BC139	0.23
BC140	0.24
BC141	0.27
BC142	0.27
BC143	0.27
BC147	0.10
BC148	0.10
BC149	0.10
BC153	0.12
BC154	0.12
BC157	0.12
BC158	0.12
BC159	0.12
BC160	0.26
BC161	0.26
BC167	0.11
BC168	0.11
BC169	0.11
BC171	0.10
BC171A	0.10
BC172	0.10
BC173	0.12
BC177	0.12
BC178	0.12
BC178A	0.12

TYPE	PRICE £
BC179	0.12
BC182L	0.09
BC183L	0.09
BC183LA	0.10
BC183LB	0.10
BC184L	0.09
BC186	0.21
BC187	0.21
BC209	0.11
BC212	0.09
BC212L	0.09
BC213L	0.09
BC214L	0.09
BC237	0.09
BC238	0.09
BC240	0.31
BC249	0.35
BC251	0.22
BC257	0.20
BC262	0.18
BC263B	0.20
BC267	0.19
BC281	0.24
BC300	0.27
BC301	0.27
BC302	0.30
BC303	0.27
BC307	0.11
BC307A	0.11
BC308A	0.12
BC309	0.14
BC337	0.12
BC338	0.15
BC487	0.20
BC547	0.10
BC548	0.11
BC549	0.11
BC557	0.12
BCX33	0.10
BD112	0.39
BD113	0.65
BD115	0.32
BD116	0.47
BD124	1.30
BD131	0.36
BD132	0.36
BD133	0.37
BD135	0.30
BD136	0.30

TYPE	PRICE £
BD137	0.30
BD138	0.31
BD139	0.40
BD140	0.37
BD144	1.39
BD145	0.50
BD177	0.50
BD178	0.50
BD203	0.40
BD204	0.70
BD222	0.73
BD233	0.36
BD234	0.34
BD237	0.44
BD238	0.44
BDX22	0.73
BDX32	1.98
BDY18	0.80
BDY60	0.80
BF115	0.30
BF12:	0.29
BF154	0.12
BF158	0.19
BF159	0.24
BF160	0.23
BF163	0.30
BF164	0.30
BF167	0.30
BF173	0.21
BF177	0.26
BF178	0.24
BF179	0.28
BF180	0.30
BF181	0.34
BF182	0.30
BF183	0.29
BF184	0.27
BF185	0.29
BF186	0.32
BF192	
BF194	0.15
BF195	0.13
BF196	0.13
BF197	0.13
BF198	0.12
BF199	0.14
BF200	0.28
BF216	0.12
BF217	0.12

TYPE	PRICE £
BF218	0.12
BF219	0.12
BF220	0.12
BF221	0.21
BF222	0.12
BF224	0.18
BF256	0.37
BF258	0.30
BF259	0.30
BF260	0.25
BF262	0.28
BF263	0.25
BF271	0.27
BF272	0.27
BF273	0.16
BF336	0.30
BF337	0.29
BF338	0.29
BF479	—
BFT	0.27
BFT	0.27
BFX84	0.27
BFX85	0.27
BFX	0.30
BFY37	0.22
BFY50	0.21
BFY51	0.21
BFY52	0.21
BFY53	0.27
BFY55	0.33
BFX	—
BHA0002	1.90
BSX20	0.23
BSX76	0.23
BSY84	0.36
BU105	1.00
BU105 02	1.50
BU105 04	2.00
BU126	1.40
BU205	1.20
BU206	1.60
BU208	1.60
OC22	1.10
OC23	1.30
OC24	1.30
OC25	1.00
OC26	1.00
OC28	1.30
OC35	1.00

TYPE	PRICE £
OC36	0.90
OC38	0.90
OC42	0.45
OC44	0.60
OC45	0.50
OC46	0.39
OC70	0.39
OC71	0.39
OC72	0.39
OC74	0.39
OC75	0.39
OC76	0.39
OC77	0.50
OC78	0.23
OC81	0.26
OC810	0.14
OC82	0.26
OC820	0.20
OC83	0.30
OC84	0.30
OC85	0.28
OC123	0.25
OC169	1.20
OC170	1.20
OC171	0.92
OA91	0.07
BRC4443	0.65
R2008B	1.50
R2009	1.30
R2010B	1.50
R2265	1.50
R2305	0.38
R2305	
BD222	0.37
R2540	2.50
S2802	—
SCR957	0.65
TIP31A	0.38
TIP32A	0.36
TIP3055	0.53
TIP31B	0.39
TIS90	0.23
TIS91	0.25
TV106	1.09
MJE340	0.50
MJE520	0.45
2N2219	0.40
2N2646	0.40
2N2926	0.15

TYPE	PRICE £
2N3053	0.21
2N3054	0.60
2N3055	0.60
2N3442	1.00
2N3702	0.15
2N3703	0.12
2N3704	0.18
2N3705	0.18
2N3706	0.14
2N3707	0.14
2N3708	0.14
2N3772	2.00
2N3773	2.50
2N3819	0.30

VALVES

DY87	0.60
DY802	0.64
ECC82	0.60
EF80	0.55
EF183	0.70
EF184	0.70
EH90	0.75
PC86	0.85
PCC89	0.65
PCC189	0.80
PCF80	0.80
PCF86	0.72
PCF801	0.70
PCF802	0.85
PCL82	0.75
PCL84	0.80
PCL86	0.85
PCL805	0.82
PLF200	1.00
PL36	£1.10
PL84	0.80
PL504	0.30
PL508	1.50
PL509	2.45
PL802	0.75
PY88	0.75
PY500A	1.60
PY81/800	0.70

E.H.T. Trays Colour

TYPE	PRICE £
Pye 691 693	4.50
Pye 715/731/735	5.50
Pye 737	5.40
Decca (Large Screen) CS2030/2232/2630/2632/2230/2233/2631	5.00
Decca 80	5.30
Decca 100	5.30
Philips G8 520/540	5.30
Philips G9	5.50
Philips 550	5.30
GEC C2110	5.50
GEC Hybrid CTV	5.10
Thorn 3000/3500	5.00
Thorn 800	2.42
Thorn 8500	4.75
Thorn 9000	5.50
GEC TVM25	2.50
ITT KB CVC 5/7/8/9	5.10
ITT KB CVC 20/25 30/32	5.50
Bush CTB25 MK3 Quadrupler	8.00
Bush X179	4.50
RRI (RBM) A823	5.00
Bang & Olufsen 4/5000 Grundig 5010/5011/5012/6011/6012/7200/2052/2210/2252R Tandberg (radionette) Autovox	6.60
Grundig 3000/3010 Saba 2705/3715 Telefunken 709/710/717/2000	6.80
Korting	6.80

E.H.T. TRAYS MONO

950 MK2 1400	4.20
1500 18" 19" stick	3.80
1500 24" 5 stick	4.25
Single Stick Thorn TV 11, 16K 70V	0.75
TV 20 2 MT	0.75
TV 2016K 18V	0.75
BUSH 718	1.30

All transistors. IC's offered are new and branded. Manufactured by Mullard, I.T.T., Texas, Motorola etc.
Please add 15% VAT to all items and overseas at cost
P & P U.K. 50p per order, overseas allow for package and postage. Cash with all orders. All prices subject to alteration without notice.

MAIL ORDER TV BARGAINS

PYE 691	22"	@ £55.00
PYE 691	26"	@ £55.00
PYE 697	22"	@ £65.00
PYE 697	26"	@ £65.00
BUSH 184	19"	@ £70.00
BUSH 184	22"	@ £70.00
BUSH 184	26"	@ £70.00
GEC 2040	19"	@ £55.00
GEC2040	22"	@ £55.00
GEC 2040	25"	@ £55.00
GEC 2040	26"	@ £65.00
KORTING	22"	@ £70.00
KORTING	26"	@ £80.00
THORN 3000	19"	@ £70.00
THORN 3000	25"	@ £60.00

Good working mono's Pye, GEC, Bush etc.

20" & 24" S/S	£20.00
20" & 24" D/S	£18.00
19" & 23" D/S P/Button	£15.00
19" & 23" D/S Rotary	£12.00

Cheques, P.O. or Cash with orders Please. Please note there is 15% VAT on all the above prices. Plus £10.00 p & p for colour TV, £5.00 for mono. ENGLAND, WALES and SCOTLAND. Inland N & S IRELAND £15.00 for colour. £7.00 for mono.

TYPE	PRICE £
IC's	
BTT6018	1.00
CA3605	1.20
MC7/c	
MC14016	0.50
SN76003N	1.40
SN76013N	1.20
SN76013ND	1.00
SN76023N	1.20
SN76023ND	1.00
SN76110N	1.00
SN76226DN	1.50
SN76227N	1.20
SN76532N	1.30
SN76550N	0.30
SN76666N	0.70
TAA570	1.38
TBA120AS	1.00
TBA120S	0.75
TBA120SQ	0.75
TBA395	2.20
TBA341	0.97
TBA520	1.40
TBA520Q	1.10
TBA530Q	1.10
TBA540	1.30
TBA540Q	1.45

TBA550Q	1.40
TBA560C	1.50
TBA560CQ	1.50
TBA570	1.00
TBA570Q	1.00
TBA800	1.00
TBA810	1.50
TBA920	2.00
TBA920Q	1.50
TBA990Q	1.50
TCA270SQ	1.45
TCA270SA	1.45
TCA270Q	—
TCA1327B	1.00
TCA800	2.00
TDA1010	—
TDA1327B	1.00
SBA750	1.75
SC9503P	1.20
SC9504P	1.20
SL901B	3.50
SL917B	5.00
DIODES & THYRISTORS	
OA47	0.06
OA81	0.06
OA90	0.06
OA91	0.07
BA130	0.10
BA145	0.16
BA148	0.18
BA154	0.18
BA155	0.10

BAX13	0.08
BAX16	0.10
BY126	0.10
BY127	0.10
BY164	0.40
BY179	0.57
BY226	—
BY227	0.12
BYF206	0.14
1N4001	0.04
1N4002	0.05
1N4003	0.06
1N4004	0.07
1N4005	0.07
1N4006	0.08
1N4007	0.08
1N4148	0.05
1N4751	0.14
1N5401	0.12
1N5403	0.12
1N5404	0.14
1N5405	0.14
1N5406	0.14
1N5408	0.25
BR100	0.22
BR101	0.28
BT106	1.19
BT108	1.23
BT109	1.09
BT116	1.60
BT120	1.60
2N4444	0.90

EXPORT COLOUR & MONO TV's AVAILABLE READY FOR USE OVERSEAS

BRIARWOOD TELEVISION LTD
Briarwood House, Preston Street, Bradford West Yorkshire BD7 1LU
Tel: (0274) 306018

TRANSISTORS, ETC.

Type	Price (£)
AC107	0.48
AC117	0.38
AC126	0.36
AC127	0.54
AC128	0.46
AC128K	0.55
AC141	0.65
AC141K	0.70
AC142	0.60
AC142K	0.65
AC151	0.31
AC152	0.36
AC153	0.42
AC153K	0.52
AC154	0.41
AC176	0.45
AC178	0.51
AC179	0.55
AC187	0.56
AC187K	0.65
AC188	0.52
AC188K	0.61
AC193K	0.70
AC194K	0.74
ACY17	1.20
ACY19	0.95
ACY28	0.98
ACY39	2.02
AD140	1.79
AD142	1.90
AD143	1.78
AD149	1.42
AD161	0.66
AD161/162	1.22
AD162	0.71
AF114	1.32
AF115	1.26
AF116	1.28
AF117	1.32
AF118	0.98
AF121	0.68
AF124	0.38
AF125	0.38
AF126	0.36
AF127	0.66
AF139	0.58
AF147	0.52
AF149	0.45
AF178	1.35
AF179	1.36
AF180	1.35
AF181	1.33
AF186	1.48
AF202	0.27
AF239	0.73
AF240	1.40
AF279S	0.91
AL100	1.30
AL103	1.58

Type	Price (£)
AU103	2.40
AU107	2.75
AU110	2.40
AU113	2.60
BC107*	0.16
BC108*	0.15
BC109*	0.16
BC113	0.22
BC114	0.22
BC115	0.24
BC116*	0.25
BC117	0.30
BC118	0.24
BC119	0.34
BC125*	0.30
BC126	0.30
BC132	0.20
BC134	0.22
BC135	0.21
BC136	0.22
BC137	0.30
BC138	0.35
BC140	0.36
BC141	0.44
BC142	0.35
BC143	0.38
BC147*	0.12
BC148*	0.12
BC149*	0.13
BC152	0.42
BC153	0.38
BC154	0.41
BC157*	0.13
BC158*	0.12
BC159*	0.14
BC160	0.52
BC161	0.58
BC167B	0.15
BC168B	0.14
BC169C	0.15
BC170*	0.15
BC171*	0.15
BC172*	0.14
BC173*	0.22
BC174A & B	0.26
BC176	0.22
BC177*	0.20
BC178*	0.22
BC179*	0.28
BC182*	0.15
BC182L*	0.15
BC183*	0.14
BC183L*	0.14
BC184*	0.15
BC184L*	0.15
BC185	0.36
BC186	0.25
BC187	0.27

Type	Price (£)
BC192	0.56
BC204*	0.39
BC205*	0.39
BC206*	0.37
BC207*	0.39
BC208*	0.37
BC209*	0.39
BC211*	0.36
BC212*	0.17
BC212L*	0.17
BC213*	0.16
BC213L*	0.18
BC214*	0.18
BC214L*	0.18
BC225	0.42
BC237*	0.16
BC238*	0.15
BC239*	0.22
BC251*	0.25
BC252*	0.26
BC253*	0.38
BC261A*	0.28
BC262A*	0.28
BC263*	0.28
BC267*	0.20
BC268*	0.28
BC286	0.40
BC287	0.49
BC291	0.27
BC294	0.37
BC297	0.36
BC300	0.62
BC301	0.38
BC302	0.66
BC303	0.64
BC304	0.44
BC307*	0.17
BC308*	0.14
BC309*	0.18
BC317*	0.15
BC318*	0.15
BC319*	0.19
BC320	0.17
BC321A&B	0.18
BC322	0.28
BC323	1.15
BC327	0.22
BC328	0.18
BC337	0.17
BC338	0.17
BC340	0.19
BC347*	0.17
BC348A & B	0.17
BC349B	0.17
BC350*	0.24
BC351*	0.22
BC352A*	0.24
BC360	0.59

Type	Price (£)
BC377	0.29
BC394	0.39
BC440	0.52
BC441	0.59
BC461	0.78
BC477	0.30
BC478	0.25
BC479	0.33
BC547*	0.13
BC548*	0.13
BC549*	0.15
BC550	0.24
BC556	0.23
BC557*	0.16
BC558*	0.16
BC559*	0.17
BCY10	0.30
BCY30A	1.06
BCY32A	1.19
BCY34A	1.02
BCY72	0.27
BD115	1.35
BD123	1.50
BD124	1.85
BD130Y	1.56
BD131	0.58
BD132	0.68
BD133	0.70
BD135	0.37
BD136	0.38
BD137	0.40
BD138	0.42
BD139	0.46
BD140	0.50
BD144	2.24
BD145	0.75
BD150A*	0.51
BD155	0.90
BD157	0.51
BD158	0.75
BD159	0.68
BD160	2.69
BD163	0.67
BD165	0.64
BD166	0.88
BD175	0.90
BD177	0.58
BD178	0.92
BD181	1.94
BD182	2.10
BD183	1.34
BD184	2.30
BD187	1.20
BD188	1.25
BD189	0.71
BD222	0.91
BD225	0.91
BD232	0.91
BD233	0.62

Type	Price (£)
BD234	0.68
BD235	0.63
BD236	0.63
BD237	0.68
BD238	0.68
BD253	1.58
BD410	1.65
BD433	0.65
BD435	0.70
BD436	0.71
BD437	0.74
BD438	0.75
BD519	0.88
BD520	0.88
BD599	0.87
BD600	1.23
BD663BR	0.86
BDX18	1.55
BDX32	2.95
BDY16A	0.63
BDY18	1.55
BDY20	2.29
BDY38	1.38
BF115	0.48
BF117	0.45
BF120	0.55
BF121	0.85
BF123	0.48
BF125	0.68
BF127	0.51
BF137F	0.78
BF152	0.19
BF158	0.25
BF159	0.27
BF160	0.20
BF161	0.84
BF163	0.65
BF164	0.95
BF166	0.50
BF167	0.38
BF173	0.35
BF177	0.36
BF178	0.46
BF179	0.58
BF180	0.53
BF181	0.53
BF182	0.44
BF183	0.52
BF184	0.44
BF185	0.42
BF186	0.42
BF194*	0.14
BF195*	0.13
BF196	0.14
BF197	0.15
BF198	0.29
BF199	0.29
BF200	0.25
BF218	0.42

Type	Price (£)
BF222	0.51
BF224 & J	0.22
BF240	0.32
BF241	0.31
BF244*	0.51
BF245*	0.43
BF254	0.48
BF255	0.58
BF256L*	0.49
BF257	0.44
BF258	0.52
BF259	0.54
BF262	0.73
BF263	0.88
BF270	0.47
BF271	0.42
BF272A	0.80
BF273	0.33
BF274	0.34
BF336	0.63
BF337	0.65
BF338	0.68
BF355	0.72
BF362	0.49
BF363	0.49
BF367	0.29
BF451	0.43
BF457	0.46
BF458	0.49
BF459	0.52
BF594	0.16
BF596	0.17
BF597	0.27
BFR39	0.30
BFR40	0.29
BFR41	0.30
BFR50	0.29
BFR52	0.33
BFR61	0.29
BFR62	0.28
BFR79	0.30
BFR80	0.29
BFR81	0.30
BFR88	0.42
BFT41	0.48
BFT43	0.55
BFW11	0.44
BFW30	2.58
BFW59	0.19
BFW60	0.20
BFW90	0.65
BFX29	0.38
BFX84	0.42
BFY50	0.38
BFY51	0.37
BFY52	0.36
BFY53	0.36
BFY90	1.98
BPX25	1.62

Type	Price (£)
BPX29	1.62
BR101	0.53
BR103	0.64
BR303	1.06
BRC4443	1.76
BRY39	0.60
BRY56	0.44
BSS27	0.92
BT106	1.50
BT109	1.99
BT116	1.45
BT119	5.18
BU102	3.35
BU105	1.80
BU105/02	1.95
BU108	2.98
BU126	2.91
BU204	2.50
BU205	2.58
BU206	2.59
BU208	2.75
BU407	1.38
BUY77	2.50
C106D	0.80
C106F	0.43
C111E	0.46
D40N1	0.64
E300	0.42
E1222	0.47
E5024	0.19
GET872	0.46
ME0402	0.18
MF0404/02	0.18
ME6001	0.18
ME6002	0.18
MJ2955	1.30
MJ3000	1.58
MJE340	0.68
MJE341	0.72
MJE370	0.74
MJE371	0.79
MJE520	0.85
MJE521	0.95
MJE2955	1.20
MJE3000	1.95
MJE3055	1.22
MPF102	0.40
MPS3702	0.33
MPS3705	0.30
MPS6521	0.36
MPS6523	0.36
MPS6566	0.44
MPSA05	0.30
MPSA06	0.32
MPSA55	0.43
MPSA56	0.45
MPSA93	0.56
MPSL01	0.33
MPSU01	0.61

Type	Price (£)
MPSU05	0.66
MPSU06	0.76
MPSU55	1.26
MPSU56	1.32
MPSU60	0.82
MPU131	0.59
OC26	1.90
OC28	1.49
OC29	1.60
OC35	1.25
OC36	1.25
OC42	0.90
OC44	0.68
OC45	0.63
OC70	0.65
OC71	0.73
OC72	0.73
OC81	0.83
OC81D	0.95
OC139	1.30
OC140	1.35
OC170	0.80
OC171	0.82
OC200	3.90
OC201	3.95
OC202	2.40
OC205	3.95
OCP71	1.98
ON236A	0.94
R2008B	2.72
R2010B	2.79
R2322	0.75
R2323	0.85
ST2110	0.49
ST6120	0.48
TIC44	0.25
TIC46	0.35
TIC47	0.45
TIP29A	0.47
TIP30A	0.50
TIP31A	0.51
TIP31C	0.67
TIP32A	0.56
TIP32C	0.72
TIP33A	0.77
TIP34A	0.84
TIP41A	0.72
TIP42A	0.80
TIP2955	0.77
TIP3055	0.58
TIS43	0.44
TIS73	1.36
TIS90	0.23
TIS91	0.28
ZTX108	0.14
ZTX109	0.16
ZTX213	0.23
ZTX300	0.16
ZTX304	0.26

Type	Price (£)
ZTX500	0.18
ZTX502	0.22
ZTX504	0.28
2N404	1.30
2N696	0.46
2N697	0.46
2N706A	0.33
2N708	0.29
2N914	0.32
2N916	0.46
2N918	0.54
2N930	0.29
2N1164	10.29
2N1304	1.40
2N1305	1.29
2N1306	1.49
2N1307	1.32
2N1308	1.53
2N1711	0.47
2N1893	0.52
2N2102	0.71
2N2217	0.55
2N2218	0.38
2N2219	0.42
2N2221A	0.26
2N2222A	0.41
2N2369A	0.41
2N2401	0.80
2N2484	0.35
2N2570	0.74
2N2646	0.82
2N2784	1.15
2N2869	2.08
2N2894	0.45
2N2904*	0.40
2N2905*	0.39
2N2906*	0.36
2N2926G	0.15
2N2926O	0.14
2N2926Y	0.14
2N2955	1.12
2N3053	0.48
2N3054	0.66
2N3055	0.72
2N3250	0.52
2N3254	0.58
2N3391A	0.38
2N3633	0.80
2N3703	0.17
2N3704	0.19
2N3705	0.17
2N3706	0.16
2N3707	0.18
2N3708	0.17
2N3715	1.70
2N3771	2.09
2N3772	2.08
2N3773	2.90
2N3794	0.40

Type	Price (£)
2N3819	0.47
2N3820	0.72
2N3866	1.08
2N3904	0.20
2N3905	0.20
2N3906	0.20
2N4036	0.94
2N4123	0.17
2N4124	0.17
2N4126	0.17
2N4236	2.20
2N4289	0.32
2N4292	0.32
2N4416	0.85
2N4444	1.90
2N4921	0.80
2N5042	1.65
2N5060	0.28
2N5061	0.30
2N5064	0.63
2N5086	0.49
2N5087	0.50
2N5208	0.59
2N5294	0.66
2N5296	0.68
2N5298	0.71
2N5322	1.16
2N5449	0.18
2N5457	0.46
2N5458	0.40
2N5459	0.58
2N5494	0.85
2N5496	1.05
2N6027	0.55
2N6107	0.71
2N6122	0.60
2N6178	1.07
2N6180	1.39
2N6211	2.74
2SB337BP	4.28
2SC458C	0.78
2SC643A	2.25
2SC930D	1.50
2SC1061	1.45
2SC1172Y	3.58
2SD234	1.48
3N128	1.60
40250	0.98
40251	1.14
40327	0.67
40361	0.48
40362	0.50
40410	0.94
40429	0.88
40530	0.79
40595	1.39
40603	1.13
40636	1.25
40654	0.89

Alternative gain versions available on items marked*. For matched pairs add 20p per pair.

LINEAR IC's

Type	Price (£)
BRC1330	0.93
CA810QM	2.44
CA3005	1.85
CA3012	1.45
CA3014	2.23
CA3018	0.71
CA3020	1.89
CA3028A	0.80
CA3028B	1.09
CA3045	3.75
CA3046	0.70
CA3065	1.74
CA3068	1.90
CA3130S	1.57
FCH181	2.40
FCJ101	3.32
LM309K	1.98
LM380N-14	1.65
LM1303N	1.03
MC1307P	1.82
MC1310P*	1.84
MC1312P	2.34
MC1327P*	1.86
MC1330P	0.83
MC1350P	1.22
MC1351P	1.42
MC1352P	1.42
MC1357P	2.92
MC1358P*	2.30
MC1458G	1.43
MC1496L	1.15
MC3051P	0.58
MFC4008	0.85
MFC4060A	0.98
MFC6040	1.11
MFC8020A	1.10
ML231	3.57
ML232	3.57
NE555	0.72
NE556	1.34
NE566	1.95
SAA1024	5.70
SAA1025	10.35
SAS560A	2.01
SAS570	2.01
SC9503P	1.40
SC9504P	1.38
SL414A	1.91
SL432A	2.52
SL450	5.10
SL901B	4.20
SL917B	5.60
SL918A	5.95
SN72440N	2.21
SN76001N	1.67
SN76003N	2.20

Type	Price (£)
SN76008KE	2.56
SN76013N	1.56
SN76013ND	1.40
SN76018KE	2.56
SN76023N	1.56
SN76023ND	1.40
SN76033N	2.20
SN76110N	1.20
SN76115N	1.62
SN76116N	1.78
SN76131N	2.10
SN76226N	2.60
SN70227N	1.61
SN76228N	1.80
SN76502N	1.92
SN76530P	0.97
SN76533N	1.38
SN76544N	1.85
SN76546N	1.85
SN76570N	1.81
SN76620AN	0.99
SN76650N	1.48
SN76660N	0.64
SN76666N	0.96
TA7073P	3.51
TAA263	2.20
TAA300	3.85
TAA320	1.10
TAA350A	2.48
TAA370A	3.18
TAA435	1.70
TAA450	3.39
TAA521	1.10
TAA522	2.09
TAA550	0.35
TAA560	1.93
TAA570	2.20
TAA611A	1.87
TAA611B	1.89
TAA621AXI	2.33
TAA630Q	3.91
TAA630S	4.18
TAA661A	2.39
TAA661B	1.75
TAA700*	2.80
TAA840	3.38
TAA861A	0.95
TAA930A	1.43
TAA930B	1.43
TAA960	3.20
TAA970	2.81
TAD100	2.66
TBA120A	0.90
TBA120S*	0.99
TBA120SA	1.02
TBA231	1.12

Type	Price (£)
TBA240A	3.98
TBA281	2.07
TBA395*	2.58
TBA396	2.40
TBA400	2.20
TBA480Q	1.84
TBA500*	2.21
TBA510*	2.21
TBA520*	2.98
TBA530P	2.24
TBA540*	2.88
TBA550*	3.13
TBA560C*	3.18
TBA570*	1.29
TBA611B	2.68
TBA641	2.55
TBA641A12	2.35
TBA641B11	2.61
TBA651	2.12
TBA673	2.31
TBA700*	2.50
TBA720AQ	2.38
TBA720Q	2.38
TBA750*	2.18
TBA800	1.65
TBA810AS	1.69
TBA920*	2.80
TBA940	3.52
TBA950	2.08
TBA990*	2.90
TCA270A*	3.55
TCA280A	1.43
TCA290A	3.46
TCA420A	2.10
TCA440	1.67
TCA640	4.26
TCA650	4.26
TCA660	4.26
TCA730	4.10
TCA740	4.04
TCA750	2.53
TCA760	1.52
TCA820	3.29
TDA440	4.16
TDA1003	1.68
TDA1004	2.73
TDA1005	3.04
TDA1022	6.89
TDA1024	0.97
TDA1034	2.98
TDA2610	2.86
TDA2640	2.86
ZN414	1.45

* Indicates Q version is also available.

DIODES

Type	Price (£)
AA113	0.17
AA119	0.21
AA129	0.28
AA143	0.18
AAY30	0.28
AAZ13	0.42
AAZ15	0.35
AAZ17	0.28
AY102	3.85
BA100	0.24
BA102	0.36
BA104	0.19
BA110	0.80
BA111	0.70
BA115	0.17
BA116	0.56
BA121	0.85
BA129	0.45
BA145	0.19
BA148	0.19
BA154	0.06
BA155	0.17
BA156	0.12
BA157	0.25
BA158	0.28
BA159	0.40
BA164	0.14
BA182	0.27
BA201	0.13
BA202	0.14
BA203	0.14
BA216	0.08
BA219	0.11
BA243	0.45
BA317	0.06
BA318	0.07
BAV10	0.10
BAV21	0.18
BAW62	0.06
BAX13	0.07
BAX16	0.10
BAX17	0.19
BAY72	0.16
BB104B	0.52
BB105B	0.33
BB105G	0.30
BR100	0.40
BY100	0.35
BY103	0.35

Type	Price (£)
BY114	0.60
BY118	1.10
BY126	0.20
BY127	0.21
BY133	0.35
BY140	1.40
BY164	0.75
BY176	2.80
BY179	0.63
BY182	1.14
BY184	0.44
BY189	5.30
BY190	4.90
BY206	0.26
BY238	0.25
BYX10	0.30
BYX38/600	0.70
BYX70/500	0.53
ITT44	0.08
ITT210	0.63
ITT827	0.80
MCR101	0.48
MR854	1.10
OA5	0.88
OA10	0.58
OA47	0.20
OA81	0.19
OA90	0.13
OA91	0.15
OA95	0.20
OA200	0.13
OA202	0.13
OA210	0.89
TIL209	0.14
TIL211	0.18
TV20	2.25
IN914	0.06
IN916	0.06
IN4001	0.06
IN4002	0.07
IN4003	0.08
IN4004	0.08
IN4005	0.09
IN4006	0.10
IN4007	0.12
IN5400	0.15
IN5401	0.17
IN5402	0.20
IS920	0.09
IS921	0.11

ZENER DIODES

400mW plastic	3.0-75V	14p each
1/1.3W plastic	3.3-200V	18p each
1.5W flange	4.7-75V	† £1.26 each
2.5W plastic	7.5-75V	67p each
20W stud	7.5-75V	£1.31 each
75W stud	7.5-75V	£7.95 each

VDR's, etc.

Type	Price (£)
E295ZZ	
/01	0.28
/02	0.28
E298CD	
/A258	0.25
E298ED	
/A258	0.22
/A260	0.22
/A262	0.22
/A265	0.22
/P268	0.22
E298ZZ	
/05	0.25
/06	0.22
E299DD/P116-P354	all 0.23
E299DH	
/P230	0.72
R53	1.75
VA1015	0.92
VA1026	0.79
VA1033/34/38/39/40/53	all 0.20
VA1055s/56s/66s/67s	all 0.23
VA1074	0.20
VA1077	0.31
VA1091	0.29
VA1096/97/98	all 0.20
VA1103	0.32
VA1104	0.86
VA1108/09/10/11/12	all 0.24
VA8650	1.20
2322 554 02221	0.59
2322 662 98003	0.88

VALVES

Type	Price (£)
DY86/87	0.75
DY802	0.75
ECC81	0.78
ECC82	0.95
ECC83	0.78
ECH81	0.83
ECL80	0.82
EF80	0.60
EF183	0.75
EF184	0.75
EH90	0.94
EL34	3.08
EY51	1.20
EY86/87	0.67
PCC84	0.61
PCC85	0.79
PCC89	0.74
PCC189	0.94
PCF80	1.20
PCF86	0.87
PCF200	2.32
PCF801	0.74
PCF802	1.20
PCF805	3.37
PCF808	2.00
PCL82	0.93
PCL83	1.12
PCL84	0.65
PCL86	1.27
PCL805/85	1.00
PD500	3.75
PFL200	1.40
PL36	1.20
PL81	0.94
PL84	0.79
PL504	1.50
PL508	1.85
PL509	3.10
PL519	3.10
PL802	3.25
PY81/P810	0.60

BRIDGES

Rating	Price (£)	Rating	Price (£)
1½A 50V	0.27	2A 100V	0.36
100V	0.28	200V	0.40
200V	0.32	400V	0.47
400V	0.40	600V	0.53
600V	0.50	800V	0.60
800V	0.58	1000V	0.87
3A 100V	0.52	6A 100V	0.86
200V	0.55	200V	0.68
400V	0.61	400V	0.74
600V	0.67	600V	0.80
800V	0.80	800V	0.86
1000V	1.20	1000V	0.95

10A and 25A ranges also stocked.

RESISTORS

Carbon Film (5%)

	Ea	10 of one value	50pc	100pc	500pc
¼W 5.6Ω-330kΩ (E12)	3p	25p	95p	£1.49	£5.40
½W 10Ω-10MΩ (E24)	3p	25p	95p	£1.49	£5.40
1W 10Ω-10MΩ (E12)	5p	45p	£1.95	£3.40	£15.25
2W 10Ω-10MΩ (E6)	9p	80p	£3.60	£6.40	£26.90

Mixes of a minimum of 10pcs of any value.

Wirewound (5%)

2½W 0.22Ω-270Ω	18p
4W 1.0Ω-10kΩ	22p
7W 0.68Ω-22kΩ	24p
11W 1.0Ω-22kΩ	28p
17W 1.0Ω-22kΩ	33p
Vertical mounting pillars	3p

Presets (†)

0.1W (Vertical and Horizontal) 100, 220, 470Ω, 1, 2·2, 4·7, 10, 22, 47, 100, 220, 470kΩ, 1, 2·5, 5MΩ **all 14p each**

0·2W (Vertical and Horizontal) Values as 0·1W **all 14p each**

FUSES (all packs of 10)

20mm Time Delay (BEAB)

40mA	£3.68
50, 63mA	£2.55
100mA	£1.88
160, 200, 250mA	£1.44
315, 500, 800mA, 1, 1.25, 1.6, 2, 2.5, 3.15, 5A	all £1.19

20mm quick-blow (BEAB)

100mA	68p
200, 250, 315, 500, 630, 800mA, 1, 1.25, 1.6, 2, 2.5, 3.15, 5A	all 56p
2A circuit breakers metal	£1.52
plastic	£1.48

LABGEAR (Details of full range on request)

TELETEXT ADAPTOR 7056. An amazing box which can be used with any UHF Receiver. **£213** + £2.25 P&P + VAT. – ask us for a fully descriptive brochure.
VIEWDATA ADAPTOR 7050. Prices and details on request.

COLOUR BAR GENERATOR
CM6052/DB. VHF/UHF gives standard 8 band colour bars + variable tuning + front panel on/off switch + sync trigger output + blank raster + red raster + crosshatch + greyscale stepwedge + colour bar + centre cross + dot pattern + centre dot. **£223.37**

CAPACITORS

Metallised Paper

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

H.V. Disc Ceramic (†)

1kV	1.5nF	18p
3kV	1.5nF	20p
8kV	10, 22, 47, 82, 100, 120, 150, 180, 200, 220pF	30p
8kV	270, 300pF	39p
10kV	1nF	67p

CONVERGENCE POTENTIOMETERS
5, 7, 10, 15, 20, 50, 100, 200, 500Ω **†38p each**

VHF to UHF CONVERTER CM6022/RA. "Televerta" for DX-ing or uhf receiver use on relay systems, Eire etc. **†£28.37**

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TELEVISION

COVER PHOTO

Our cover photograph this month was provided by Mullard Ltd. and shows an ion implantation machine at their Southampton factory being used in the production of i.c.s for teletext and viewdata applications. Ion implantation allows the doping levels in semiconductor material to be very closely controlled. Mullard Ltd. is currently the largest UK manufacturer of teletext and viewdata chips. Production is expected to reach two million this June, with half exported.

Tackling Technology

For those concerned with maintaining consumer electronic products, the problems of keeping pace with the developing technology are ever increasing. In such fields as plumbing and car servicing the principles change little while the applications change but slowly. Joe Bloggs Crash Repairs is unlikely to be called upon to service an aeroplane or a guided weapon, nor will anyone phone South Croydon Heating and Plumbing Ltd. because their teleprinter's had a fit. Things of this sort seem to be happening to us all the time however! Complicated, sometimes gimmicky, TV sets, projection models, colour TV cameras, VCRs in six different formats, half of them already obsolete, and, coming shortly, synthesized tuning and video discs. How can even the most conscientious technician keep up to date on all these fronts?

If he's good at his job, well equipped and not too rushed, he'll be able to put right most of the things that come his way. But what happens when he comes up against an obscure intermittent fault in a piece of equipment he only half understands and has never seen before? How does he cope when he doesn't know what standard of performance to expect from a new piece of equipment and is confronted by a demanding customer who's just parted with several hundred pounds? What's he to do with a nice little TV camera which gives a sickly green and grey picture when the poorly designed manual (which he conscientiously ordered as soon as he saw the thing on the shop shelves) hasn't a word of circuit description and calls for heaven knows what in the way of test jigs and equipment?

Some would say that the answer to these very real problems lies in training courses run by manufacturers or maybe the local technical college. The value of such things is not nowadays, we submit, as great as it once was. Human nature being what it is (and we speak from experience in these matters), the details so carefully collated and mentally digested tend to get blurred and forgotten unless one is dealing with the piece of equipment concerned constantly. Five or ten years ago, servicing courses on the Thorn 3000 say or the ITT hybrids were worth their weight in gold, but with the high reliability of the latest sets and their diverse circuitry you all too often find yourself confronted on a service assignment with a product you've never seen before – inside, anyway. Be you the most able engineer in the world, this isn't good for the ego or for customer relations!

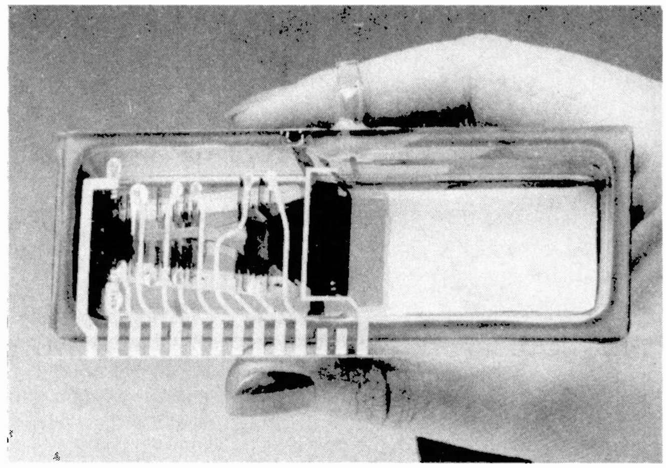
So we have to resort more and more often to the manufacturer's Technical Department. Roving technical liaison engineers seem to be getting rarer these days, and their job is to inform and advise – not repair equipment! Now irate customers and problems with showroom displays cannot await the exchange of learned correspondence between the dealer's engineer and the setmaker's technical office, so the telephone is often the only resort available – if you see a glowing telephone line alongside the A21, it'll probably be because a new type of VCR is on the shelves and going wrong on approval in customers' homes, and the manufacturer has yet to get around to distributing service manuals!

When we phone, how greatly our reception varies! How different are the oracles of Sydenham and Shropshire, of Slough and Gloucester! Having circumnavigated the obstacle course presented by separate telephone numbers for different departments, and often had to swallow the considerable financial pill of waiting many minutes on the phone before getting through to the hapless adviser in the technical office, we find a tremendous variation in the service offered – varying from the excellent to the abysmal. We don't mean to knock these gents, most of whom are friendly and helpful souls doing a thankless task, sometimes in very difficult circumstances. It can't be denied that some of their enquiries come from people who shouldn't be dabbling with this sort of equipment at all, and we know from our own experience with the query service that diagnosis from afar is often difficult even with all the necessary information to hand, and sometimes impossible without.

Even so, how many manufacturers and agents can put their hands on their hearts and claim that their technical liaison department does justice to the clever wizards who design the circuits, specify the components and arrange for the lot to be put together? We can think of one, maybe two, amongst the two score or so of setmakers with whom we deal. Some liaison people we reach on the telephone have never worked on the equipment upon which they advise us; some seem to try to get by on clouds of theory; some just frankly admit that they are not conversant with this or that product, and cheerfully suggest we forward it to them for attention – sometimes a totally impractical course.

Is it too much to expect a circuit description in a service manual covering a new and complex product? How many hours, and hard earned pounds, have been spent on endless dialling of engaged numbers in south and south east London, and in waiting for the technical office to become free? No doubt readers will have comments to make and views to express on this difficult subject – maybe even one of the denizens of a technical office would care to give his viewpoint. Over to you!

Teletopics



One of the Sinclair flat-screen tubes produced on the pilot production line at St. Ives, Cambridgeshire.

SINCLAIR'S POCKET TV

Sinclair Research Ltd. have announced a £5 million, four-year capital investment programme to put into full-scale production their Model 2700 pocket radio/TV set with its innovatory flat-screen c.r.t. Production of both the tube and the set itself is being subcontracted to the Timex Corporation in Dundee. The manufacturing agreement reached with Timex comes at the end of a five-year, £1 million plus, partly NRDC-backed research and development programme during which the technical aspects of the tube were sorted out and the techniques and methods for automating its production established – the latter include a new method of vacuum forming glassware. The new investment, funded by Sinclair Research with in addition a regional development grant and £1·5 million from the Scottish Economic Planning Department, will result in a tube production capacity of a million a year by the end of phase one in 1982.

The tube's principles have been described in these pages before – see pages 653-4 of the October 1979 issue. In its production form the tube is even smaller than previously envisaged – approximately 4 × 2 × $\frac{3}{4}$in. The set itself will be assembled alongside the tube production line and is designed to retail at around £50. We've been sceptical about mini TV sets in the past, but at this sort of price there should be a substantial market. It will be able to receive transmissions in most parts of the world, tuning as it does over the v.h.f. and u.h.f. bands, and a major USA retail chain is understood to be planning to place a substantial order during the first year of production. The set also incorporates provision for v.h.f./f.m. radio reception. It will measure about 6 × 4 × 1in. and weigh only a few ounces.

According to Clive Sinclair, the production subcontract was awarded to Timex because of their experience in designing and making automatic production machinery and reputation for precision engineering. The decision was taken after an exhaustive appraisal of international alternatives – in particular an in-depth examination of the facilities and finance available in Hong Kong.

The flat-screen tube has its gun to one side, and in addition to vertical and horizontal deflection requires a further deflection field to bend the beam through 90°. The beam strikes the phosphor screen from the same side that the tube is viewed. This latter feature means that the tube is inherently brighter than a conventional one, and Sinclair have in mind its modification for use in projection systems, where tubes have to be driven hard to obtain a bright projected image. Since the tube is flat, the rear side of the screen can be connected directly to a heatsink. Sinclair foresee a three-tube projection set with a 50in. diagonal colour display and the optics and electronics fitting into a unit the size of a shoe box.

The multi-standard Sinclair Microvision pocket TV has a 3in. screen and is expected to be available in 1982.

HITACHI VIDEO DISC PLAYER

Hitachi have decided to adopt the RCA CED video disc system and are understood to have started the manufacture of players at their Yokohama plant. The player is to be launched in the US during the summer, at an anticipated price of around £220. The aim is to produce some 10,000 a month initially.

TATUNG SIGN DECCA DEAL

As forecast last month, the Taiwanese firm Tatung is to buy from Racal the Decca radio and television interests. Tatung will be paying £1·1 million for the Decca TV plant at Bridgnorth, which will give them a foothold within the EEC. TV production at Bridgnorth has been running at 80,000 sets a year recently: Tatung intend to expand this, using advanced technology, and have guaranteed for a year the jobs of 500 of the present 850 labour force. A subsidiary, Tatung (UK) Ltd., will be set up to run the operation, which includes the development laboratory at Bradford, from June 1st.

STORM IN THE VIDEO TEACUP

The intense rivalry between the VHS and Betamax VCR systems seems to have been the cause of the recent brief storm in the video teacup. It all started with a news item in Japan's financial daily to the effect that Sanyo were to start producing VHS VCRs. Now as you all know, Sanyo are one of the main manufacturers of Betamax machines, so some bright press officer jumped to a conclusion and promptly issued a press release suggesting that Sanyo were about to move from the Betamax to the VHS camp. The facts behind the story turn out to be that the US firm Sears

Roebuck, which is the world's largest retailing organisation and obtains VCRs from Sanyo, had insisted on VHS machines. As a result, Sanyo arranged for the production by its subsidiary firm Tokyo Sanyo of VHS machines specifically for Sears Roebuck, with the stipulation that the Sanyo brand name should not be used on the machines. Sanyo are planning to produce 1·8 million Betamax machines in 1982, and to double production in the following year. Planned production of VHS machines by Tokyo Sanyo is for 200,000 units in 1982, again doubling in 1983.

Meanwhile Cap Ten Industries are planning to introduce in the UK this summer a Betamax VCR, with an advanced specification and at a competitive price, produced by NEC. Sony themselves are planning to produce 1·8 million Betamax machines this year, with production increasing to 2·4 million in 1982. Sony's chairman Akio Morita comments that the boom in VCRs is creating extra demand for colour sets, as a result of which Sony are planning to produce 2·7 million CTVs this year.

NEW SETS

An extremely versatile set has been introduced by JVC – the CX610GB 6in. v.h.f./u.h.f. portable colour receiver/monitor. It's capable of PAL or SECAM reception, and will operate on any of the following systems – PAL B, G or I, and SECAM B, G, D, K or KI, i.e. the CCIR (W. European) and OIRT (E. European) standards. The colour decoder automatically switches to the correct system, and the corresponding sound i.f. can then be selected. The set's versatility is further enhanced by the four-way power supply option – a.c. mains, ordinary batteries, a 12V car battery or its own rechargeable battery pack. Video sockets enable it to be used with a camera or for off-air recording. The suggested price, including VAT, is £259.

Pye have added a 20in. model to their range of teletext-equipped colour sets. The 3237 comes complete with infra-red remote control and uses the basic Philips KT3 90° chassis.

TELETEXT/VIEWDATA DELIVERIES

Official estimates for teletext and viewdata receiver and adaptor deliveries have recently been made available for the first time. The figures are as follows:

Year	*Teletext sets*	*Teletext adaptors*	*Prestel sets*	*Prestel adaptors*	*Teletext/ Prestel sets*
1977	2-3,000	—	—	—	—
1978	7,000	—	—	—	—
1979	28,000	2,000	750	—	2,000
1980	75,000	5,000	3,500	1,000	3,500

Of the Prestel registrations in 1979, 1,800 were business and 200 domestic, the figures for 1980 being 7,200 and 800 respectively.

The Department of Industry recently held a conference with the aim of gingering things up a bit.

SANYO'S NEW COLOUR TUBE

The basic principles of the beam-indexing colour c.r.t. are far from new: a tri-colour phosphor screen, with vertical RGB phosphor stripes, is used with a single electron gun, the RGB inputs to modulate the single beam being switched in RGB sequence. The problems concern the high-frequency switching and the need to synchronise this with the scanning of the beam (this is where the indexing bit comes in). The great advantage is the power saving, with only one gun and no shadowmask to intercept the beam. The problems are probably not so great using modern circuit techniques, and Sanyo have announced the successful development of a beam-indexing tube which they claim reduces the power consumption by 50 per cent compared with an equivalent shadowmask tube. Sanyo intend to use the tube initially in a 6in. colour set which will have a power consumption of only 12W.

ANOTHER VIDEO "MOVIE CAMERA"

The next great leap forward in the video world is going to be the portable combined camera/VCR unit. And as usual various non-compatible prototypes are beginning to surface. We've described the Sony Cam-Corder in some detail previously, and also mentioned the Hitachi Mag Camera. The latest version of this species to be announced is Matsushita's "micro video system", which has a two-hour capability using a cassette smaller than a standard audio one. For the record, the sizes of the cassettes used in these prototype systems are as follows:

Sony 56 × 35 × 13mm (recording time 20 minutes)
Hitachi 112 × 67 × 13·6mm (recording time two hours)
Matsushita 94 × 63 × 14mm (recording time two hours).

Whilst the Sony and Hitachi units use solid-state image sensors, the Matsushita unit employs a newly developed ½in. colour pickup tube called the Cosvicon. In conjunction with some specially developed i.c.s (several featuring large-scale integration) this has enabled the power consumption to be reduced to only 5W. Matsushita intend to develop the mass production technology required for the system whilst co-operating with other companies in establishing a standard format for this type of equipment. We shall see!

STATION OPENINGS

The following relay stations are now in operation:
Cwmaman (Mid-Glamorgan) BBC wales ch. 39, Welsh fourth programme ch. 42, BBC-2 ch. 45, HTV Wales ch. 49.
Lampeter (Dyfed) Welsh fourth programme ch. 54, BBC Wales ch. 58, HTV Wales ch. 61, BBC-2 ch. 64.
Ludlow (Shropshire) BBC-1 ch. 39, ATV ch. 42, BBC-2 ch. 45, TV4 ch. 49.
Matlock (Derbyshire) BBC-1 ch. 21, ATV ch. 24, BBC-2 ch. 27, TV4 ch. 31.
St. Bees (Cumbria) TV4 ch. 54, BBC-1 ch. 58, Border Television ch. 61, BBC-2 ch. 64.

All the above transmissions are vertically polarised.

TRADE WORRIES

A substantial increase in Japanese CTV exports to the EEC during 1980 is expected to be revealed when the final figures are announced – up from some 500,000 sets in 1979 to over 700,000. A particularly large increase has been registered in exports to W. Germany – these rose by almost 100 per cent. Amongst the firms feeling the pinch is W. Germany's largest setmaker Grundig, which plans to close down four consumer electronics factories this year – following two years in which another four plants were closed and 8,000 of the 40,000 staff were laid off.

On the monochrome receiver side the European Commission is holding an investigation into the alleged dumping of South Korean sets, following a complaint from the European Association of Consumer Electronics Manufacturers. According to the Association, some 814,000 12 and 14in. S. Korean monochrome portables were dumped on the European market last year at prices 21 per cent below cost. Exports in 1979 totalled 122,000 sets, S. Korea's share of the EEC market rising from five per cent to 22 per cent between 1979-80.

TV4

Mr. Ellis Griffiths has been appointed Chief Engineer of the new Channel Four Television Company. His responsibilities will include the design and installation of the network centre for the Channel, and the standards and engineering operations when programmes commence in November 1982. Mr. Griffiths was previously Technical Operations Manager at Thames Television's Euston Studios.

The IBA reports progress with engineering work on the Welsh fourth programme network – over 50 relay transmitters have already been installed, but cannot be brought into operation until the six main high-power stations come on air in November 1982.

MORE VIDEO FROM HITACHI

Hitachi have followed up the launch of their VT8000 VCR (see *Teletopics* February) with a further model offering additional features. The new VT8500 VCR has a suggested price of £665 including VAT. Added to the range of colour cameras is the VKC770, a version of the VKC750 with an electronic viewfinder. The suggested price is £517·50 including VAT. For a review of this camera under its Hitachi Denshi label see our January issue.

Letters

BALANCING LINE OUTPUT TRANSISTORS

Reading the problem (*Service Bureau*, February) about balancing the line output transistors in the Rank Z718 chassis prompts me to write regarding a recent experience with one of these sets. The symptoms we had were much the same, i.e. to start with the overload circuit shutting down. The two line output transistors were replaced, but on trying to balance them we couldn't obtain a lower reading than 10V across 5R6. We discussed the matter with Rank, who told us that the line output transistors must be a matched pair. These were obtained and fitted, and we then managed to get a near zero reading. The voltage would shoot up however and then drop back to zero. Now John Coombes, writing in your February 1980 issue, reported a similar fault which was found to be due to intermittent shorting turns in the line driver transformer 5T1. Replacing this gave us a zero balance reading with no further trouble – it comes complete with all the associated components (diode, resistors and capacitors) incidentally.

F. H. Stansby,
Hornchurch, Essex.

THAT TANDBERG TROUBLE

I was most interested to read Derek Snelling's account (February issue, page 206) of the disastrous Tandberg CTV2-2 breakdown, having had a similar problem some five or six years ago. The set was brought in by one of the field engineers, who delightedly told me that "I was going to love this one". The tube neck was broken, and the whole scanning assembly could be moved about, accompanied by a "scrunching" sound.

Investigation revealed signs of severe arcing where the tube neck had fractured. Unfortunately the customer had not taken out the four year tube guarantee and the set was only about 18 months old – and had not been bought from us. A new tube was fitted, and the rest of the trouble-shooting commenced. The self-oscillating chopper power unit had failed, and needed several replacement devices, including the chopper transistor itself. The tripler and the line output transistor had also failed. When all these obvious victims had been replaced, the set was powered up using a variac. The mains supply was gently increased, but the e.h.t. seemed to get very lively at a remarkably low mains voltage. A test showed that it had already risen to 27kV.

This led to replacement of the flyback tuning capacitor, the e.h.t. then being restored to normal. As in Derek's receiver however we next discovered that several of the convergence output transistors had failed, and the EW modulator had also blown. Replacing these items cleared all the faults – it was then "only" a matter of setting everything up properly.

I had already explained to the customer that the situation was pretty disastrous, but they were still shaken by the final extent of what had happened. It ended up with a white-faced husband whose wife was crying on my shoulder. I finally gave them cups of tea and six months' interest-free credit to allow three equal payments in settlement – all because of one capacitor!

Keith Cummins,
Southampton.

UNUSUAL DEGAUSSING CIRCUIT

Malcolm Burrell's comment about fuse blowing due to short-circuit diodes in the degaussing circuit (see *Fun and Games*, March) might puzzle some readers. The fact is that the degaussing circuit used in the Electrohome monitor (see Fig. 1) is a bit unusual. The two back-to-back diodes D911/2 allow a.c. through to the coils at switch on and turn off when the posistor R901 has reached its high-resistance state, thus isolating the coils. The diodes can cause mains

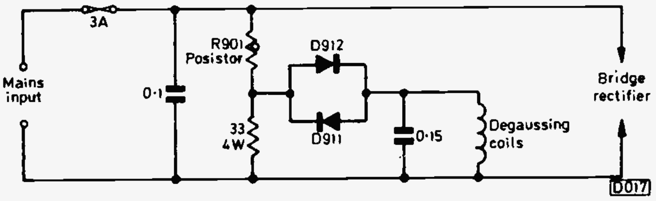


Fig. 1: Degaussing circuit used in the Electrohome monitor.

fuse blowing – I found this out when searching around in a dark pub corner and running out of fuses – but why this should happen is hard to see. Any ideas?

A. Mole,
London, W4.

STOLEN VIDEO

On January 26th the following equipment was stolen from a car in Soho:

1 Sony DXC1640 colour camera, serial no. 50020.
1 Sony VO4800 portable recorder, serial no. 10061.
1 Sony power supply unit, serial no. 10077.
3 BP60 batteries.

All this equipment was engraved N.F.S. in prominent

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25 mixed **TV Presets** £1.00
20 assorted **TV VDRs** and **Thermistors** £1.20
10 assorted TV **Convergence Pots** £1.00
20 assorted **TV knobs,** includes push button, chrome, control types etc. Mostly Thorn and ITT £1.00
10 assorted **Valve Bases,** B9A, ceramic, EHT, etc. £1.00
20 assorted **Sync Diodes** blocks for various TVs £1.00
10 **Spark Gaps** £1.00
20 assorted **Zener Diodes** 1 watt and 400MW £1.50
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positions. As we're not in a financial position to replace this equipment, we would appreciate hearing from any readers to whose notice it might come.
Peter Wilson, Senior Video Engineer,
The National Film School,
Beaconsfield Film Studios, Station Road,
Beaconsfield, Bucks. HP9 1LG.
Telephone Beaconsfield 71234.

TRANSISTOR REPLACEMENTS

I see from the February *Service Bureau* that another reader recently had the identical fault to one I experienced – bottom foldover on the Hitachi Model CNP190. Transistor trouble was suspected, but one problem is that the 2SA, 2SB, 2SC series transistors can no longer be obtained. Marshalls suggested an AF124 as a replacement for the 2SA15V field driver transistor, and this cured the fault. As it's a four-legged device however the screen lead had to be cut off and the other leads carefully sorted out. Towers gives the OC44N and 2N2614 as alternatives, and this would have avoided the complication. Incidentally, I first tried replacing the 2SC936 field output transistor with a BDX32: it lasted just one day, so the original device was replaced. All is now well.
J. H. Brooks,
Walworth, London.

CHRISTIAN VIDEO

In the past eighteen months or so there has been a great increase in the number of VCRs rented or sold. Before long they will no doubt be considered necessities rather than luxuries. Most of the video tapes now on sale are secular in content, the Churches still not being alert to the possibilities that VCRs present.

I would be glad to hear from any of your readers who are interested in a Christian video tape ministry, and who perhaps have their own cameras. Video technology now offers great possibilities for propagating the Christian Gospel.
Michael Byrne, Director, Christian Video Outreach,
Credenhill Court,
Credenhill, Herefordshire, HR4 7DL.

Dealing with Intermittent Faults

Derek Snelling

As TV sets get more reliable, various intermittent faults are coming to account for an increased proportion of service calls. The first problem with this type of fault is that it's never present when you call at the customer's house. The set can be taken back to the workshop of course, but even then location of the fault can be difficult – while it's always best to carry out the repair in the customer's home if possible.

Defining the Fault

The first thing to do is to try to ascertain from the customer the exact nature of the fault. This requires a certain amount of detective work – the customer's initial description of the fault should not be accepted at face value. I've had the description "no picture" given in cases of field collapse, loss of vision signal, no signals at all, no e.h.t., and loss of line hold for example, which is understandable coming from someone not familiar with the workings of a TV set. Another misleading description I had recently was "poor focus" in a case that turned out to be an intermittent convergence problem.

To overcome this difficulty, try to simulate the fault while the customer watches. By adjusting the height, width, line and field hold and set h.t./e.h.t. controls, removing the aerial connection, and switching off one or more colours as necessary, you should be able to get a reasonable idea of the part of the set in which the fault lies, e.g. the decoder, line output stage, etc.

Fault-finding Procedures

Once you've located the area where the fault lies, the next step is to try to find the cause of the problem. Try tapping the area with the handle of a screwdriver – this should reveal the presence of dry-joints or cracks in the printed tracks. Successively lighter taps should then enable you to narrow the area down to just a few components, when resoldering all the connections in the area and if necessary bridging cracks in the print with wire should eliminate the problem. If the set is an old one, particular attention should be payed to areas subject to heat, such as valvebases, where cracks are common.

If tapping or flexing the panel has no effect, try heating it with a hairdryer or cooling it using a freezer aerosol. This will reveal any components that are sensitive to temperature change – semiconductor devices and resistors are particularly prone to this type of fault. The cure is then simply a matter of replacing the sensitive component. Take care though, as some circuits are sensitive to excessive temperature change when in fact working correctly.

These techniques should sort out a good 75 per cent of intermittent faults. For the rest, check all relevant controls and plugs and sockets for intermittency, and carefully examine the components in the suspect area, changing any discoloured resistors or leaking capacitors. Change any polystyrene capacitors, since these are notorious, also any high-value resistors. If this fails, change any likely semiconductor devices or valves.

In older sets, check for carbonised parts of the board subject to heat. A carbonised area can be conductive, giving rise to tracking. The only cure for this sort of thing is to drill or cut away the affected area – until you get back to unburnt board – replacing any copper tracks with wire (remember to note where the tracks went before cutting!).

Intermittent Fuse Blowing

We are left with perhaps the most difficult type of fault – intermittent fuse blowing. You visit a dead set, change the fuse and it works perfectly for days or even weeks before the fuse again fails. You're obviously not going to see this fault happen, so some detective work is again necessary.

First examine the fuse. If it's blackened, there was a virtual short-circuit across it at the moment of failure. If the wire has simply parted, the cause could be a small overload over a long period or a gradually increasing overload. Secondly, ask the customer whether anything happened when the fuse blew – was there perhaps a bang or crack from the back of the set, indicating arcing, did the picture go first, did it close in slowly from the sides, etc.? This may enable you to narrow down the possibilities.

If you have a blackened fuse and thus an intermittent short-circuit there are certain likely causes – a valve or the c.r.t. could be sparking (try tapping them), the insulation of some wiring could be faulty, or a transformer could be breaking down. Resistors can be discounted, as they don't go short-circuit intermittently. Similarly capacitors don't normally go short-circuit intermittently, though this is not unknown – mains filter capacitors are notorious for misbehaviour of one sort or another. If a semiconductor device goes short-circuit, again this is usually a permanent rather than an intermittent condition, though they can be susceptible to thermal runaway which can account for the other type of fuse failure.

Two other possibilities to consider on certain types of set are (1) does failure of the line oscillator result in an overloaded line output stage, and (2) is there a crowbar trip which when it fires puts a short across the mains fuse? In the former case, failure of the line oscillator while the set is running will result in the fuse suddenly blowing. Suspects here are capacitors in PCF802 sinewave line oscillator circuits. In the latter case it's necessary to check up on the conditions that cause the crowbar to operate and investigate further.

If the fuse is not blackened, check the setting of the h.t. and e.h.t. supplies – the receiver may appear to work normally with these set incorrectly, but the excessive current may be sufficient to cause the fuse to fail after a time.

Should the line oscillator fail to start, or not start quickly enough, the line output stage current may increase until the fuse blows. This depends on the type of circuit employed – line output transistors remain off in the absence of drive, while line output valves switch on.

Finally, check for any modifications introduced to prevent spurious fuse blowing – this applies particularly to the more modern types of power supply.

These notes should have covered most causes of intermittent faults. Happy hunting! ■

CCTV Arrow Generator

Andrew Parr, B.Sc., C.Eng., M.I.E.E.

THE unit to be described was designed so that a controllable marker could be inserted on a closed-circuit TV picture. The marker consists of a movable arrow which can be rotated to point in any of four directions – up, down, left or right. The arrow can be displayed in black, white or flashing between black and white at about 1Hz. A cheaper option is also described – a movable (but obviously non-rotatable) spot which can also be displayed in black, white or flashing between the two.

The unit is for connection between the camera and the monitor, and the controls are simple. A joystick positions the arrow on the screen, a four position switch selects the arrow direction, a further four-position mode switch (video, black, white, flash) completing the controls.

Basic Principles

Drawing an arrow on a CCTV picture involves producing suitable bright-up (or black-out) signals for mixing with the video. The arrow consists of the dot matrix shown in Fig. 1, i.e. 7 × 7 dots which can be moved to anywhere on the screen by altering times T1 and T2. Arrow rotation is something we'll come back to later (also an option for an arrow with a solid head).

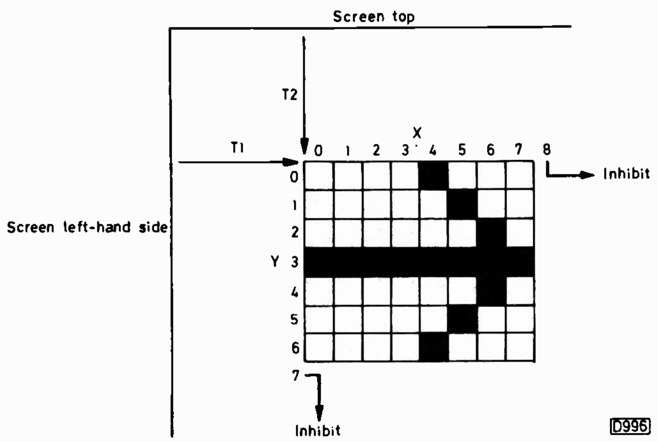


Fig. 1: Arrow format.

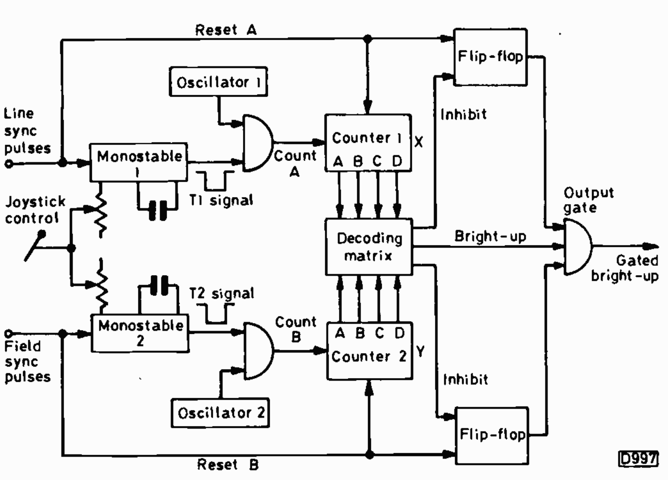


Fig. 2: Simplified diagram showing the logic required to produce a right-pointing arrow.

The circuit thus falls naturally into two parts. First a video board which extracts the sync pulses from the incoming video signal and adds the arrow dots to the signal. Secondly the logic which produces the dots for the video board.

The logic required to produce a non-rotatable arrow is shown in simplified form in Fig. 2. The line and field sync pulse inputs come from the video board and are used to trigger the two monostables whose cycles are controlled by the joystick position control. These monostables position the arrow on the screen therefore. They gate the outputs from the two oscillators, inhibiting the outputs until an arrow is called for. The oscillator outputs thus start at the position on each line and field at which the arrow is required.

The oscillator outputs are fed to two four-bit counters. The first three bits from each counter are fed to a decoding matrix to produce the arrow bright-up at the correct times. If we call the horizontal counter X and the vertical counter Y, Fig. 1 shows us that we need bright-up pulses at X4/Y0, X5/Y1, X6/Y2, X6/Y4, X5/Y5, X4/Y6 and Y3/X0-7. The decode matrix looks for these counter states and produces the necessary bright-up pulses. The oscillator frequency thus determines the size of the arrow.

Once started, the counters run to the end of the line or field. They are then reset by the next sync pulse. This means that the decode matrix would produce a set of arrows which would fill the lower right-hand portion of the screen. To ensure that only one arrow is displayed, two flip-flops are used to inhibit the output from the decoding matrix. They are reset at the start of each line/field by the sync pulses, and switch over when the corresponding counter reaches a count of 8. The inhibit flip-flops thus gate the output from the decode matrix, ensuring that only one arrow per field is displayed.

The circuit described so far displays only a right-pointing arrow. To get arrows that point in other directions modifications are required. The first stage is to reverse the arrow, thus giving left- or right-facing arrows, then to add the up/down options.

If the least significant bits of counter 1 are inverted, the counter will appear to count down from 7 to 0. The decode matrix will then produce a left-facing arrow. To obtain left/right selection we must be able to switch the inversion of the counter's output. This can be done using the NEV gate – see Fig. 3(a) – whose truth table is as follows:

Input A	Input B	Output
0	0	0
0	1	1
1	0	1
1	1	0

It will be seen that with 0 at the A input the output is the same as at the B input, while with 1 at input A the output is the inverse of input B. The circuit shown in Fig. 2 is thus modified as shown in Fig. 3(b), SW1 enabling us to select whether the pulses fed to the decode matrix count up or

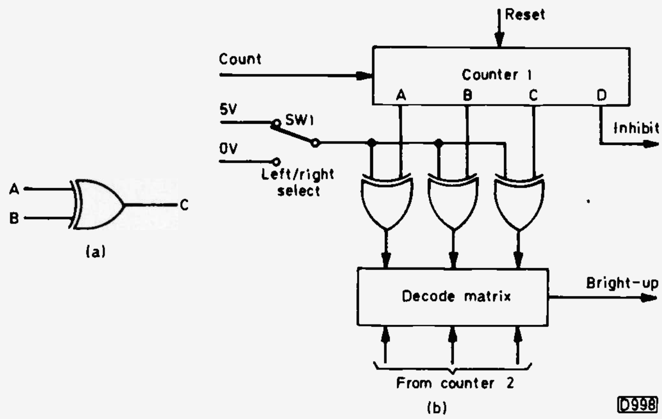


Fig. 3 (above): (a) NEV gate symbol. (b) Modification to the basic system to give left/right pointing arrows.

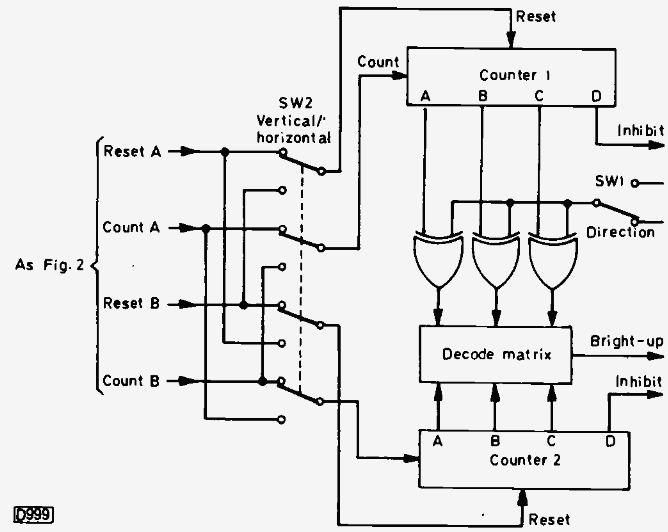


Fig. 4 (right): Principle of four-direction arrow selection.

down. SW1 thus controls the arrow's direction, pointing left or right.

Finally the circuit modification to produce an arrow pointing in a vertical direction. The decode matrix does not know up from down, so if the output from oscillator 1 is connected to counter two and vice versa (Fig. 2) we'll get a vertical arrow. Switch SW1 in Fig. 3(b) now selects an upwards or downwards facing arrow. To select up/down/left/right, four changeover switches are required – to switch the oscillator outputs and the reset inputs to counter 1 and 2 as required (see Fig. 4). The gating in the practical circuit is done using semiconductor switches: the direction selection switch thus needs to be a four-position, two-bank type – one bank controlling the NEV gates shown in Fig. 3(b), the other bank for the changeover switches shown in Fig. 4.

Practical Logic Circuit

The practical circuit (Fig. 5) closely follows the principles outlined above. Line and field sync pulses from the video board (see later) trigger monostables IC1a/b to obtain the line and field delays. Front panel control RV1 thus sets the horizontal position and RV2 the vertical position of the arrow. IC2 contains two monostrables which are used as the horizontal oscillator, IC3 similarly providing the vertical oscillator. RV3 and RV4 determine the oscillator frequencies. In the prototype unit these were brought out as

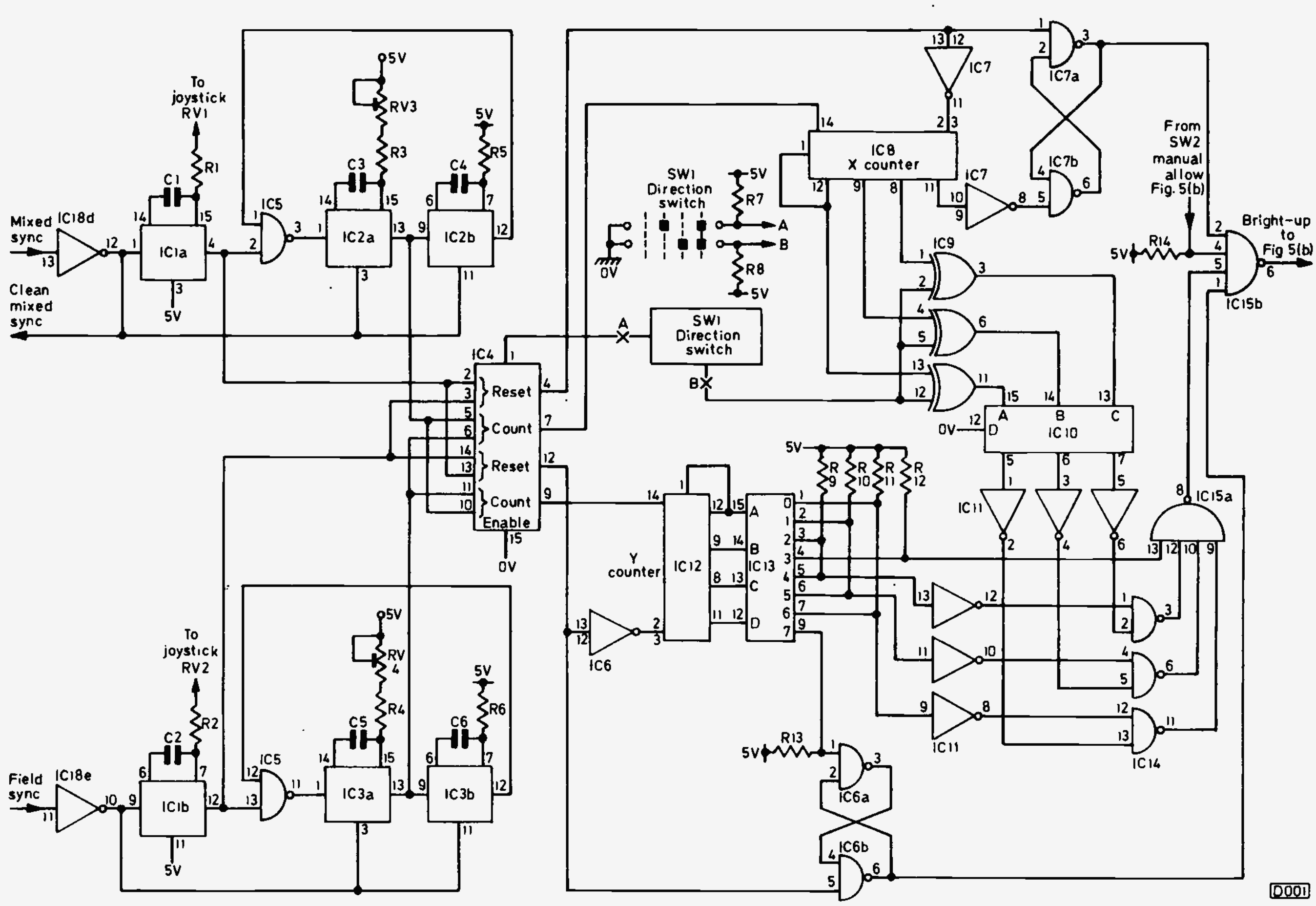


Fig. 5(a): Arrow logic.

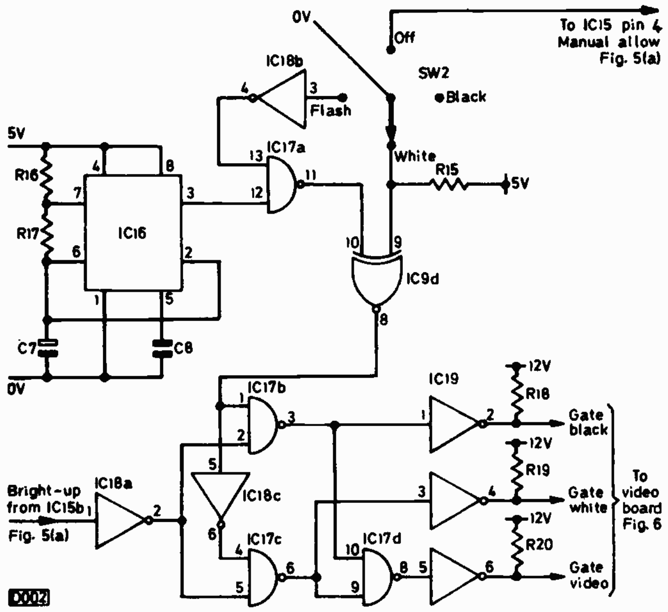


Fig. 5(b): Arrow logic continued.

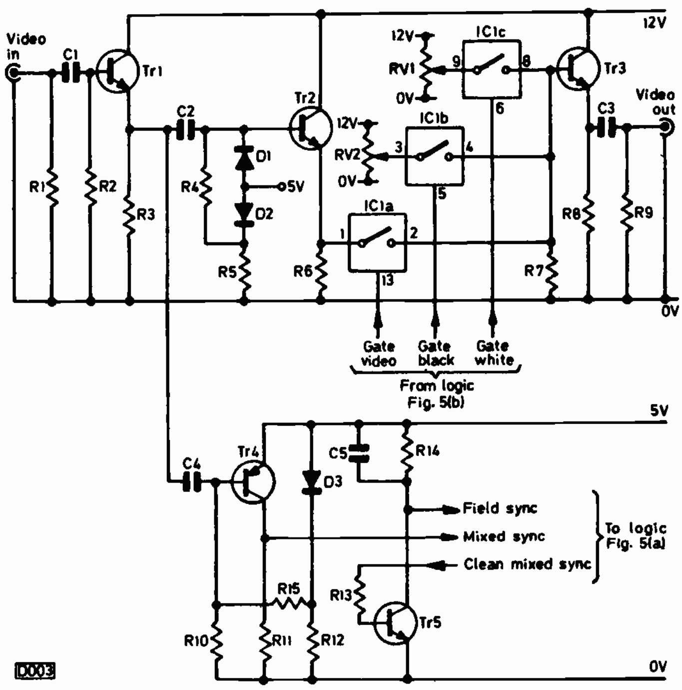


Fig. 6: Circuitry on the video board.

a ganged front panel control labelled "arrow size", but this feature was found to be of little practical use. Presets are recommended therefore. IC5 gates the oscillators.

Vertical/horizontal switching is provided by the 74157 multiplexer IC4. It contains four changeover switches which are controlled by pin 1. For example, pin 4 can be connected to pin 2 or pin 3 depending on the signal at pin 1. Obviously pin 1 is connected to the horizontal/vertical bank on SW1.

The reset and count pulses from IC4 go to the X and Y counters (IC8 and IC12) and the inhibit flip-flops (IC7a/b and IC6a/b). The Y counter is decoded by the 7445 binary to decimal decoder IC13. From Fig. 1 it will be seen that the arrow is symmetrical about a Y count of three. The open-collector outputs on the 7445 allow outputs 0-6, 1-5 and 2-4 to be linked directly.

The X counter output goes to the NEV gates in IC9 as outlined in Fig. 3. The outputs are then decoded by IC10. Examination of Fig. 1 shows that only counts of 4, 5 and 6 are needed.

The decoding is done by IC11, IC14 and IC15a using brute force methods. The circuit simply tests for each of the conditions given earlier, with IC15a as an output OR gate. The output from IC15a is a 1 whenever an arrow dot is required.

The inhibit flip-flops IC6 and IC7 are reset by the respective reset pulses, and are set by the counter states. The Y counter decoded output 7 is used to set IC6, the X counter most significant bit being used to set IC7. The decoded X counter output cannot be used since IC9 reverses the count direction.

The two inhibit outputs and the manual allow signal are gated at IC15b with the arrow data to produce a low-going signal when an arrow dot is required.

The arrow's "colour" is determined by SW2. Its first position is "arrow off" and goes to IC15b pin 4 to inhibit the arrow dot data. The positions "black" and "white" gate the data via IC17b or c – see Fig. 5(b). If "flash" is selected, oscillator IC16 inverts the data at IC9d to switch between black and white at approximately 1Hz.

Video Circuit

The video board has three switches which gate the video output. The first two select black and white levels and are controlled by the outputs from IC17b and c. The third gates the video from the camera, and is operated via IC17d when no arrow dots are required.

The circuit of the video board is shown in Fig. 6. This is fairly conventional and straightforward. The video signal is terminated by R1 and buffered by TR1. The output of TR1 is d.c. restored by D1/D2 and fed to switch IC1a via TR2. The two remaining switches, IC1b and c, are fed from potentiometers RV1 and RV2 which set the black and white levels. The three switches are selected by signals from the logic described above. Transistor TR3 provides a low-impedance output at 75Ω.

Sync Circuit

Transistors TR4 and TR5 extract the sync pulses. TR4 is normally biased off by D3, and is turned on by the negative sync pulses. These mixed sync pulses are squared by the Schmitt trigger IC18d and are used as line sync pulses to trigger monostable IC1a.

The squared mixed sync pulses also turn on TR5, whose output is integrated by C5 and R14. The resulting output

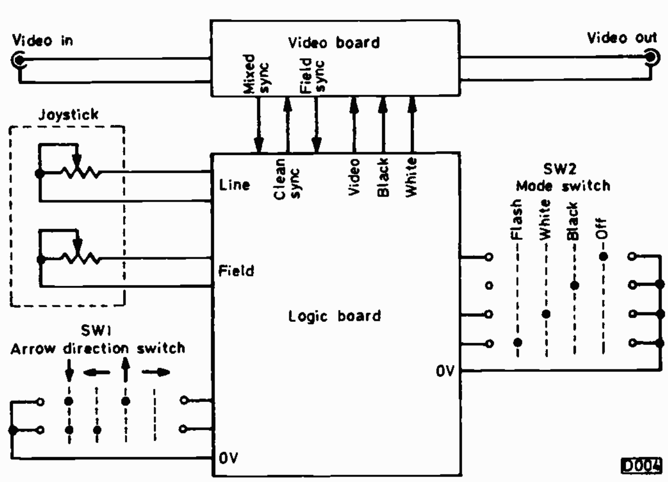


Fig. 7: Interconnections between the video and logic boards.

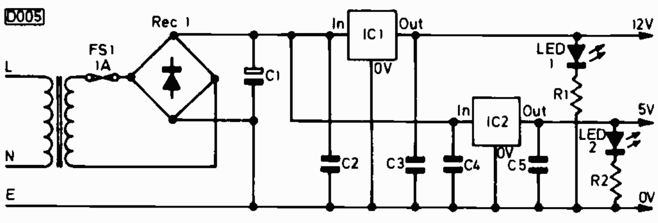


Fig. 8: Power supply circuit.

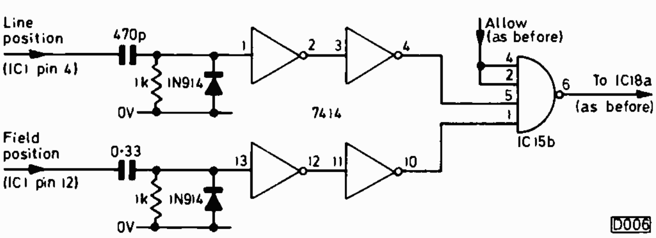


Fig. 9: Modified circuitry giving a movable spot.

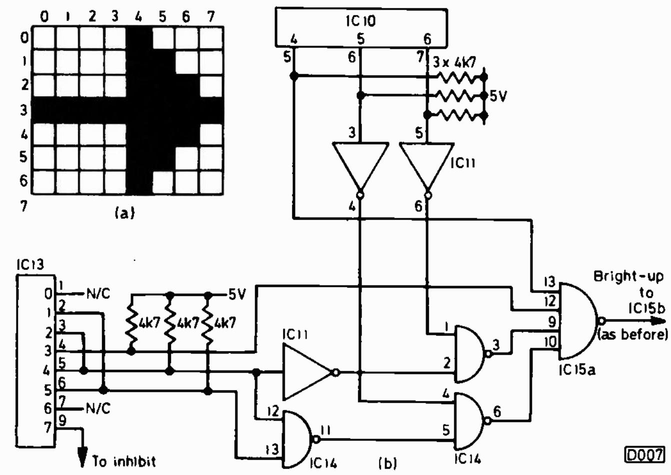


Fig. 10: Decoding circuit for an arrow with a closed head.

consists of field sync pulses which are squared by IC18e and used to trigger monostable IC1b.

Construction and Setting Up

The prototype was built in two parts – with one board for the TTL logic and another for the video circuitry. A general purpose i.c. board was used for the logic, and standard 0·1in. strip board for the video. No layouts are given, since the wiring is largely pin-to-pin and straightforward. Care should be taken to keep the wiring to the monostables IC1-IC3 as short as possible to prevent faulty triggering. Each i.c. should have an 0·01μF capacitor connected across its supply pins. Fig. 7 shows the board interconnections.

The most fiddly part of the setting up is the mechanical positioning of RV1 and RV2 in the joystick controls. These should be set so that with the joystick at the top left position RV1 and RV2 are at minimum resistance. In the control used by the author this involved manipulating small coupling pieces with Allen screws arranged in highly inaccessible places.

With RV1 and RV2 set, RV3 and RV4 should be set to mid-range and the system connected between a camera and monitor. "White arrow" and "black arrow" should be selected and the video board presets adjusted to give the required levels. Note that maladjustment of the controls can cause loss of picture sync. RV3 and RV4 can now be set for the required arrow size. A small size is preferable so that the eye can't resolve the dots.

Move the joystick from top left and observe its range. Because of component tolerances, it's unlikely that the arrow will reach the opposite screen boundaries when the joystick reaches the end of its travel. C1 and C2 should therefore be trimmed by adding small value capacitors until the desired travel is obtained. Too large a value will cause

★ Components list

Logic board

Resistors:

R1-15	4·7k
R16	1k
R17	10k
R18-20	4·7k
All	¼W
RV1-2	250k lin.
RV3-4	25k lin.

Capacitors:

C1	0·0022μF ceramic
C2	1μF polyester
C3	22pF ceramic plate
C4	47pF ceramic plate
C5	0·068μF polyester
C6	0·033μF polyester
C7	10μF tantalum
C8	0·01μF ceramic disc

Plus 19 0·01μF ceramic disc decouplers, one per i.c. across the supply

Semiconductors:

IC1-3	74123
IC4	74157
IC5-7, 14, 17	7400
IC8, 12	7493
IC9	7486
IC10, 13	7445
IC11	7404
IC15	7420
IC16	555
IC18	7414
IC19	7406

Note: IC2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 and 13 are not required for the simple spot alternative.

Integrated circuit supply connections

7400, 7404, 7414, 7416, 7420	pin 14 5V, pin 7 chassis
7445, 74123, 74157	pin 16 5V, pin 8 chassis
7493	pin 5 5V, pin 10 chassis
555	all connections shown
4016	pin 14 12V, pin 7 chassis

Video board

Resistors:

R1	82Ω
R2	4·7k
R3	680Ω
R4	10k
R5	1k
R6	680Ω
R7	10k
R8	330Ω
R9	1k
R10	1M
R11	22k
R12	680Ω
R13	10k
R14	1k
R15	22k
All	¼W
RV1/2	5k lin.

Capacitors:

C1	22μF 25V electrolytic
C2	1μF polyester
C3	47μF 25V electrolytic
C4, 5	0·1μF polyester

Semiconductors:

TR1, 2, 5	BC108 etc.
TR3	2N3053
TR4	BC478 etc.
D1, 2	1N914 etc.
D3	OA81 etc.
IC1	4016 (CMOS)

Miscellaneous hardware

2-bank, 4-position rotary switch
1-bank, 4-position rotary switch
Mains switch
Joystick assembly
Video connectors
Veroboard and case

Power Supply

IC1	7812	R2	470Ω ½W
IC2	7805	C1	4700μF 25V electrolytic
R1	1k ½W	C2-5	2·2μF polyester

LEDs, 1A bridge rectifier, 0-12V 1A secondary mains transformer, heatsinks as necessary for IC1/2.

the arrow to vanish off the screen edge and possibly reappear in ghostly form elsewhere on the screen.

The circuit requires a 12V rail for the video board and a 5V rail for the logic board. These are provided by the simple i.c. regulators shown in Fig. 8. Bolt the regulator i.c.s to the case or some other suitable heatsink.

Variations

A cheaper alternative is to use a non-rotatable dot. This can be obtained using the circuit shown on Fig. 9. A 7414 i.c. produces small pulses at the end of the cycles of IC1a and IC1b. These are gated together at IC15 with the manual allow signal to give a low-going signal to IC18a, as before. This option is "instead of" and not "as well as" the arrow circuit. The component list shows which chips are required for the dot indicator.

The arrow shown in Fig. 1 has an open head. Some users have preferred the closed head shown in Fig. 10(a). This can be obtained by rearranging the wiring of IC11, 14, 15 to that shown in Fig. 10(b). This simply alters the operation of the decode matrix to give a closed arrow head. ■

Servicing the Thorn 4000 Chassis

Part 2

David Robinson

It's in the field timebase that the price for using toroidal scan coils has to be paid – the field output stage has to supply a 6A peak-to-peak output, and consumes some 40W in doing so. The NS raster correction system is unusual in that modulation of the field scan takes place at a low level, the line-frequency correction signals being passed through the field output stage. This has a certain elegance about it, but does mean that the output stage's signal handling requirements and hence the dissipation are further increased.

The modulator stage is VT401 (see Fig. 5), which acts as a bidirectional switch. When it's switched on by the line pulse applied to its base, the amplitude of the line pulse output obtained at its collector is determined by the field-frequency sawtooth waveform applied to its emitter. The main collector load is the NS pincushion amplitude control R405, which is returned to chassis. During the first half of the field scan, VT401's collector is negative with respect to its emitter – the transistor works well enough under these conditions, the only proviso being that as the emitter is being used as the collector the 5V reverse voltage rating of this junction must be observed. R404 gives a small offset to the field ramp to compensate for the fact that the red and green guns are below the tube's centre line: in this way curvature of the picture's horizontal centre line is prevented.

The pulse output produced by VT401 is not directly suitable for pincushion correction of course. Integration is required to obtain a line-frequency parabolic waveform, and this is provided by the integrator stage in thick film unit TF401, with a final variable integration by R402 and the input capacitance of the main amplifier. Much of the field timebase circuit is incorporated in two thick-film units.

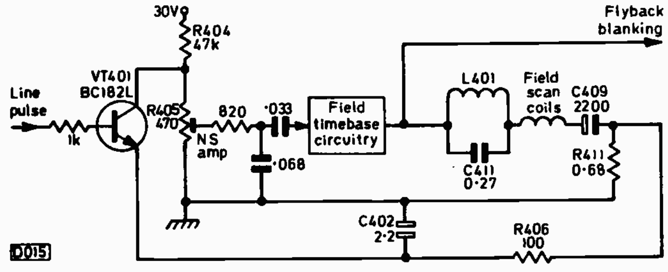


Fig. 5: Simplified circuit showing the way in which NS raster correction is carried out in the Thorn 4000 chassis. The signal developed across R411 is also used as feedback in the field timebase and is fed to the convergence circuits.

TF401 also contains the field oscillator circuit (an astable multivibrator), while TF402 contains a two-transistor preamplifier followed by a complementary-symmetry driver stage. The output stage consists of another complementary-symmetry pair, VT402/3, types TCER84 and TCER83 respectively. Suitable replacement types are the RCA 2N6109 in the VT402 position and the RCA 2N5296 in the VT403 position.

Having passed the modulated line parabola through the field output stage, the remaining problem is the high inductance of the field scan coils – this makes passing line-frequency signals through them difficult due to the high-voltage drive required. The problem is solved by including the network L401/C411. C411 forms a series resonant circuit with the scan coils at line frequency, L401 being included to pass the field frequency waveform. In fact as seen by the scan coils, the pincushion correction waveform is larger than the field scan waveform.

The field timebase is generally very reliable, apart from occasional output transistor failure. A slight reduction of height as the set warms up is normal, due I suspect to the presence of the current monitoring resistor R411. Linearity is determined by fixed components: this is not entirely successful in some cases, but for the perfectionist there's space on the panel to fit a potentiometer in series with a fixed resistor in place of R417.

The flyback blanking circuitry is on the field timebase panel. This and the tube protection system (see Fig. 6) linked to the line output stage should be born in mind when investigating no raster faults.

Convergence System

The convergence system was certainly designed with ease of setting up in mind. It's a pleasant change to have separate controls that don't interact for the top and bottom, and to have the static convergence controls so readily accessible. These are mounted, along with the dynamic convergence controls, in a plastic box with a long cableform that can be unwound to allow the box to be brought round to the front of the set.

Because of the balanced line output stage configuration, the line waveforms required can't easily be derived from the scan coils. An extra winding on the line output transformer is thus used to obtain line-frequency sawtooth waveforms of opposite polarity and also a parabolic line-frequency output. A field-frequency sawtooth is taken from across

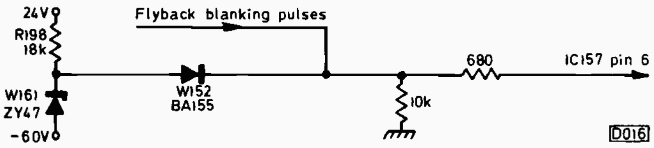


Fig. 6: Circuit used to provide tube protection in the event of line output stage failure. The anode of diode W152 is reverse biased by the network R198/W161, which is connected between 24V and −60V supplies. Since the −60V supply is obtained from the line output transformer, via a voltage doubler circuit, failure of the line output stage will remove this supply. W152 will then be forward biased via R198 and a positive voltage will appear at pin 6 of IC157, removing the c.r.t. drive signals.

R411. These waveforms are fed to the hand-held convergence unit where the field-frequency sawtooth is split into top and bottom sections by thick-film unit TF601. The various waveforms are combined and adjusted by the various controls, giving four outputs for feeding to the convergence neck unit.

The output at 33/13 can be thought of as red + green, as it passes currents equally through the red and green coils, so moving the red and green lines towards each other horizontally. The output at 33/20 is the red − green output which applies opposite currents to the red and green coils, so correcting any vertical red-green separation. The other two outputs are both for blue, one feeding the main blue coil with variable line and fixed field signals, the other feeding variable field signals to the blue static coil.

The main line controls are numbers 7, 11 and 15, feeding line parabola. The sawtooth controls 8, 12 and 16 provide small tilt corrections in either direction.

The neck unit has a matrixing circuit to separate the red and green signals from red + green and red − green, and three power amplifiers (VT501/2/3) to drive the convergence coils. Again the dissipation is rather high, this time due to the amplifiers having to handle the line and field waveforms added together, but at least the usual troublesome high-wattage potentiometers have been avoided. VT501 drives the red convergence coils, VT502 the green coils and VT503 the blue coils (radial).

With convergence faults it's important to interpret the symptoms correctly. For example, it may appear that the red-green convergence is non-existent. But on closer examination, and on trying a few of the controls, you may find that the red lines can be adjusted quite normally but the green lines stay fixed (all the red-green controls except static move the red and green beams by equal amounts). The most usual offenders are the output transistors, although thick-film units TF501 (red-green) and TF502 (blue) can also fail. The RCA 2N5298 can be used to replace the Thorn TCER82 output transistors.

Four dual-resistor units (two TF503s and two TF504s) are used in the static circuit. They often go open-circuit in one half, giving a one-way adjustment. Earlier types are encapsulated in a casing which cracks up with the heat, but this doesn't always spell failure. The edge connectors to both convergence units can become intermittent.

Tubes

So much for the main receiver. It must be said that the quality of the tubes seems to vary considerably. Some give a nice bright picture with excellent focus right out to the corners. Others look well worn even when almost new, and good grey-scale and resolution may be unobtainable. This doesn't seem to be related to any particular make of tube, but it's a point worth bearing in mind when judging the set's performance.

Tubes with different heater current requirements have been fitted in these sets. The 20in. A51-152X, 22in. A56-150X and 26in. A67-150X tubes require 900mA at 6·3V, and the heaters should be taken via connections 18/1 and 18/2 to the heater winding on the mains transformer. The 22in. A56-160X and 26in. A67-510X require 750mA at 6·3V and should be connected via 18/1 and 18/3 to the mains transformer heating winding. Note however that a different mains transformer was introduced for use with the low heater current tubes – part number 00D3-082-P01. The original type of transformer (part number 00D3-071-00P-001) must be used with high heater current tubes only.

Remote Control

The type of remote control unit most likely to be encountered has a seven-button transmitter giving three analogue controls (volume, brightness and colour) plus channel stepping. The analogue settings are retained when the set is switched off by powering the memory i.c. from a rechargeable standby battery. Later versions can in addition switch the set to standby and back again by prolonged operation of the channel change button. With this version the standby battery is dispensed with, all the analogue settings being reset to mid-point at switch on instead. The earlier version can be identified by the analogue reset button on the back of the set (designed to confuse those familiar with the 3500 series!) and the later one by the standby neon on the front panel. Note that the later type will go to standby if powered up with the on-off button already depressed, but will come on if switched on at the button – thanks to the reset contacts at the back of the switch.

The usual remote control fault is incorrect or no remote control action due to drift of the remote control transmitter frequencies. The transmitter can only be set up using a frequency counter. Just pressing the input lead against the transmitter PCB without connection is usually adequate. There are two adjustments, a coil (L951/2) and a trimmer capacitor (C954): the principle is similar to trimming and padding on a radio receiver. Set the trimmer for 44·4kHz on colour down, and the coil for 33·6kHz on channel change. Repeat both adjustments until they are correct. If the transmitter is completely dead, the transducer is almost certainly faulty.

The single most troublesome component on the remote control receiver unit is the bridge rectifier W555. If it's orange in colour, I would recommend replacing it as a precaution. The symptoms are intermittent non-operation of the unit, with incorrect analogue settings (this latter can be misleading if the remote control has been dead for some time and the customer has reset the front panel controls). On the later version the set may suddenly switch to standby, then appear to operate normally for some time afterwards.

Drift of the analogue settings is sometimes caused by the ERC3064 i.c. which stores them. Before condemning this i.c. however connect a scope, preferably synchronised to the line timebase, to the preamplifier output (point 134 on the main panel). Any amount of line-frequency signal here spells trouble. Although care has been taken to use ultrasonic frequencies that lie between line-frequency harmonics, line pickup can still cause erratic remote control operation. To cure this problem, first check that the microphone lead is dressed away from the tube. Then turn down the remote sensitivity control R468, which is accessible through a grommet in the unit's back plate, in order to reduce the line pickup consistent with maintaining adequate remote control range. To check, ensure that the signal from the transmitter limits at the maximum range to be used.

AUSTRALIAN REPORT

As we mentioned in Part 1 last month, large numbers of these sets were assembled in Australia and S. Africa. From Australia a correspondent, Frank Klamka, reports as follows.

The chassis is very common here though there are some differences from the UK versions. Instead of touch tuning, there's a simple rotary v.h.f. tuner, while on the mains input side there's a mains isolating transformer – so the rectifier board is different. Here are some stock faults.

No Results

Dead set, c.r.t. heater alight, chopper transistor VT301 and fuse F301 blown. This can be caused by arcing in the deflection yoke (between the line and field coils), by the h.t. rectifier W364 being short-circuit, or by an overload if the dynamic (excess current) trip is not working. The latter situation arises because with an overload such as a short-circuit line output transistor and the trip out of action the chopper has to take the full load. The trip may not work simply because someone has backed off the setting of R325, or because of out-of-tolerance components in the trip circuit. Dry-joints on the switched-mode module also cause chopper transistor failure. The chopper usually fails for no other reason however, replacement (with the fuse) restoring normal operation. To check the operation of the dynamic trip, just rotate R325. Towards one end of its travel the set should shut down, indicating that the trip is working. Correct setting must be done as described in the manual.

Set squeals for a second or a loud click is heard, then switches off. This is the trip coming into action due to an overload. The usual causes are the e.h.t. tripler, the line output or e.h.t. transistor short-circuit, C342 in the e.h.t. generator stage short-circuit, a defective field driver thick-film unit (TF402), short-circuit field output transistors, or shorted turns in the deflection yoke.

The trip may come into operation without an overload being present if the sensing resistor R363 goes high in value or open-circuit. Its value seems to be very critical.

Repeated failure of the line output transistor is caused by the flyback tuning capacitor C331 going open-circuit.

Thick-film Units

The thick-film units used in these sets are a source of trouble, TF501 and TF502 in the active convergence circuitry on the neck module being the worst offenders. This latter fault gives all sorts of convergence problems, but it's not worth listing them since you seldom get exactly the same symptoms twice. R517 (10Ω), which is mounted on the print side of the convergence neck module, sometimes goes open-circuit, giving almost no red/green control (this resistor, also R516, was added in later versions using TF501 part number 00S1-039).

TF302 can be responsible for EW correction problems, with some or none of the associated controls working. TF303 is sometimes responsible for the set e.h.t. control not working, with reduced width.

On the field timebase panel TF401 can cause intermittent rolling and NS raster correction problems. TF402 can be responsible for severe scan distortion or collapse, sometimes when hot. Partial field collapse occurs when one of the output transistors VT402/3 or R411 goes open-circuit.

TF151 on the signals board is a collection of resistors. When the 220Ω section (between pins 2 and 3) goes open-circuit the supply to the luminance i.c. (IC155) is removed. The result is a bright raster with no video. Other sections of this unit go open-circuit, but not all that often. Most are associated with IC155, but the 12Ω section (pins 1-2) provides the supply to IC157.

Thick-film unit faults are often intermittent, and can usually be made to come and go by moving the unit with the fingers.

IC Troubles

Many of the i.c.s can give trouble. IC153 (SN76033N) causes no sound or distorted sound; IC101 (TCA270) causes various video problems, sometimes only when hot; IC155 (TBA396) causes no brightness or incorrect operation of the front controls – the brightness control may affect other functions for example; IC156 (SN76228) gives the no colour symptom. The TBA396 is not directly equivalent to the BRCM200 used in earlier production in position IC155.

IC157 and IC301 give the most trouble however. The former (SN76227) causes excessive blue or flyback lines. IC301 (TCEP100) can be responsible for the power supply being inoperative with no line whistle, or for a wildly fluctuating h.t. voltage with the raster coming and going – freezer will usually confirm the diagnosis in this case.

Fault Summary

The 12V zener diode W151, which stabilises the 12V rail, can go open-circuit when hot. Various symptoms occur – from a snowy picture to horizontal pulling.

W152 in the protection circuit goes leaky, with the symptom of flyback lines on the picture.

C166 which tunes the sound detector quadrature coil can change value, with the result that the sound level drops. Some technicians simply turn up the preset volume control. This restores the sound level, though it's rather noisy with the interesting symptom of a very loud clank from the speaker when changing channels – so loud in fact that it frightened me to death when I first heard it! The reason for this is that the sound channel is responding to noise pulses regardless of frequency while not responding much to the intercarrier sound signal, which is at 5·5MHz here.

C221 (0·1µF), C204 (820pF) and C211 (0·047µF) on the chroma subpanel go leaky or short-circuit, causing no or wrong colour. They are tiny black types and can be tricky to check as the leakage may be intermittent. If in doubt, replace all three. Some panels use other types which are more reliable.

If the e.h.t. sensing resistor R352 (1MΩ) goes open-circuit, the e.h.t. rises to around 30kV and the set e.h.t. control has no effect. Always check the value of R352 after replacing the tripler.

If the first anode supply rectifier W308 goes short-circuit the symptoms are no raster and a burning smell. Poor focus is caused by the focus control itself. Intermittent horizontal collapse is likely to be due to the yoke plugs not making proper contact, either on the main board or the line shaper board (top centre).

One of the guns producing a hazy picture is usually due to a heater-cathode short, with the result that the colour concerned is smeared. ■

The Shooting of Sam Magrew

Les Lawry-Johns

HE was a funny sort of fellow. Sort of round, if you know what I mean – five foot tall, five foot wide and five foot deep, with a face proclaiming that the Lord had not been too generous when dishing out the intelligence quota. He had to screw up his watery blue eyes to protect them from the smoke that forever issued from the fag that stuck out of his mouth – it was there the whole time he spoke, which he did incessantly while never really saying anything. He probably kept it there whilst eating as well. I vaguely recognised him as a labourer for a local builder, which perhaps explains why the local pub keeps falling to pieces.

Anyway, he came into the shop one morning, talking before he even got through the door and expecting me to understand exactly what he meant though I'd heard only the half of it. I can't possibly record his exact words, only the gist of it.

Apparently his old TV had finally given up the ghost and had been dispatched to the graveyard. As a replacement, his sister had given him a "new" Bush set which had gone wrong a couple of years previously and had been stored in her loft. He would like it got going again. No, he couldn't bring it in as he didn't have a car. And he'd like it done today otherwise his old mum, who was a cripple, wouldn't have anything to watch. Which is why I nipped up there to see if I could sort things out.

It was a hybrid monochrome set – A774 chassis. Its on/off switch was faulty for a start, and as it had been stored for a couple of years I thought it would be prudent to take it back to the shop. As I prepared to put it in the car, he cheered me up by telling me that I'd been the last one to repair it, and that although his sister thought I was all right her husband hadn't liked me. I thanked him for this interesting bit of information and departed, promising to return before evening so that the old girl could see the night's programmes. Before I left he shouted out that he wanted his name put on the set, because he didn't want it changed over for one that was no good.

"Magrew. Sam Magrew. Anyone round here will tell you." I drove off wishing I hadn't got involved to start with. I couldn't really spare the time away from the shop, and I had this funny feeling . . .

There were several other jobs that had to be done before I could attend to Sam's set, but when I got to it I fitted a new volume control-on/off switch and checked for any obvious shorts. Switch on and the valves lit up, but as soon as the line timebase got going the e.h.t. rectifier's heater winding on the output transformer started arcing. This wasn't surprising, in view of the fact that it had been stored. So I pondered upon the wisdom of either fitting a new transformer or simply replacing the heater winding and keeping my fingers crossed. Totting up the cost of a new transformer, plus the on/off switch etc., I came to the conclusion that the total would be no mean factor to Sam, who'd had the set given to him anyway. So out came the DY802's holder, and some e.h.t. cable in sleeving provided the winding. I knew this was a mistake, but like a fool kept on. The e.h.t. now came on nicely, and there was good sound. But sync was nowhere in sight. The sync separator transistor is tucked away on the left centre, near the vertical strut. It proved to be open-circuit. On replacing this the picture locked and looked good. So I stuck the set in the car and nipped it back smartly.

"Fifteen quid" bawled Sam, "I could have got a new one for that." The old girl tutted in agreement. Sam pulled out a wad of tenners and fivers and peeled off the fifteen.

"I hope it ain't going to give no more trouble after all this."

I began to loose my cool. "If the set's been stored in the loft for a couple of years, I'm responsible only for what I've just done, not the rest of the bloody thing."

Another Visit

Next morning Sam reappeared. "We saw the telly for just four hours, then it went off again. My mum's not very pleased I can tell you."

So we popped up and found that the line output transformer had given up the struggle. I put a new one in, with a stick rectifier, and carefully checked the drive and operating conditions, shutting my ears to the uncomplimentary conversation that was going on in the background about my abilities as a repairer of tellys. I'd intended to waive the charge on the transformer for the sake of customer relations, but as I could hear that these were already at a low ebb I cheered Sam up by asking for another tenner. This wouldn't put the balance right, but would help a bit. There was immediate uproar, and I think he said something about going to the race relations. This seemed a bit queer, but I eventually got out and beat a hasty retreat.

The Final Visit

You'll never guess who turned up next morning. Hard things were said. Suitably translated, the gist of his comments were to the effect that when he'd paid through the nose for a job he expected it to have been done, not half done. "What about the pub that keeps falling to pieces" I asked? "That's nothing to do with me, I only mix the cement."

So up we went again, and I was shocked to find that the new transformer had a short between windings, as a result of which the smoothing resistor lit up like a firebar. I told him I'd take it down to the shop to check it thoroughly, but he didn't listen because he was moaning about the money he'd already spent. So I counted out the exact sum he'd paid and put it on the table. Like a flash he grabbed it.

"You had the set given to you, and now you've grabbed that you haven't paid a bean. The only looser around here is me." That was my swan-song.

"Leave the set alone" he said unnecessarily. "I'll get Dave around the corner to fix it. He'll do it in no time and won't charge either."

On leaving, I felt I'd done something wrong somewhere. I've shortened the story so as not to bore you – in fact two new line output transformers had had to be fitted, and both had shorted to earth through the windings after some five hours' use. The line drive waveform appeared to be perfectly correct.

It was probably all my fault, but Sam's attitude was less than constructive so it was possibly six of one and half a dozen of the other. If you happen to meet a Bush set with an A774 chassis and a new line output transformer with a short, be careful.

I had a dream that night. Sam Magrew was at the bar telling everyone that Long John Lawry was a bum. As I entered through the swing doors, Sam went for his gun and I went for mine...

It Never Rains

After that awkward epic, we just had to have another. Nothing complicated, just a Bush colour set fitted with the A823 chassis. No field scan after working normally for a few minutes. So we checked the vertical scan balance control 6RV2 and resoldered the pegs of the pincushion correction phase coil 6L20. No trouble at all, no more field collapse. Run the set for twenty minutes or so, then await collection.

Half an hour later there was a phone call to say that the colour had gone. Back it came. Change decoder panel: still no colour. Change i.f. panel: colour restored. Attack chroma amplifier and change little round transistors, fitting better known ones. Lovely colour. Check for thirty minutes. No loss of colour, no field collapse.

Next day there was a phone call to say that there was now no sound or raster and would I call as they thought that carting the set around was having a bad effect on it... So off I went. Blown l.t. fuse due to the BY164 l.t. rectifier being short-circuit. Fit more manly BY225 bridge and new fuse. Sound o.k., picture o.k., colour o.k. Would I mind if they gave the set a few days' trial before popping the money in?

Colour Faults

Three Thorn colour sets (3500 chassis) appeared in rapid succession. All with colour faults that may be of interest.

The first gave a nice monochrome display, but when the colour control was turned up only blue and green were in evidence. This ruled out a good 80 per cent of the decoder circuitry, so we settled down to check the R – Y channel, from the bridge demodulator onwards. Our first suspect was the small electrolytic which couples the signal to the base of the R – Y preamplifier transistor on the video panel. This turned out to be all right however, so we moved back to the decoder panel. The filter choke L304 between the bridge and the output connection was open-circuit. Repair the choke and full colour is restored.

Feeling pleased about this quick one, we turned to the next. No colour. Check for presence of gating/blanking pulse from line output stage at 12/9. Present. Check at other side of pulse coupling resistor R351. Pulse still there. Check presence of chroma signal from i.f. panel at 12/4. Present and correct. Check for presence of colour turn-on voltage at base of chrominance amplifier transistor VT309. Nothing – there should be 17V at TP2. Check back through the circuit and find that the emitter-follower transistor VT305 is open-circuit, preventing the 4·43MHz reference signal going any place. Replace VT305. Nice colour. Another quicky! Could our luck last? No it couldn't.

The next one was a bitch. It needn't have been, since we'd had the same thing a couple of years previously. But suffering from senile decay as I am, I can never remember these things until I've spent a lot of time rediscovering them. So round and round the decoder we went, looking for the cause of the loss of colour. The basic problem was that the ident signal was missing. Think carefully about the ident stage. The 330Ω emitter resistor is decoupled by an 0·22μF electrolytic. Maybe this had dried up, killing the ident signal through negative feedback action? Bridging it seemed to restore everything to normal, but a replacement failed to make any difference. Tap the stage and the colour came back. Turn the set back upright and the colour went. Then it dawned on me. Removing the 7·8kHz coil's can revealed a sliver of solder which had obviously fallen into it during the course of a previous line timebase repair. Just as in the case two or three years back.

Why my brilliant, retentive memory keeps failing me like this I don't know. Honey Bunney says it's all these sex books her cousin brings in for me. He has lots of technical books given to him as surplus by someone who collects them from newsagents, and scattered amongst them are these naughty books I find of some small interest. But I don't really think they cause loss of memory.

No Field Scan

A Philips colour set (G8 chassis) was a little too large for its owner to bring in, so we had to pay it a call. The fault reported was no field scan, and as this can be a little awkward at times we took a spare timebase panel with us. This was as well, since on checking the voltages around the two BD131 output transistors everything seemed to be about right. So we fitted the spare panel, then spent some time on other little jobs that needed sorting out – grey scale, convergence, etc. Having satisfied the lady of the house that the set was now in 100 per cent condition (even though the original complaint had simply been about the field collapse), we took the faulty panel and ourselves back to the shop.

On the bench, the panel was checked. The transistors and the BRY56 s.c.s. all appeared to be in order, but the field charging capacitors C4451 and C4452 were virtually open-circuit. Replacing these electrolytics and applying about 30V to the supply connections F1 and F2 proved that the panel was now working – because of the buzz from the loudspeaker of the signal tracer – but as we didn't have a G8 around we couldn't tell exactly how well the panel was performing. When one did come in, for a new line output transformer, we took the opportunity to check the panel. The height and linearity were not up to standard, and although the BD131 output transistors read all right on a meter new ones had to be fitted to restore some range to the operation of the presets.

Dog Attacks Vicar

Ben is fairly large as rough coated collies go. Placid too, as far as people are concerned. When it comes to territory and other dogs however, it's a different story. His pet hate is a black dog which comes past with its owner and marks his patch as it were. If he could get out when that dog passes there'd be an awful reckoning. The problem now is that Ben's dislike of that dog appears to have turned into a pathological hatred for all things black. For example, there's a lady who passes with a black shopping basket on wheels. This makes Ben go berserk.

Well the other Sunday morning we'd just returned from our walk and I'd slipped Ben's chain off prior to opening the door when I caught sight of the vicar toddling down the road, supported in the main by his rolled umbrella.

"Morning vicar." I'd hardly got the words out when Ben rushed straight at him, with every hair standing on end. Not a pretty sight. Ben's teeth fastened on the black umbrella, and the vicar was robbed of his support. Fortunately Ben realised his mistake at once, and looked rather sheepish even before I cuffed him round the ear. But the vicar was going round in circles trying to stay on an even keel. I tried to help, with the result that we both gyrated around a couple of times. Profuse apologies were offered and accepted. "It's your umbrella" I explained, "it's black you see."

Needless to say, Ben's been in the dog house ever since.

VCR Clinic

Steve Beeching, T.Eng.(C.E.I.)

A couple of the older Philips VCRs have been in for repair this month. The first was an N1500 with the complaint of intermittent colour when recording, the little green light not coming on. The little green light indicates that the colour section of the receiver part of the machine is working correctly, being linked as it is to the colour-killer circuit (see Fig. 1). Now transistor TS1407, which drives the light and switches the 25V supply through to the chroma amplifier transistors TS1405/6 when a colour recording is being made, is often known to give trouble. Not this time however.

Working on colour panel 3 without the small extension board that used to be given away with the earlier machines is difficult. If I'd any sense, I'd have changed the panel for the spare one I had in stock. But that's the easy way. Instead, I checked the ident signal at the collector of the ident amplifier transistor (TP307). There should be a large, 24V peak-to-peak 7·8kHz waveform at this point. What I found was 5V, and not at 7·8kHz. The ident stage is preceded by the burst amplifier/discriminator module U1507, which was found to have chroma and 4·43MHz subcarrier inputs. So it should have had the correct output, but hadn't. The answer was obvious: change U1507. So I did this and it didn't work, i.e. the fault was still present. Perhaps the 4·43MHz reference oscillator module U1506 was faulty? Change this and the fault had cleared, but why? Job satisfaction does not come from panel swapping, even at module level. Fortunately the N1500 manual shows the circuitry inside some of the modules. A look at the U1506 module's circuit gave a distinct clue in the form of a BA102 varicap diode, which did indeed prove to be the cause of the trouble.

The second of these machines was an N1501 with another intermittent fault – random switch off. It sat on the bench for some time under test. When the fault occurred, the meter light went out but the head motor was still going. I leapt at the machine, AVO in hand, but the light then came on again. This happened two or three times, the machine sometimes unthreading. Each time the fault would clear, then return.

Various subtle techniques were used – hairdryer, freezer, flame thrower, sacrifice the cat... The problem was eventually traced to the diodes in the 24V bridge rectifier circuit – D101/2/3/4. They are often responsible for troubles in this area. Type OF194 or BY127 may be fitted, but it's best to replace them with 1N5401s, enlarging the board holes to take the thicker leads. The light (LA1) can be extinguished should the diodes go short-circuit, blowing the 3·15A fuse Z101 which is mounted next to them.

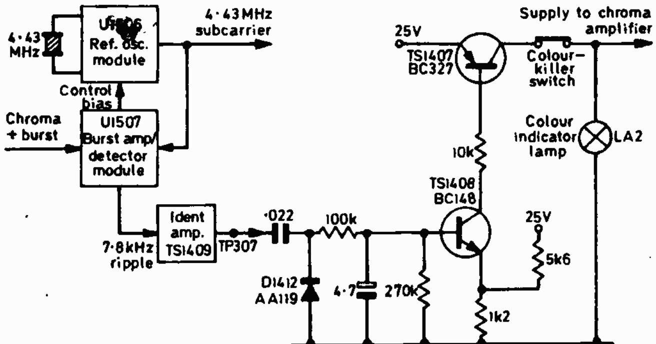


Fig. 1: Ident/colour-killer arrangement used in the Philips N1500 VCR.

Great Fun?

Great fun was had this month when a large video company sent along a National Panasonic NV8600 video recorder with the complaint that it wouldn't replay in colour. I checked this and there was indeed no colour. As a further check a known good tape was tried, but the symptom was the same. Obviously a no colour fault. Clever, eh?

Some hours and a couple of colour i.c.s later I was getting nowhere. I just couldn't find anything wrong at all. The circuits were all working correctly, but something seemed to be wrong with the phasing of the replay signal, giving the impression that the replay circuits were getting it wrong. If you read your *Television* carefully, you'll know (see May 1980) that with the VHS system one head records the colour on a subcarrier at some 627kHz, the other head doing the same but with the subcarrier retarded by 90° per line (which means that one cycle is missing every four lines). This is all done in the interests of avoiding colour crosstalk between the signals on adjacent tracks. It seemed to me that the replay circuit was trying to replay the head A recording in the head B mode and vice versa. Now VHS recorder pundits will know that this is not possible unless... the video heads are fitted 180° out of phase!

The fault report did not say that the colour had gone after new heads had been fitted, and what's more the top of the machine didn't look as though it had been removed for months. But, mused I, we'd better check. Remove top, look at video heads, bang own head on wall. Fit video heads correct way around and guess what... pretty colours, and much relief. Subsequent enquiries, or rather a red hot phone call asking what class one moron had been mucking about, revealed that the machine had been sitting for some three months on the shelf and that no one knew much about it or was admitting anything. The invoice will have sorted the men from the boys.

Parts – and Information – Awaited

A Grundig 2 × 4 plus is still awaiting final attention. A new opto-sensor was fitted in the drum unit in order to stabilise the erratic servo so that we could decide whether the audio head was faulty. Well, during a little general discussion with Grundig it turned out that they are not yet releasing certain information on mechanical alignment. This has made it difficult to align the little opto-sensor, and is not going to make life any easier when it comes to audio head replacement – but more of that next month.

Enter a 2 × 4 plus that had been dropped – but only slightly, according to the customer. Anyway, it refused to thread up, except for a short bit. I tried board substitution as a quick check, but this revealed nothing. So I called Grundig, explained the situation, and they promised to call back. As Grundig didn't sound too convincing, I decided to take another look at the mechanics underneath – you know the bits I mean, the ones you can't get any information on. I discovered a small solenoid with a bit of plastic sticking out of it. Not knowing whether it should or shouldn't be there, due to not having any information..., I gave it a wiggle and it came loose. "Oh dear" thought I (at least that's what

I thought in print). But the recorder then threaded up and worked all right (so far). It appears that this solenoid should operate a small switch mounted near it. Anyway, when Grundig rang back to say that they'd no idea what the trouble was I told them.

More Parts Awaited

Another minor problem arose with a Philips N1700 which had very poor capstan servo lock. A discussion with the customer revealed that it worked all right with older tapes, but not when it now recorded and played back the new tape. The servo was not a million miles off lock, just very so slightly off, what you might call a "soft lock". Our immediate and astounding conclusion was that the audio/sync head was worn on the sync bit. A check with the scope confirmed this, and parts are awaited . . .

A Batch of VHS Machines

There was a time during January when Andy and I were going through VHS machines at the rate of six a day – we'd had a batch dropped in our laps you see. The faults were various, including "made in Holland" type drum servo motors with intermittent start characteristics or taking too much current, creating servo problems in some portable VCRs. There was the odd head replacement, along with a pause latching mechanism that wouldn't – wouldn't latch, that is. Also a play key which jumped out of latch after the machine had threaded up. It's the "clunk" from the mechanics that causes the key to jump out of the latch – you can file the key, using a needle file, and put a slope on the lip which sits on the latching bar. This way you don't have to replace the key or its assembly.

What's Ahead?

Lastly I must say that I'm astounded, if not amazed, at the consistency and reliability of the Toshiba V5470. Someone recently referred to Toshiba as the sleeping giant of video, and I agree. New models are due for release this summer, and you might care to watch for what may come from Ferguson in disguise. In the same vein I have it on good authority (the rep was tortured) that the yet to be announced Grundig machine has so many features on it that they're at a loss to know what to develop next.

The Thorn TX10 Chassis

Eugene Trundle

IN THE February 1980 issue we reported in detail on the Thorn TX9 chassis, mentioning amongst other things the economic climate in which it was conceived and born. It's a simple, remarkably compact chassis designed to drive 90° colour tubes of the PIL variety. In our experience the TX9 has proved to be very reliable and has fulfilled its early promise. In fact we've yet to encounter our first fault in one, though we must admit to not having all that many of them in our care. There are now 22in. TX9 sets incidentally.

The other half of Thorn's colour TV master plan consists of the TX10 chassis for driving 110° tubes. For several weeks recently one of these sets, a 22in. Ferguson Model 3765, sat in glory in my living room. I've still not quite recovered from seeing its rendering of Kate Bush in concert!

Vital Statistics

The TX10 is designed to drive 20, 22 and 26in. tubes of the 30AX type and the similar thin-neck RCA S4 type. There's but one "tolerance" control to match the chassis to the scan yoke. As with the TX9, simplicity is the keynote of the design and the basic chassis can be used with a variety of screen sizes and consumer options – the same chassis can be removed from a basic 22in. set and without any modification fitted into a 26in. remote controlled set with teletext and tone controls. This versatility is a characteristic of the chassis, with its ability to operate with a simple or sophisticated remote control system and sweep tuning, drive an external loudspeaker, provide headphone or hi-fi outputs, incorporate bass and treble controls and accept video inputs. The latter facility embraces many things – teletext, viewdata, TV games inputs, signals from a camera and use as a data display, for example as a VDU with a home computer. To these ends a video/audio input/output socket is fitted and the video bandwidth is no less than 10MHz. This is far beyond the 5·5MHz capability required for present TV transmissions, giving really crisp data displays. In fact we suspect that in the smaller screen sizes at least the c.r.t. phosphor "dot" size and the 625-line standard are the limiting factors determining the resolution.

The power consumption has been kept low – 70W at zero beam current. This is 28W more than the TX9, an extra 20W being required for 110° scanning plus 8W for peripheral circuitry. While the signal stages and the field timebase are for the most part similar to those used in the TX9, the power supply and line timebase are totally different and the RGB output stages are of the class AB type.

Apart from the i.f. daughter board, the chassis is to all intents and purposes a single board design. The board is in two separate sections (signals and power supply/timebases) in the final chassis assembly, but is cut into two only at a late stage of production. The two sections of the board are then mounted in a hinged steel frame, which results in a slim chassis with easy access for servicing. The metal chassis is isolated from the mains, facilitating the external connections previously mentioned, all the mains-live circuitry being protected by red plastic covers.

Signal Processing

There is some complication in the TX10's front end due to the provision of sockets for sweep tuning and remote control. Otherwise the varicap tuner plus i.f. preamplifier/SAWF/TDA2540 i.f. amplifier/demodulator i.c. arrangement follows the pattern set by the TX9. The sound department is also the same, with a single TDA1035T i.c. The loudspeaker is an 8Ω type however. Let's hope that the isolated chassis doesn't result in too many liberties being taken with the external speaker wires –

or we'll need to stock up on these!

The single-chip decoder used is the TDA3560, as in later production versions of the TX9 (earlier production used the quite different μPC1365C). The TDA3560 does not need an external chroma delay line driver stage and operates with an 8·8MHz crystal. As a result of the latter feature, U and V reference signals with the correct phases for demodulation are obtained automatically and no adjustments in this part of the circuit are required.

The most important point about the TDA3560 however is its ability to accept and handle external video input signals. A blanking input is provided, along with the RGB input pins, so that any size or shape of black hole can be inserted in the picture and filled with characters or graphics from an external source. Alternatively the data can be superimposed on the picture, the blanking input then giving a crisper result than would be obtained by simply mixing the data and video signals within the chip. This arrangement also offers versatility in data or graphics presentation, for example the ability to surround characters with white or black edges.

The RGB output stages are also worth mentioning. They are mounted on the c.r.t. base panel to reduce stray capacitance, and consist of three three-transistor configurations – a cascode pair plus an emitter-follower to improve the h.f. performance. The result is a bandwidth of 10MHz with a low current consumption.

Timebases

The field timebase is similar to the TX9, in that most of the circuitry is within a single i.c., a TDA1044 this time instead of a TDA1170S, but there's an external output stage to provide the additional deflection power required for 110° deflection. The output stage (see Fig. 1) looks rather basic, and at first sight quite impractical since the bases of the output transistors are strapped together – you'd expect crossover distortion from this arrangement! The key to this however is R777, which feeds the scan coils directly from the chip during the part of the field scan (about the centre) when both output transistors (TR772/3) are non-conductive. A further external transistor (TR771) boosts the supply to the output stage during the flyback period. This works as follows. During the forward scan D771 is conductive and the positive plate of C781 is at 26V. When the flyback occurs, the flyback booster circuit in IC771 feeds a positive-going pulse to the base of the emitter-follower TR771 which switches on. The 26V developed across R786 increases the voltage on both plates of C781 by the same amount, the positive plate rising to 52V. D771 cuts off, and the supply to the external (TR772/3) and internal (within IC771) output stages is thus doubled. C775 and the network R778/C776 are included to prevent instability.

The line processor i.c. is a TDA2576. In addition to the expected sync separator, flywheel line sync and line generator circuits, this i.c. produces the sandcastle pulse required for the decoder i.c. and incorporates a clever teletext blanking circuit. The line oscillator runs at twice the normal speed, so that division of the clock frequency (31·250kHz) by 625, plus a triggering input from the field sync, enables a precisely timed teletext blanking pulse to be generated by counting to lines 21/334. This happens only in the presence, recognised by the chip, of a full-specification broadcast field sync pulse train – so you won't loose the top of your tennis game or camera picture. The teletext blanking waveform emerging from pin 1 of the chip is added to the sandcastle pulse fed to the decoder.

The TX10's line output stage is simplicity itself. Shorn of the responsibility for generating the e.h.t. and most of the other supplies (the chopper circuit provides the e.h.t.), there's simply a BU208B output transistor, a small transformer, a flyback tuning capacitor, scan-correction capacitor, the scan coils and very little else. The line output transformer in fact consists of a small choke, with a secondary winding that provides 60V and –60V pulses.

Since harmonic tuning of the line output transformer is no longer necessary (this is required only when there's an e.h.t. overwinding to complicate matters), the usual EW diode modulator circuit can be dispensed with. Instead, as in the 4000 chassis circuit described last month, an EW modulator transistor is connected in series with the line output transistor – between its emitter and chassis. The EW modulator transistor is a Darlington type (BD677) whose base bias is controlled by the width potentiometer.

Whenever the line scan and the e.h.t. are provided by different stages, there's the risk of danger to the c.r.t. screen should the line scan fail. To prevent this, the c.r.t.'s first anode supply is obtained from a rectifier which is fed from the junction of the scan coils and the scan-correction capacitor.

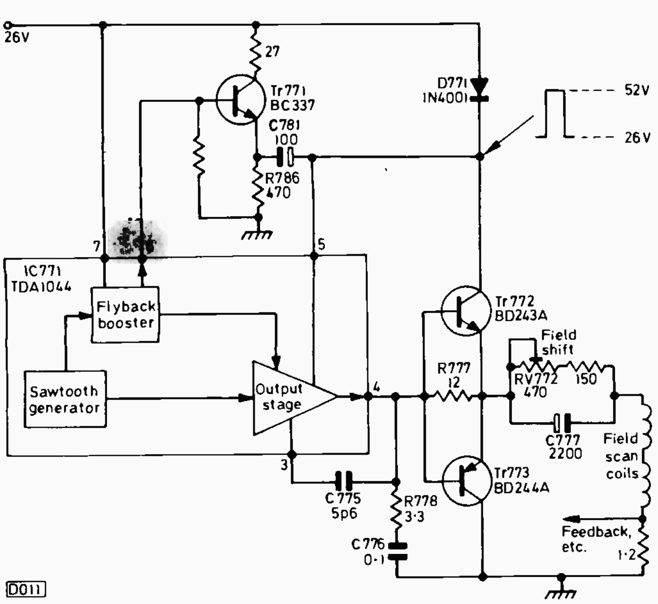


Fig. 1: The TX10's field output stage.

Power Supply Circuit

In many ways, power supply circuit design has come round full circle with the TX10. With the power supply providing the e.h.t., an isolated chassis and a very simple line output stage, the basic arrangement is just like that used in the 1938 EMI TV set that lives in the corner of my workshop (the one that David Looser described last October)! The control operations in the TX10 are provided by a TDA2582 chip – the only chips in the EMI set occurred if you dropped the chassis on the rectifier valve and smashed it . . .

The incoming mains supply is fed to a bridge rectifier (D701) which charges its reservoir capacitor C708 to some 320V. This is applied to the collector of the BU208B chopper transistor TR701 (see Fig. 2). A small mains transformer (T702) provides a start-up supply, the supply for the chopper driver transistor, and energy for the remote control receiver (if fitted). The TDA2582 contains a 15·625kHz oscillator which is synchronised to the line oscillator. The output from this passes via a pulse-width modulator stage within the i.c. to the chopper driver which switches the chopper transistor on and off. The pulse-width modulator varies the mark-space ratio of the chopper transistor's drive waveform, i.e. the on and off times of the chopper, thus regulating the supplies obtained from the chopper transformer T705. These include the e.h.t. and a 150V line for the line output stage. Feedback from the 150V line to the TDA2582 controls the action of the pulse-width modulator, i.e. the regulation. The i.c. also contains slow-start and comprehensive protection circuitry – the latter monitors the chopper current (the ripple flowing via T703), the h.t. and e.h.t. voltages (the latter indirectly) and the beam current.

Apart from the first anode and start-up supplies, the chopper transformer T705 provides all the supply lines in the TX10 – the e.h.t. comes from a diode-split secondary. When the chopper transistor switches off, a "line flyback" pulse is produced. The e.h.t. and the 205V (for the RGB output stages) supplies are obtained by "flyback" rectification, the other supplies being produced by rectifying the "scan" part of the waveform in the chopper transformer in order to achieve good regulation. One of the secondary windings on the chopper transformer provides the drive to the line output transistor.

The operation of the chopper itself is new and worth going into in greater detail. Apart from the chopper transistor TR701 and transformer T705, the components involved are diodes D702/3/4, capacitors C711/2 and coil L702. When TR701 is switched on, current flows via L702 and the primary winding of T705. When TR701 is switched off, the magnetic fields established around the two windings collapse. C712 tunes the primary winding of T705 to provide the "flyback" pulse. At the end of the half cycle of oscillation, D704 conducts, damping the circuit. The action is that of an efficiency diode, C711 being charged by the linear decay of current. C711 is also charged during the chopper transistor's off period by the energy decay in L702, D703 being on during the whole of the chopper transistor's off period.

When TR701 switches on again, D704 and D703 switch off (unless the mains voltage is low, when D704 will remain on briefly). D704 will also be conductive during the slow-start period, before C711 has fully charged. D704 switches off when the charge across C711 is such that its cathode is positive with respect to its anode when TR701 switches on. Now the charge developed across C711 is proportional to the chopper transistor's on/off time, increasing when the

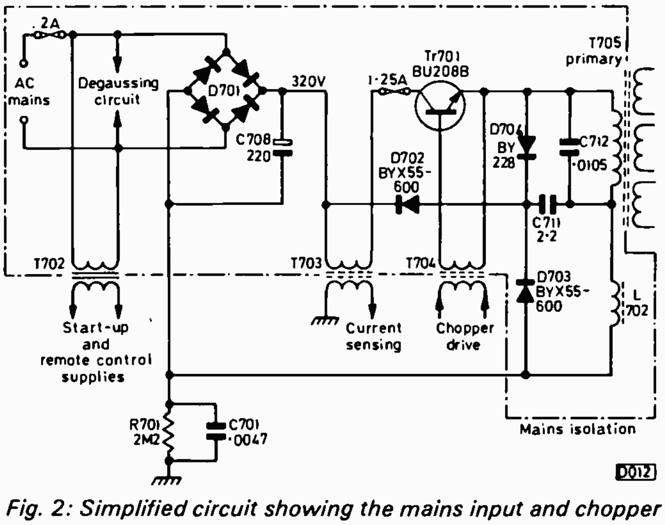
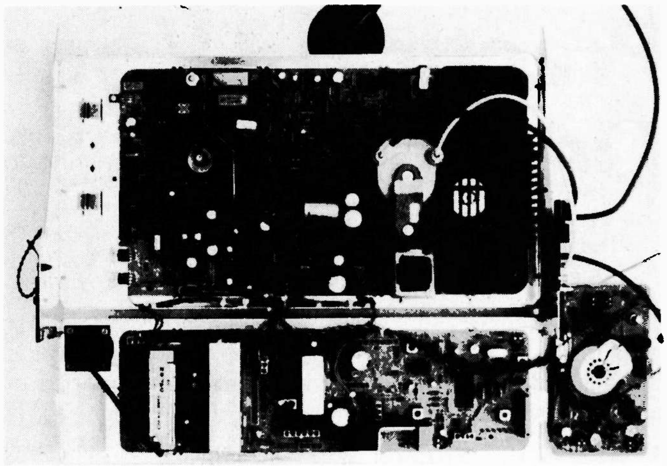


Fig. 2: Simplified circuit showing the mains input and chopper power supply arrangements. The chopper transformer T705 has a diode-split secondary to provide the e.h.t.



The Thorn TX10 chassis, with the signals section at the bottom in the hinged down position. The mains-live section is beneath the plastic cover shown at the top right.

transistor is on for a longer time. The result of this is that D702 conducts, feeding the surplus energy in C711 back into the supply to improve the efficiency of the circuit.

This all adds up to a very efficient power supply, with an unusually large number of energy stores – C708, C711, L702, T705 and the reservoir capacitors associated with T705's secondary windings. Mains isolation is provided by no fewer than four transformers (T702/3/4/5) plus the network R701/C701, all of which have to comply with BEAB requirements.

Evaluation

Such is the standard of excellence amongst current TV receiver designs that it's difficult to make any really significant comparisons between the TX10 and its competitors. The picture quality is excellent – but then so is that with all current commercial designs. Like the TX9, the e.h.t. regulation, or more strictly the picture size/brightness performance, is very good – but so is everyone else's! The cabinet and much of the stand is of plastic material – as again are most contemporary sets. Our review model did not incorporate teletext or viewdata, which was a pity since this would have brought out some of the best features of the design.

As with our TX9 Thorn review set, I had to make a little internal adjustment before perfect reception was secured – this time to the a.f.c. and vision detector coils. Again I found that the customer controls were a bit fierce and non-linear. In the review set, the volume and colour controls were the main offenders – only the middle third of the volume control's track had significant effect.

On test card an excellent display was obtained, with good geometry and the teletext truly blanked. Sound was satisfactory from the necessarily small loudspeaker. For a cost-efficient (that's what we call it nowadays!) design, the performance is very acceptable and comparable with anything the opposition (even the expensive Danish and oriental opposition) can offer. The chassis layout is delightfully clean and easy to get at – none of those myriads of plug-in modules that continental setmakers seem to like. Ah, you may say, but mightn't this make field servicing more awkward, since chunks of circuitry can't be substituted? Not really, since the straightforward circuitry employed means that fault-finding should prove to be relatively simple. The engineering elegance of a neat layout lies in the simplified production procedures. In conclusion, well done Thorn – rule Britannia! ■

Practical TV Servicing: Dealing with Strangers

S. Simon

To THE newcomer, all TV sets are unfamiliar. So in dealing with them he must follow the advice of others, or plod through certain established servicing procedures in order to uncover the cause of the problem with which he is confronted. He then has to obtain and fit the necessary parts in order to find out whether or not the full story has been revealed. He may find that there are hidden (to him) factors that led to the breakdown.

Even the experienced engineer is not all that much better off – because it depends on what you mean by "experienced". A chap may have vast experience of Thorn sets say, and be able to rattle off all the stock faults on these with scarcely a moment's hesitation. But confront him with a strange set, a Philips G11 say, and he'll have to pause a while. If the trouble's not too obvious, the chances are he'll pick up the phone and consult a friend who is as knowledgeable on Philips sets as he is on Thorn chassis. The friend will probably be able to guide him to the seat of the trouble, be it a faulty diode, a burnt out choke or perhaps a dry-joint in an unexpected place. If he has such a friend that is. If he hasn't, and he elects to do the job, he too must plod and hope that the fault will not turn out to be too obscure.

We had something to say on this subject in a previous article ("When You Meet a Stranger"), but it seems time to enlarge upon the topic, particularly with respect to certain more up-to-date sets that provide a noticeable lack of simple signposts to aid diagnosis. So as not to leave anyone out, let's start with a bit of a recap.

Is there a Mains Transformer?

Most of the earlier colour sets – the ones still most likely to be encountered – used a mains transformer, and it was customary for the tube's heaters to be supplied by a winding on this. Most monochrome portables also have a mains transformer, to reduce the 240V mains supply (UK) to approximately the same voltage that would be applied to the set from a car battery (12V). There were exceptions amongst portables however, a notable example being the Indesit T12 which employed a switch-mode "pump" circuit. The GEC 3133 and 3135 portables also used this arrangement. Now the problem with these and with many other less familiar circuits is that some sort of start-up system may be required. This was not the case with the first UK chassis to have a switch-mode power supply, the famed Thorn 3000/3500 chassis, because this one did have a mains transformer which powered the l.t. side of things in a conventional way following switch on. Though it caused us all a few grey hairs, it didn't quite have the mystique that seems to surround some more recent chassis, with their start-up capacitors and resistors and what have you. These need to be approached with some caution, particularly since a set that is apparently "dead" may in fact be very much alive.

Robbed of the mains transformer we can't, with a colour receiver, rely on the tube heaters providing a visual indication that power is reaching the set. Nor can the chassis be relied upon to be at neutral potential. In many sets nowadays the chassis is at half mains potential, because the mains input is first fed to a bridge rectifier circuit. The chassis may be connected to the bridge's negative or positive output, which is something else to think about. We can't in this short article consider all the various circuit permutations you may encounter: instead we'll look at one or two of the less common arrangements, from the bench point of view – heavy on the practical aspects, light on theory.

The Indesit T12LGB Portable

Most of you will by now have come across the Indesit T12LGB portable with its unusual transistor pump circuit. Whilst some of the common faults this set presents – field collapse or no signals for example – are straightforward, there comes a time when one of them is brought in with the comment that it's dead, though a meter check shows that it's very much alive. First check whether it works when supplied from a 12V battery. If it does, the start-up circuit will have to be investigated (see Fig. 1).

A d.c. reading of some 300V or more may be obtained around the top right-hand side electrolytics C902/3. A voltage of 220V or so may be found at the collector (the body) of the top right-hand side power transistor TR902 (the pump). If it isn't, check the wirewound resistors in series with the transistor – R909 is likely to be open-circuit. It's above the transistor. The other resistor (R908) is on the bottom centre heatsink and is connected via two obvious leads to the top right. By and large then, no trouble so far.

Assuming that the voltage is reaching the pump transistor, the fact that precious little else is happening means that the pump isn't pumping. Cries of "well I never!" The d.c. voltage at the collector of the pump transistor must not only be high, it must also be smooth. So we double check the reservoir electrolytics C902/3, noting that the main suspect – the second one down, C903 – has its negative side connected to chassis whilst the upper one doesn't. The start-up supply is obtained from the junction of

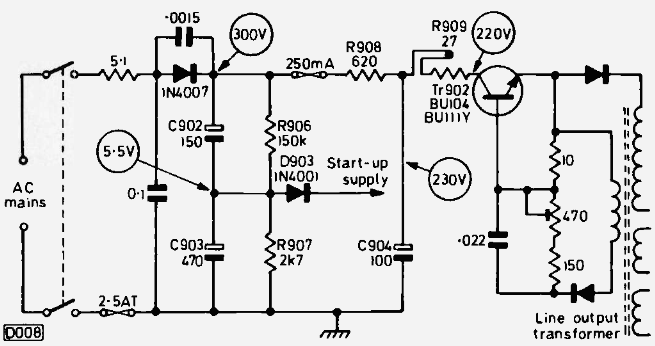


Fig. 1: Power supply arrangements used in the Indesit T12LGB monochrome portable, showing the mains input and rectifier, the start-up circuit and the pump transistor Tr902.

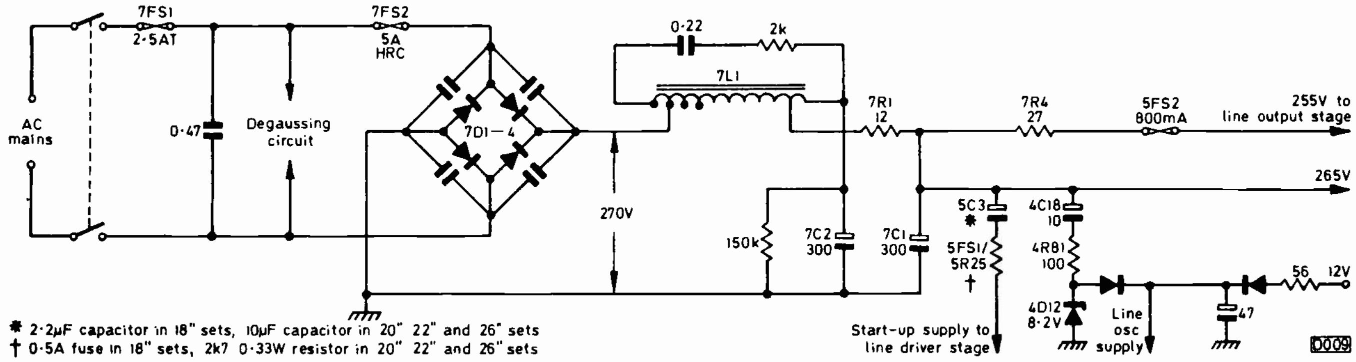


Fig. 2: The mains input, h.t. and start-up circuits used in the Rank Z718 solid-state colour chassis. The mains bridge rectifier 7D1-4 produces the h.t. supply, stabilisation being carried out via the EW modulator circuit.

these two electrolytics, being developed across the lower resistor (R907) in the potential divider network R906/7. Why is a start-up supply required? Well, the pump transistor feeds energy into the line output transformer, and is driven by a secondary winding on the transformer. All the rest of the supplies in the set are derived from the transformer – including the supplies for the line oscillator and driver stages. Until these latter start to function, nothing else can happen. No line output stage operation, no drive to the pump transistor – nothing. Hence the start-up feed to the line oscillator etc. via D903 – which switches off once everything starts to operate normally. The start-up voltage is roughly 5·5V – the voltage at the cathode of D903 is 17V (the boost supply) once the line output and transistor pump circuits have come into operation.

So if the set's not starting, the first check must be for about 5·5V at the junction of C902/3/R906/7. If the reading obtained is low, there's probably some sort of heavy drain – due say to C903 being leaky, or to one of the transistors fed from this point being short-circuit. C903 incidentally is at the bottom right and is not part of the top group. If the voltage reading obtained is on the high side however the start-up supply is open-circuit. This could obviously be due to D903 being open-circuit, but the print from the top right capacitor runs down the right-hand side and loops across at the bottom to feed the diode. Near this loop there's a weak point at an opening in the panel for a plastic support member. Vibration can cause a crack from this opening across the print, thus leaving the diode's anode unsupplied.

The later T12SGB (push-button model) uses a similar circuit, though with variations. The basic scheme is the same however. The GEC 3133/3135 portables also have the same pump and start-up system, but of course the print fault tip is not applicable in this case. So you should now have a rough idea of what's likely to be wrong on these sets if there's a high d.c. supply present but the set is otherwise not working.

The Rank Z718 Chassis

Let's next put a Bush-Murphy colour set on the bench – one fitted with the Z718 chassis (Models BC6100 etc.). A quick check at the centre left power board will show whether the mains voltage is being applied via the two fuses 7FS1 and 7FS2 to the bridge rectifier 7D1-4 (four BY126 diodes or similar). It's not uncommon to find one of the fuses open-circuit because one or more of the diodes is short-circuit, but we digress.

Assuming that the bridge is intact, we can check the voltage across its output – something over 250V should be recorded. We are not dealing with a switch-mode arrangement this time – regulation in this chassis is built into the line output stage, operating via the EW modulator circuit. Once again however nearly all the supplies in the set are derived from the line output stage, so something has to be done to get the line oscillator and driver stages working before the line output stage can start up and the whole set spring to life. What's done is to provide both these stages with a capacitor start-up supply. Right, so we've got an apparently dead set but there's plenty of h.t. at the output of the bridge rectifier. The h.t. should also be present at the line output transformer and at the body of the upper of the two line output transistors – assuming that 7R1, 7R4 and fuse 5FS2 are all intact of course (see Fig. 2).

Two electrolytics provide the start-up action. 5C3 (2·2µF or 10µF depending on screen size) charges to provide the line driver stage with a kick-start so to speak, via 5FS1 or 5R25 (which could be open-circuit). 4C18 does the same thing for the line oscillator, the series resistor 4R81 being quite small (safety). The 8·2V zener diode 4D12 is included to ensure that the line oscillator's start-up voltage doesn't exceed this figure. A fair amount of current flows through 4R81 at switch on, which explains why it's often found to be faulty and as a result responsible for the set appearing to be dead.

These arrangements mean that you should get an audible surge at switch on, though the set may then lapse back into apparent non-operation. This occurs if the overload trip operates, removing the drive to the base of the line driver transistor. If this happens, we take one or two steps to unload the likely things that could lead to the trip tripping. Undoubtedly the first thing to do is to disconnect the e.h.t. rectifier, which is a frequent cause of the problem. Then take a look at the full circuit in the manual to see which other items can be disconnected to leave the line output stage unburdened – there are lots of possibilities, which are outside our main concern here, which is start-up arrangements, but we would mention that under normal working conditions with a normal picture the voltage at the slider of the overload trip control 5RV3 should be 6·5V.

Returning then to failure of the set to start up, if the h.t. supply is present we immediately check 5FS1/5R25 and 4R81 to ensure that they are intact before checking 5C3 and 4C18 by testing each in turn (bridging them with the set switched on is not a check).

The Rank T20 Chassis

The Rank chassis which succeeded the Z718 was the T20. There was also the Z179 (for 110° delta-gun tubes), but that used a thyristor stabilised h.t. supply of the type found in chassis such as the Philips G8, so we won't consider this one for the present. It's the switch-mode power

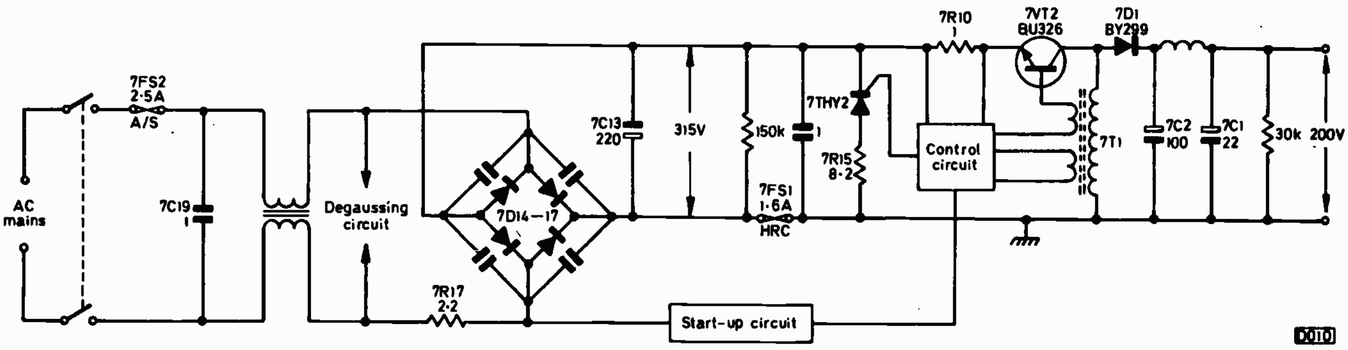


Fig. 3: Simplified diagram showing the way in which a regulated 200V h.t. rail is obtained in the Rank T20, T22 and T26 chassis. The bridge rectifier 7D14-17 produces a supply of approximately 315V across its reservoir capacitor 7C13 – note that this supply is negative with respect to chassis, which is in turn at half mains potential. This negative, 315V supply is applied to the emitter of the chopper transistor 7VT2, which is connected in a self-oscillating circuit with feedback between its collector and base via the chopper transformer 7T1. The control circuit adjusts the chopper transistor's on/off times to provide the voltage regulation. The output developed across the primary winding of 7T1 is rectified by 7D1, which in turn develops a regulated 200V supply across its reservoir capacitor 7C2 – this supply is positive with respect to chassis. Though the chopper is self-oscillating, it requires a start-up circuit to trigger it into action at switch on. This consists of a diode which feeds a positive-going mains pulse, after clamping and shaping, to the base of 7VT2. In the event of excessive output from the chopper due to a fault, the overvoltage protection thyristor 7THY2 will fire, blowing fuse 7FS1.

supply used in the T20 that's more likely to be encountered and more likely to give cause for concern.

Fig. 3 shows the main features. Basically, 7VT2 is a self-oscillating chopper whose on/off times are varied so that a stabilised supply is obtained from the rectifier 7D1. Our main interest however is the set's habits when it turns up on the bench. The mains input is fed to a bridge rectifier (7D14-17) as in the Z718 chassis, but this time the positive output from the bridge is taken to chassis via the 1·6A HRC (high rupture capacity) fuse 7FS1. This is not unusual today, a similar arrangement being found in solid-state ITT colour sets for example. The 315V negative output from the bridge will be found at various points in the power supply's control circuitry but will not be found in the receiver proper. After the power supply unit, the chassis is the normal current return path for the 200V h.t. line which is positive with respect to it. The chopper transistor's emitter stands at some 315V negative with respect to its collector.

Before making any tests, it's as well to study the full circuit in the manual carefully. Use 7VT2's emitter as the reference point when carrying out voltage checks in the chopper control circuitry.

Possible causes of the dead set symptom in the mains input circuit are the 1·6A (later changed to 2·5A) anti-surge resistor 7FS2 and the 2·2Ω resistor 7R17. If 7FS2 is found blown, the likelihoods are a shorted diode in the bridge rectifier circuit or the mains filter capacitor 7C19 being short-circuit or troublesome. If 7FS1 is found blown, the crowbar thyristor 7THY2 may have switched on, possibly due to a fault in its firing circuit. It normally sleeps unused – and may thus be overlooked.

The usual complaint however is tripping due to excess current. This is nothing to do with the power supply. As in the Z718 chassis, a trip removes the drive to the base of the line driver transistor when the load on the line output stage is excessive. So the answer is again to unload everything that can be unloaded in the line output stage and try again. The tripler is an obvious suspect but, we hate to tell you this, in most cases the trouble is due to shorted turns in the line output transformer – the evidence for which consists of the winding overheating even though the tripler has been disconnected. Sorry.

Oh yes, start-up arrangements. Again, most of the supplies in the set are derived from the line output stage. Since both the line output and line driver stages are powered from the 200V h.t. rail however (the line driver stage via a 1·8kΩ fusible resistor, the line output stage via an 800mA fuse which was removed in later production), only the line oscillator requires a start-up supply. The arrangement used is exactly as in the Z718 chassis, a 10μF capacitor (4C19 this time) charging from the 200V h.t. line. There's a small 100Ω series resistor (4R49), again as in the Z718, and the same remarks apply. The chopper circuit itself is self-oscillating but not self-starting. The start-up circuit has not however given us any trouble.

Miller's Miscellany

Chas E. Miller

AS I've said before, particular types of faults seem to turn up in batches. I've recently had this experience once again. This time it all turned out to be to my advantage – it also proves the point that a TV engineer has to have a long, long memory.

The set that started this chain of events off was one of the original ITT, well KB in those days, Featherlight portables – I'd better explain, for newer readers, that the reference is not to a type of surgical goods. Dear me no, it's to a compact all-valve (except for the u.h.f. tuner, which wasn't always fitted initially) transportable set that appeared in the mid-60s. The VC11 dual-standard chassis. The one I had to deal with was one that lacked the u.h.f. tuner, which made it rather less than satisfactory for the job my friend had in mind for it – for use by his son to receive Open University programmes. Had I known this at the start, I probably wouldn't have got involved with it, but you know how difficult it can be to refuse.

I switched on with little enthusiasm – from my recollection, the sets were nothing much to write home about when they were new some sixteen years ago. Up came the sound, but there was no sign of a picture. The timebase was whistling healthily enough however, so I gave it a few minutes. Nothing happened, so I sighed and switched off. By chance I looked at the bench mirror and saw the raster collapse to a bright spot. Something stirred in the back of my mind. Wasn't there a certain resistor that used to fail? I found an ancient manual, blew off the dust, and discovered the faded inscription "if the brightness is low check R167". This 4·7MΩ resistor is connected between the boost supply and the c.r.t.'s first anode, and was virtually open-circuit.

When a new resistor had been fitted the results were ridiculously good for such an old set. The picture was so bright I could only conclude that the set had been in store for most of its life. It was returned to a delighted owner and might have been forgotten except for another chance happening next day.

This time another acquaintance called in to say that he was on his way to buy a rebuilt colour tube and did I want him to pick up any for myself? So I asked him why he needed a tube himself?

"It's for that Thorn 8000 you repaired for me a month or so ago – it's gone absolutely flat. Everyone says it must be the tube."

Now when I last saw that set it was in excellent fettle, with nary a sign of reduced emission or any other tube fault. So I persuaded him to let me have another look at it before going to all the expense of a new c.r.t.

At first sight it looked as if I'd wasted my time. All the classic symptoms of a bad tube were present – very poor brightness, flaring on highlights and so on. It seemed hardly worth even trying the tube tester on it. But as I switched off there was once again that brilliant spot as the raster collapsed. Wondering whether this was going to be a repeat of the previous day's performance, I measured the c.r.t. base voltages. The grids should have been at about 27V – measured at the junction of R613 and R615, which provides forward bias for the beam limiter diode network. The voltage was virtually zero however, due to R615 having risen from 180kΩ to a very high value indeed. Replacing this resistor restored the brightness to a very acceptable level.

After this it was certain that a third repair of the same type would be required – it was actually waiting for me in my secondhand set store! I'd been presented with another Thorn colour set, this time a 3000, which was alleged to be completely worn out. When I got around to trying it out I was gratified to find out that the picture wasn't too bad at all. After half an hour or so it had all but disappeared however. Flushed with my recent successes, I again checked the c.r.t. voltages. Grid voltage wrong again, this time due to R451 (910kΩ) having changed value as a result of which all the guns were close to cut off. A replacement resistor – it's mounted on the field timebase panel – did the trick, and I was now feeling very self-satisfied indeed. Which is usually the signal for a kick in the pants from fate.

Sure enough an hour or so later, during a test run, the picture began to lose all its red. Not too difficult this one – simply a high-value resistor (R725, 1·5MΩ) in the feed to the red first anode preset increasing in value. During a further test run however the picture seemed gradually to lose its crispness – it eventually, and suddenly, went bright green, the luminance information virtually disappearing. It required a session with the scope to fathom this one out. I finally tracked it down to the luminance coupling electrolytic C204 (100µF) on the video panel. It was open-circuit, and must have been failing gradually over a period since a new one brought the picture up to almost "new tube" standard. Well that was some three-four months ago, and the set's given satisfactory service ever since.

VINTAGE SPOT: VIDOR

Few people nowadays would associate the name Vidor with anything other than batteries. The firm was once one of the UK's largest manufacturers of portable radios however – along with their chief competitor Ever Ready, also of course a battery making concern. And for a few years during the late 40s and early 50s they also produced what they called televisors.

Early Models

Many of the designs of that time bordered on the eccentric. The Vidor sets featured good design and workmanship however. One of the earliest models was the CN370, which was introduced at the time when the BBC service was being extended to cover the midlands – via the Sutton Coldfield transmitter. This was a difficult period for setmakers, since many of them were committed to t.r.f. designs which couldn't easily be adapted for the new channel 4. Even the superhets of the day weren't always readily tunable – in many cases new sets of aerial and oscillator coils had to be fitted, plus perhaps a few changes made to associated capacitor values. Vidor however opted for a commendably simple approach – a two-channel superhet which could receive either channel 1 or 4 at the turn of a switch.

It was a 12in. console model which had a handsome cabinet with doors. There were two main front controls – volume-on/off and brightness – plus six presets which were hidden behind an ornamental metal strip. Separate r.f./i.f. and timebase/power chassis were used, a practice to which Vidor subsequently returned.

Of the total of 18 valves, ten were used on the signals chassis. Seven of these were EF91 miniature r.f. pentodes, the others being a couple of EB91 double diodes (demodulators/interference suppressors) and an EL41 audio output valve. The anode of the local oscillator valve was coupled directly to that of the r.f. amplifier valve, both being coupled to the mixer valve by a 500pF capacitor. This was an unusual arrangement: it required fewer components than many contemporary designs and was inherently stable.

Careful thought had also been given to the i.f. amplifiers, which in the main used only single tuned circuits. Alignment was thus exceptionally straightforward, requiring only three main coil adjustments. The sound and vision i.f. signals were separated immediately following the mixer, the sound take-off coil acting as one of the rejectors in the vision channel. Vision a.g.c. was then a long way in the future, so an r.f. gain control was included in the r.f. amplifier valve's cathode circuit. In similar manner, the cathode circuit of the first vision i.f. amplifier valve included a preset (one of those behind the ornamental strip) which acted as the contrast control.

The h.t. and e.h.t. supplies were both mains derived, from a transformer which also supplied the heaters and provided mains isolation. A focus coil was included in the h.t. smoothing circuit – it was bypassed by a preset which gave fine control over its effect. The timebases were simple enough – two 6K25 thyratrons plus two output pentodes. The EL33 field output pentode was *RC* coupled to the high-impedance scan coils. An EL38 did duty on the line side, with a simple output transformer having but two windings.

Perhaps the most unusual bit was the video/sync separator circuitry. The EF91 video output pentode V6 drove the c.r.t. grid. It was followed (see Fig. 1) by an EB91 double diode which in addition to acting as the sync separator also provided d.c. restoration of the video applied to the c.r.t. This meant that everything was back-to-front compared to what we generally expect. The input to the cathode of V7A had negative-going sync pulses to switch the diode on, the coupling capacitor C22 acquiring a positive-charge to hold the diode off between sync pulses. V7B acted as a clamp, and the diodes were followed by an EF91 which amplified the sync pulses.

Altogether this was an excellent receiver, capable of giving good results and service. An electrically similar model, the CN377, was housed in a compact table cabinet and had a 9in. tube. The speaker was alongside the screen, to the left, both cabinet openings being of the same size. Electrically it differed in using EF42 valves in place of the EF91s, T41 thyratrons which meant an extra heater winding on the mains transformer, and transformer coupling in the field output stage.

The CN390 Series

In some respects the following CN390 series (Models CN390/CN391/CN4201/CN4202 and fringe versions CN405/CN406) was a case of one step forward, one step back. The e.h.t. was obtained by the vastly safer means of an overwinding on the line output transformer, but the chassis was no longer isolated, the mains transformer being of the autotransformer variety. There was also the abandonment of the two-station switch, with separate models for the London and Birmingham transmitters. That

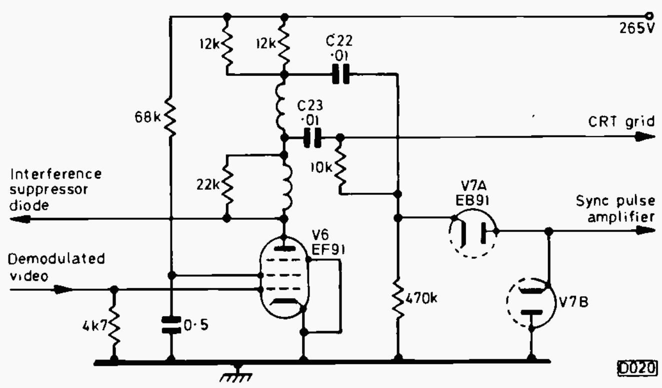


Fig. 1: The video output and diode sync separator stages used in the CN370.

must have cost quite a bit on the production side.

The basic circuit remained much the same however, though "the works" were this time accommodated on one large flat chassis. The line timebase consisted of a single self-oscillating EL38 valve (see Fig. 2), with the sync pulses applied to its suppressor grid, while an EL41 was used in the field output stage. As before, there were two gain controls. The preset in the r.f. amplifier valve's cathode circuit was this time used as the contrast control, the sensitivity being adjusted by altering the voltage applied to the mixer valve's screen grid. The video/sync arrangements became conventional, with cathode drive to the c.r.t. and a pentode (EF91) sync separator. The sets were housed in a cleverly designed console cabinet: the lower half was in the form of a useful bookshelf, the loudspeaker being mounted horizontally on a mid-height deck. The fringe models had a sharper i.f. response rather than an extra stage – no doubt the slight loss of fine detail would have been of little consequence under fringe area conditions.

Enter the ECL80

The next series of models (CN4206/7/8/9), again in fringe and service area versions, used the same basic r.f./i.f. section, though with further changes in the gain/contrast control arrangements. This time the newly introduced ECL80 valve put in an appearance – in the audio department and in the line timebase. As an audio valve the ECL80 was a poor performer compared to the EL41 used in the previous sets.

Come 1951

Vidor returned to a two-chassis layout in the following CN4213/CN4215/CN4216 series, which appeared in 1951. The first two were electrically identical, in console and table presentations respectively, the CN4216 being a table model with slight chassis modifications to permit the preset controls to be front mounted. It was also fitted as standard with a neutral grey tube filter to improve the contrast under bright lighting conditions.

These sets used virtually new circuitry throughout. The r.f./i.f. section now employed EF80 pentodes, with a self-oscillating mixer, and was tunable over the five Band I channels. A GEX34 crystal diode put in an appearance as the vision detector. Another thing that came back with these sets was the use of a diode sync separator followed by a pentode amplifier. No need for any d.c. restoration, since the EF80 video output valve was d.c. coupled to the c.r.t.'s cathode.

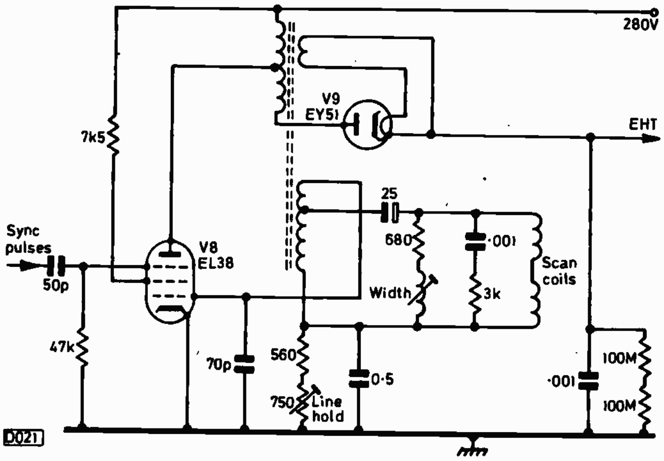


Fig. 2: The single-valve (plus e.h.t. rectifier) line timebase circuit used in the CN390 series.

There were three ECL80s this time – audio, sync amplifier/field blocking oscillator and field output/line oscillator. The remaining thyratron had finally departed from the field timebase, while on the line side a boost diode appeared, the output stage using a more modern PL81/PY80/EY51 configuration. Vidor's name for the boost diode was "primary recovery diode", which seems fair enough as it recovers the energy otherwise wasted in the line output transformer's primary winding.

This time there was an a.c./d.c. power supply – no transformer and with a PY82 replacing the GZ32 that had been used as the h.t. rectifier till then. The series heater chain incorporated the idea, popular at the time, of a thermistor shunted by an ordinary resistor – of 330Ω in this case. As a result, the thermistor's warm-up time was delayed and the valves came up very gradually indeed. So gradually that one sometimes despaired of them ever getting going, especially with the PY80's normal three-minute warm-up time!

Conversion

These sets gave good service over long periods. The simple and stable i.f. amplifiers were well suited to 13-channel use when a turret tuner was added – the correct procedure was to convert the original mixer valve for use as an extra i.f. amplifier. The previous models were not so easy to convert since their i.f.s were lower than usual – 9·75MHz vision and 6·25MHz sound. Years later however those old 6·25MHz sound i.f. transformers became unexpectedly useful. No doubt many readers will remember how the old Bush twin-chassis sets could be coaxed into operating at 15·62kHz so that with a u.h.f. tuner in place of the v.h.f. one and the vision detector diode reversed quite good 625-line pictures could be obtained. It was not possible to receive the sound without altering the sound i.f. transformers however, and it was here that the Vidor ones came in handy since they were directly interchangeable and easily tuned to the intercarrier sound frequency. It was relatively simple to knock up a modified ratio detector which produced acceptable sound. One of the sets I modified in this way was carted around to all sorts of locations to test signal strength, and after long and useful service ended up as the basis of a DX receiver. But that's another story . . .

Footnote

A friend who has a Murphy Model CV1917 (Rank A823 chassis) rang up to complain that the picture was marred by what sounded like a hum bar. I took some replacement smoothing capacitors with me, including the usual test one with its long flexible leads. For once the fault showed up immediately the set was switched on, so I anchored the negative lead of my test capacitor under a handy screw on the power unit and prepared to bridge the smoothers to see if one had lost capacitance. I borrowed a mirror to observe the results, and guess what – the hum bar had gone. "Oh no" I thought, "not another rotten intermittent fault." It then dawned on me that the problem had simply been a poor connection between the board and the supporting metal frame – this was confirmed by loosening the screw and tightening it up a couple of times.

Now what do you charge for tightening a screw? The famous railway engineer George Stephenson is supposed to have performed a similar duty for which he charged £10.0.6d – 6d for tightening the screw and £10 for knowing which one to tighten. But I couldn't even claim that small credit, since it had been purely a matter of luck. I hadn't intended to make a charge anyway, so I was spared the mental effort of coming to a decision. The fact remains however that it costs as much to make a call to do a minor servicing job as it does to carry out a major repair. I thought I'd ask my old friend Ike Hodge, whose "Guide to Coarse Servicing" is a byword in such cultural centres as the local pub, what his feelings on the matter were. I'll let you know in the next *Miscellany*.

Selected New Products

LEADER TEST GEAR

A. Marshall (London) Ltd. have been appointed stockists for the Leader range of test equipment, which is imported by Sinclair Electronics Ltd.

Of particular interest to the TV servicing trade is a dual-trace oscilloscope, Model LBO-508A. The unit features a 10mV/cm sensitivity with a bandwidth of d.c. to 20MHz at a price of £299 (+ VAT). We hope to include a review of the instrument in a future issue of *Television*.

Also of interest in the range is the LBO-80 high-voltage probe. This is a 20kΩ/V self-contained instrument that can measure e.h.t. up to 40kV with an accuracy of ±3%. The price is £13 + VAT, and again we hope to include a test report in a future issue.

A. Marshall (London) Ltd., Kingsgate House, Kingsgate Place, London NW6 4TA.

DIGITAL CAPACITANCE METER

B and K-Precision have recently announced a portable, auto-ranging digital capacitance meter, Model 830. In use, one of ten ranges is automatically selected and the value of the unknown capacitor is shown on the 3½ digit l.c.d. display. The capacitance range is from 1pF to 199·9μF, with a basic accuracy of 0·2%. A "range hold" switch is incorporated. This freezes the instrument in one range to reduce the response time when the capacitors to be measured are within a narrow value range. Battery life is quoted as 20 hours for continuous use, but there is provision for an a.c. mains adaptor. The suggested price tag is around £100 plus VAT.

INEXPENSIVE SCOPE

Albol Electronic's SB3M scope has a price tag of only £99 + VAT. The bandwidth is d.c. to 3MHz, with automatic timebase triggering, 50mV/cm sensitivity and a calibration accuracy of ±5%. The input impedance is 1MΩ in parallel with 30pF.

Albol Electronics and Mechanical Products Ltd., 3 Crown Buildings, Crown St., London SE5 0JR.

THANDAR DMMS

Two new l.c.d. digital multimeters have been introduced in the Sinclair Electronics Ltd. Thandar range.

The TM352 is a hand-held instrument with a 3½ digit 0·5in. display covering d.c. voltages from 100μV to 1,000V, a.c. voltages from 100mV to 1,000V, direct current from 100nA to 10A, and resistances from 1Ω to 20MΩ. The instrument also features an audible continuity check and a transistor gain measurement facility. Push-button controls give rapid and easy operation, whilst compact size and long battery life make the instrument useful for field servicing. The price of the TM352, complete with battery, test leads and a one-year guarantee, is £49·95 + VAT.

The TM353 is a 3½ digit l.c.d. multimeter for use in the workshop or in the field, its main feature being a battery life in excess of 3,000 hours. Supplied complete with a test lead set and alkaline batteries, the TM353 costs £84 + VAT and carries a one-year guarantee.

Sinclair Electronics Ltd., London Road, St. Ives, Huntingdon, Cambridgeshire PE17 4HJ.

ALCON LCD MULTIMETERS

Two new Miselco pocket multimeters have been announced by Alcon Instruments Ltd. Designated the "Super 20" and the "Super 50", they offer sensitivities of 20kΩ/V and 50kΩ/V respectively on both the a.c. and d.c. ranges. In addition to voltage, current and resistance ranges, there's a simple semiconductor test facility. A signal injector which is rich in harmonics up to 500MHz is also available.

In addition to the usual fuse protection, the instrument features a novel neon discharge system and a new electronic high-speed cut-out which disconnects the instrument from the circuit under test should a dangerous overload be applied. The "Super 20", which in our opinion is the more suitable instrument for television work, is available off the shelf at £56.81 including VAT, complete with case, leads and instructions. An optional high-voltage probe extends d.c. range to 30kV.

Alcon Instruments Ltd., 19 Mulberry Walk, London SW3 6DZ.

NEW SCOPEX SCOPE

Scopex Instruments Ltd. have announced a new low-cost, high-performance scope. The dual-trace instrument offers a 10MHz bandwidth, 2mV/cm sensitivity and a 10 × 8cm display. The price of £230 + VAT includes two high-impedance probes and carriage within the UK mainland.

Scopex Instruments Ltd., Pixmore Industrial Estate, Pixmore Avenue, Letchworth, Hertfordshire SG6 1JJ.

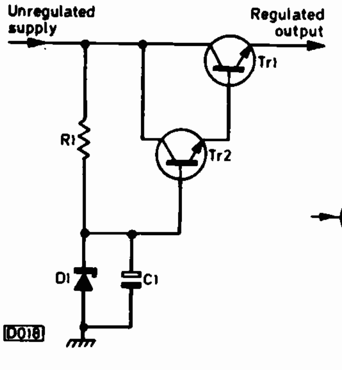
Darlingtons in TV

S. George

ONE of the neatest uses of transistors is the Darlington pair, where one transistor directly drives the base of a second one with no biasing or other components involved in the coupling between the two transistors. The advantage is that the current gain of the combination is approximately the product of the individual gains of the two separate transistors, which means that a high overall gain figure can be achieved using a low-power device to drive a higher-power one. The idea was first put forward by S. Darlington as long ago as 1953, for driver/output stage use in audio amplifiers. Since then, various alternative arrangements have appeared, for example pnp/npn configurations and drive from either the collector or the emitter of the first transistor – also of course output from the collector or emitter of the second one – and there's also been increasing use of Darlington pairs in TV receiver circuitry.

Voltage Regulator Circuit

One of the earliest uses of the Darlington pair in TV sets was in series voltage regulator circuits. Fig. 1 shows a simple series regulator circuit with Tr1/2 being the Darlington pair. Zener diode D1 stabilises the base voltage applied to Tr2, and the output obtained at the emitter of Tr1 will remain steady at 1·4V less than the voltage at the base of Tr2. The use of the Darlington pair increases the current handling capability of the circuit – compared with the use of a single power device in position Tr1 that is. It's interesting to note that the circuit also functions as an active filter, since the capacitance of C1 in Tr2's base circuit is in effect multiplied by the circuit's overall current gain. Switch-on surges are thus minimised, and there's considerable saving in component cost and size. The circuit is widely used, a well-known example being the l.t. regulator in the ITT CVC5/CVC9 series of hybrid colour chassis. In this example the low-power device is a BC170B and the high-power device an AD161.



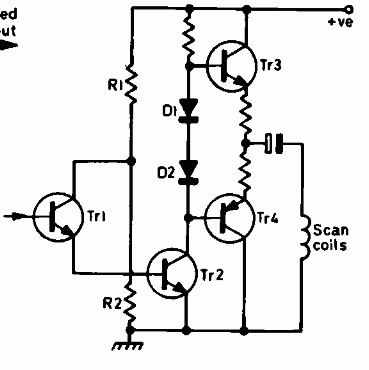


Fig. 1 (left): Darlington pair of transistors in a simple voltage regulator circuit without feedback. The output is stabilised at 1·4V less than the voltage, set by zener diode D1, at the base of Tr1. The circuit acts as an active filter, since the value of C1 is much less than would otherwise be necessary to provide smoothing.

Fig. 2 (right): Use of a Darlington pair of transistors (Tr1/2) as a field driver stage.

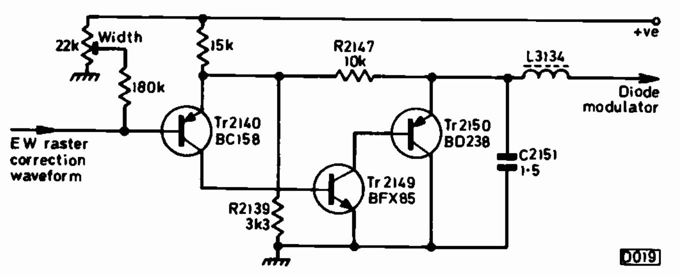


Fig. 3: A triple Darlington configuration, with pnp and npn transistors, used to provide the EW modulator drive with a 20AX tube (Philips G11 chassis).

Drivers/output Stages

One of the earlier TV uses of a Darlington pair as a waveform amplifier was in the field driver stage of the Thorn 8000 series chassis, where the first transistor is a BC147 and the second a BC142. The circuit is shown in simplified form in Fig. 2. R1/2 are included to limit the voltage swing at the collector of Tr1 and the current flowing in this transistor, while diodes D1/2 develop the forward bias for the bases of the complementary push-pull output pair Tr3/4.

It's quite common nowadays to find the Darlington pair sharing a common encapsulation. Examples include the BU807 line driver/output device used in monochrome portables, the BD677 which is used as the EW modulator in the Thorn TX10 chassis, and the BUW81A which is used as the chopper-plus-driver in the Decca 70 chassis.

Multiple Darlington Circuits

As mentioned earlier, the Darlington principle has been developed to include pnp/npn combinations – also triple-transistor configurations. Our final example illustrates both these techniques. It's an EW modulator driver circuit widely used with the 20AX colour tube. The example shown in Fig. 3 is used in the Philips G11 chassis.

Here we have a pnp/npn/pnp configuration, with the first two transistors operated in the common-emitter mode and the final transistor in the common-collector (emitter-follower) mode. The result of course is an amplifier with high gain and a low output impedance. The emitter voltage for the final transistor is provided by the diode modulator circuit, while R2147/R2139 are included to provide voltage negative feedback. The output is taken via the low-pass filter L3134/C2151, which has negligible effect at the EW correction waveform's field frequency while preventing line-frequency signals being fed into the circuit. Note that there's phase reversal in the first two stages,since they are operated in the common-emitter mode, but not in the final stage: overall therefore the amplifier's input and output are in phase.

Semi-Darlingtons

The term Darlington pair is sometimes loosely used to refer to a d.c. connected transistor pair where the first transistor has an emitter of collector load resistor. Whilst the gain of such a circuit may approach that of a Darlington pair, correctly speaking the base current of the second transistor in a Darlington circuit is the entire emitter or collector current of the first transistor. ■

Fault Report

Dewi James

I'M back running my own repair service after doing a stint with one of the large rental chains. The result of course is that all sorts of sets are appearing on the bench instead of just a few chassis. There certainly seem to be quite a few Hitachi sets around here. Let's summarise some recent experiences with them.

Hitachi Models

A set fitted with the NP6C chassis had a picture that was becoming narrow intermittently, sometimes returning to normal width almost immediately, at other times remaining narrow for quite long periods. The change was accompanied by a sizzling sound, rather like an e.h.t. discharge. After much searching and voltage checking etc., moving from the line output stage to the switch-mode power supply and back again, the fault was eventually traced to R937 (220Ω) which is connected to pin 5 of module CP902 (type HM9102) in the h.t. voltage sensing section of the power supply.

Failure of sets fitted with the NP6C chassis to start is not uncommon. The usual causes are dry-joints or a defective transistor in the multivibrator start-up circuit. On this occasion however the defective transistor was TR903 (2SC458) which shapes the pulse from the line output stage before applying it to the pulse-width modulator circuit.

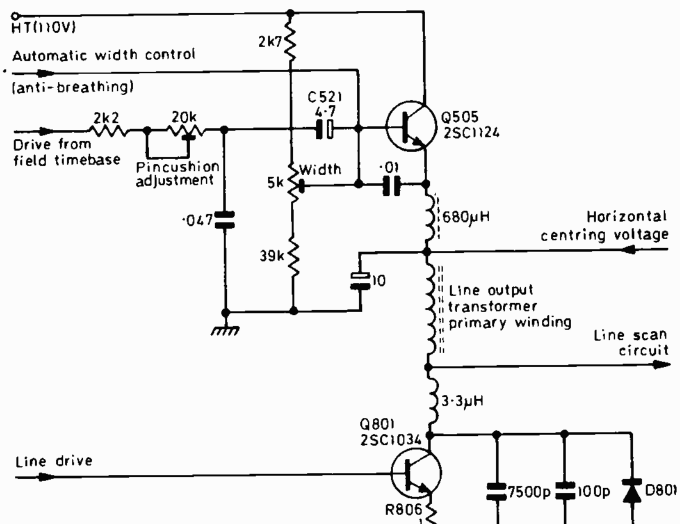


Fig. 1: The EW raster correction system used in the Sony 13in. colour portable Models KV1300UB, KV1310UB and KV1330UB. Correction is applied by connecting the modulator transistor Q505 in series with the h.t. feed to the line output transistor Q801. This means that the series chopper transistor Q903 on the power supply panel, the modulator transistor Q505 and the line output transistor Q801 are connected in series. The e.h.t. is obtained from the "converter" stage, which is interposed between the line driver and output stages. In addition to the field-frequency correction waveform fed to the base of Q505 via C521, an anti-breathing correction voltage is applied from the circuit shown in Fig. 2 – Sony called this "automatic zoom correction". A similar circuit to that above is used in the later Model KV1340UB – the very early Model KV1320UB is completely different.

The next set was fitted with the latest NP8C chassis. The only sign of life was a low-frequency buzzing sound coming from the region of the chopper transformer T901. The 108V and 54V rails were present and correct, and there was drive at the base of the line driver transistor Q701. Its collector voltage was high however. Whilst trying to figure out why this was so, and why the line output stage was not working, we discovered that the print to R714 (5Ω, 8W) was open-circuit. So we repaired this and found that far from improving matters we'd now lost the supply rails. Time to take a good look at the circuit. It turned out that R714 is the sensing resistor for the excess-current trip, being connected in series with the line output stage. The fault turned out to be a short-circuit line output transistor (Q702, type 2SC1942). Oh, and you could find this fault in GEC sets, since the same chassis is used in Models C2057H and C2257H.

Two sets with colour problems. The first was an old one (Model CNP860) with the complaint that the colour was all right for the first hour after switching on, colour bars then developing on the screen. Sure enough, after an hour colour lock was lost. Twiddling the reference oscillator transistor's collector coil L1005 restored normal colour – we were tempted to try this because there was already a matchstick sticking in the coil! In the end, replacing the varicap diode CR1003 fixed this bit of nonsense, and we were able to throw the matchstick away. The other set was rather more recent, a CTP202 (PAL-4 chassis). This time the complaint was no colour, and after disabling the colour-killer by linking TP454-5 we discovered that the real problem was no colour sync. The burst signal was present at TP457, i.e. at the burst input to the phase detector circuit, and the set oscillator frequency control R497 had a little effect towards one end of its travel. Not unexpectedly, the cause of the trouble was the phase detector diodes CR454/5.

Sony Colour Portables

Two dead Sony 13in. colour sets. The first was an elderly KV1300UB, with its cut-out open and the 2A mains fuse open-circuit. The chopper transistor Q903 (2SC867) and the pincushion modulator transistor Q505 (2SC1124) were both short-circuit. The second was a slightly later KV1310UB, and again the cut-out was open, due in turn to the chopper transistor Q903 being short-circuit. We replaced the chopper, did a few cold checks, and switched on again. The sound came up perfectly, but there was no field scan. Check and find the vertical output-1 transistor,

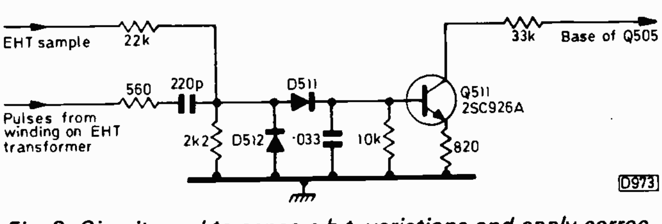


Fig. 2: Circuit used to sense e.h.t. variations and apply correction to the base of the EW modulator transistor Q505. The e.h.t. ("flyback") transformer is driven by the converter transistor Q802. The e.h.t. sample is obtained from the tripler circuit.

another 2SC867, short-circuit. Replace and switch on, but still no field scan. The transistor's 27Ω, $\frac{1}{8}$W feed resistor R566 was open-circuit. Presumably, in view of its low wattage rating, this is a safety resistor. Switch on again and we had some field scan, but it was insufficient and bent over on itself. This was due to the other field output transistor Q509 (type 2SC1124) being short-circuit. I thought a 2SC1127 would do, and in fact it produced some improvement, but it was not until the correct transistor was obtained and fitted that we had normal field scan. Incidentally, someone had also fitted an MJE340 in the audio output position instead of the correct 2SC867, but it seemed to be working correctly so I left it alone.

Unfortunately we still had quite severe pincushion distortion. The width control, which sets the bias applied to the base of the pincushion modulator transistor Q505 (see Fig. 1), was functioning, so we felt that the transistor was likely to be o.k. It turned out that C521 (4·7μF), which feeds the correction waveform to its base, was open-circuit. That must be it I thought. Wrong! After the set had been on for a few minutes, the brightness began to vary. So did the vertical and horizontal amplitude. So we monitored the 110V rail with a scope, and found large spikes that coincided with the variations. After much head-scratching, some luck and a masterly bit of diagnosis, we traced the fault to the fact that the chopper transformer T601 was breaking down internally. Replacing this item completed the repair, and I must assume that it was the spikes on the h.t. line that had lead to the breakdown of most of the other items.

Sharp C2072

The final set in the Japanese department was a Sharp Model C2072, with a barely visible raster but the sound o.k. Simply low c.r.t. first anode voltage, due to R627 (330kΩ) being open-circuit. There are three of these 330kΩ resistors in series in this set, so presumably any one of them can become faulty.

Some Continentals

A Grundig 2210GB appeared in our workshop during a particularly wet Wednesday. Apparently it had "gone off" during Coronation Street. "It must be a valve" the wet apparition at the door said, "I was going to have a look at it for a friend, but I've no time just now." We've all come across these local experts of course. Dry-joints around the line output stage are a common cause of the trip cutting out to give the dead set symptom on these sets, but this one was the exception. Each joint looked perfect. I was going to have to earn my money.

A visual check revealed that the focus VDR had disintegrated, something that can be quite a spectacular occurrence at times. This wasn't the reason for the set being dead however. The cause was traced to R514 (2·7Ω, 4W) in the h.t. feed to the line output stage being open-circuit. There were no detectable shorts, so R514 and the focus control were replaced and the set switched on. Everything came on normally and the set's worked correctly ever since.

The Waltham hybrid monochrome Model W125 was a new one to me, but a couple have turned up recently (the circuit was given in the August 1977 issue of *Television* incidentally). The first displayed a blank raster, with neither vision nor sound signals and the 24V and 12V rails at about 5V. D401 produces these supplies, being fed from a winding on the line output transformer, and things were back to normal after fitting a new diode. The second set had an inoperative brightness control due to a changed value resistor in the brightness circuit.

Another new one to me was the Salora Model 1F3K (F chassis). The set is of Finnish manufacture and had been sold by a large store. The complaint was sound but no picture, though there was obviously e.h.t., as indicated by the sighing of the scan coils and static on the face of the screen. Easy I thought: no c.r.t. first anode voltage. Check at pin 10 and find plenty of voltage, also a hefty focus voltage at pin 1. Cathodes about right at 140V. Brief moment of panic – after all I'd never seen one of these sets before, was in a tiny cottage on the north east coast of Anglesey, twenty miles from base, and it was a cold, wet Saturday afternoon – just two hours before the Wales/England match at Cardiff Arms Park. Before making a dash for it, let's check the grid voltage. Bingo: a large negative voltage, hence the cut-off tube with no brightness. Trace through circuit using diagram found in plastic envelope attached to back of set. The grid bias is derived from the 220V rail, which comes from the line output stage, the feed resistor being RA34 (100kΩ). This was faulty of course, and on replacing it we had 11V positive at the c.r.t. grids and brightness on the screen. The grid circuit is used for flyback blanking incidentally.

This set has many interesting features, one being an automatic search and store system – the set can scan the bands automatically, indicating where it is at any instance by means of a green line on the screen. When it finds a station it stops, and if you want the station you press the store button and the appropriate channel selector button. Once repaired, the set gave an excellent picture. I had an even worse moment of panic later that same afternoon, my sanity being restored this time when Steve Fenwick kicked a penalty just before the end of that match. I'm not sure whether I can take much more of this.

Home-brewed Troubles

So much for foreigners. On the home front we recently had a Philips G8 that was giving an excellent imitation of a set with a faulty tube, i.e. a misplaced shadowmask. The purity was out, and none of the rasters would converge. These faults turned out to be due to open-circuit resistors however. The purity trouble was due to R1358 (1·5Ω) in the degaussing circuit being open-circuit. It's on the power supply panel. The misplaced rasters were due to R1920 (10Ω), R1933 (10Ω, R/G parabola balance) and R1934 (10Ω, R/G parabola) in the horizontal R/G convergence circuit all being open-circuit.

The trouble with a Decca set fitted with the 80 chassis was no sound and a bright white raster. The sound problem was easy enough – a new TBA800 audio i.c. put that right. The bright white raster took a little more effort however. Not unexpectedly, the collector voltages of the RGB ouput transistors were low. So we traced back along the luminance signal path, and discovered that there was no voltage at the emitter of the luminance emitter-follower transistor TR208 (BC157), though there was voltage at its base. Replacing this transistor restored the picture.

Finally, a set fitted with the Rank Z718 chassis. The problem was foldover at the bottom of the screen, and no amount of jiggery pokery with the field timebase controls would get it right. This chassis uses one of those rather complex class AB field output stages, and the biasing conditions can give rise to difficulties of this sort. Sure enough 4R30 (13Ω) was found to be damaged, and after replacing it and the nearby diodes 4D4-7 (to be on the safe side) the fault had been cleared.

Long-distance Television

Roger Bunney

JANUARY is traditionally a poor month for DX-TV reception. Not so this time however. Periods of enhanced reception, via all modes of DX propagation, have been reported by many enthusiasts.

A letter from Arthur Milliken (Wigan) describing reception of suspected Arabic signals on chs. E2 and E3 during the afternoon of December 26th arrived too late to be mentioned in the last column. The ch. E2 signal consisted of a feature film with a floating image of two men talking, dressed in Arabic clothing. The later ch. E3 signal produced an Arabic news announcer with clearly defined letters on the station identification. The signals were also received by Brian Fitch (Scarborough). The mode of signal propagation is unknown.

There was Sporadic E activity on several days during the period under review. December 30th produced a short but interesting lunch time opening, with signals from E. and W. Germany on chs. E2 and E4. The 31st was even more dramatic here, with very strong Polish signals on chs. R1 and 2 and weaker ones on ch. R3. There were also Russian ch. R1 signals, but these tended to be mixed with more distant Russian ch. R1 signals arriving via F2 propagation. The result was rather a lot of interference! There were yet more SpE signals on January 4th – from Norway, Sweden, Finland and Russia. These signals, throughout Band I, were reported by various enthusiasts in the UK.

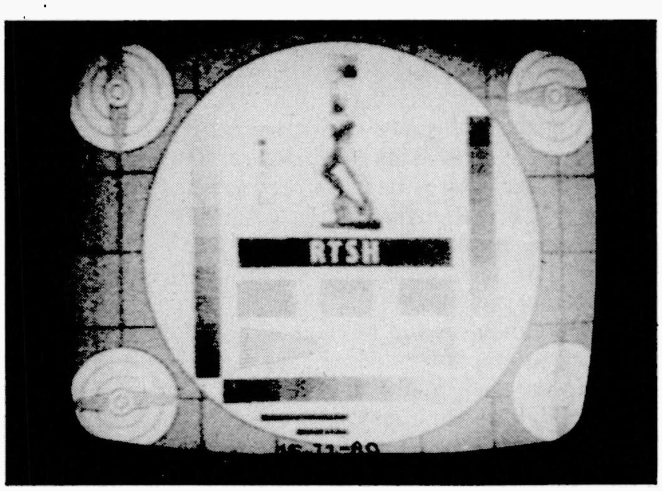
The best SpE opening seemed to occur on the 9th, during the mid-morning. I logged NRK (Norway) chs. E2/3, SR (Sweden) chs. E2/3/4, TSS (Russia) ch. R1 and YLE (Finland) ch. E2 here at Romsey – most of these signals were very strong. In addition, Brian Fitch logged YLE ch. E3. In the late afternoon of the following day, Mark Baldwin (Rugby) received RUV (Iceland) ch. E3. There was a lull during the following week, then a further spell during which Cyril Willis (Cambridge) noted sustained signals from RTVE (Spain) on chs. E2/3. There were further SpE signals on the 20th/21st, both Andrew Webster and Arthur Milliken receiving, during two-hour openings, RTVE chs. E2/3/4 and RAI (Italy) chs. IA/B. RTP (Portugal) and NRK were also received in the UK on these days.

Meteor shower/scatter reception was particularly rewarding. Apart from the Quadrantids shower during the first week of January, there was a high level of random MS activity on most days. Mark Baldwin, who has been upgrading his installation, has been successful with Band III MS reception on chs. E5/6, logging numerous signal pings. This is a difficult field. Mark can just receive a weak signal, via tropospheric scattering, from Roermond (Holland) on ch. E5. This serves as a sync reference, with the pings registering "on top". Mark is currently using a home constructed eight-element Band III array, but intends to erect a Jaybeam ABM11 aerial which should increase his Band III capability. He received a Derby amateur TV station (G8VBC), at a distance of some 40 miles, using a Wolsey Colour King aerial!

Tropospheric reception was the most significant during the period however. A high-pressure system at the turn of the year produced enhanced tropospheric propagation from December 29th through to January 1st. Brian Fitch received several German transmitters on the 29th, then more widespread signals to the south and east on the 30th, with French and German Band III and u.h.f. signals. DFF (E. Germany) ch. E34 was noted in Eastern UK, and during the late afternoon Cyril Willis was rewarded with DR (Denmark) ch. E7. There were many signals on the 31st – here at Romsey they tended to be noisy though slow fading. For many enthusiasts in Eastern UK the highlight of the period was CLT (Luxembourg) on chs. E7/21. These signals were still visible on the 2nd, when the others had all faded. There was a smaller tropospheric opening on the 9th, with W. German stations at u.h.f., and at the time of writing (on the 27th) conditions are improving.

F2 reception has been rather lacking unfortunately, and it seems as if the best of the present cycle has now passed. TSS ch. R1 was present via F2 only during the first week of January. The most dramatic F2 reception was of Australia ch. A0 (46·25MHz vision) on January 10th – with possible SpE enhancement at the Australian end. Several UK enthusiasts noted this sustained signal, which lasted for over an hour. Ryn Muntjewerff received the signal weakly in Holland, for over an hour "on and off" with at one time a floater – this is a "first" in Holland. Mark Baldwin had the signal for some twenty minutes from 0846GMT. There was

Reception from the Russian Stat-T satellite, at 714MHz, by Ian Roberts in South Africa.



The Albanian test card, on ch. IC, received in Holland by Ryn Muntjewerff.

a weak image for only about three minutes here at Romsey, and at Shaftesbury the signal wasn't even visible!

In all then it's been a very active month for the time of year, and I fear that February/March will be rather quieter.

Overseas Reports

Petri Pöppönen (Lahti, Finland) reports SpE reception on December 23rd, 27th and 31st and January 4th, 5th, 6th, 8th and 9th. He's logged very weak ch. 51 (714MHz) signals from the south east, with unusually difficult sync problems, and wonders whether this might be direct broadcasting from the Russian Stat-T satellite at 99°E – see later!

From Australia, Anthony Mann, Robert Copeman and Wenlock Burton have all reported a very active SpE season. Double-hop propagation is common, and New Zealand signals as high as ch. 2 (55·24MHz) have been seen in Perth, Western Australia. Anthony Mann travelled some 700 miles north of Perth recently, to Exmouth, where he reports incredible conditions – ch. B1 sound and vision and ch. F2 sound on five of the seven days he was there! Ch. B1 on a hand held portable radio receiver gave "local quality" results. Anthony reports that ABC-TV has just been made available via a 4GHz satellite downlink – being transmitted on ch. 8. This is one of four other similar relay outlets. Other signals he mentions receiving whilst at Exmouth include Malaysia, China and Russia. As an historical note, the Carnarvon beacon (52·32MHz) 500 miles from Perth has been received by G4BPY in Birmingham (UK). From programme guides, it seems that the UK reception of ch. A0 on January 10th came from TVQ0 Brisbane!

DX-TV Book

The second edition of my DX-TV book "Long Distance Television Reception (TV-DX) for the Enthusiast" has now been published by Babani Publishing Ltd., at £1·95. The catalogue number is BP52. The new edition has been updated and expanded, including a section on satellite reception. It's available from booksellers or by post from South West Aerial Systems at an inclusive price of £2·15.

ATV Transmissions

Steve Whalley (15 Goodwood Place, Trertmar, Stoke-on-Trent), who holds an ATV licence, reports that several amateur TV stations are active in the Stoke area – mainly on Sunday mornings from 1000 and on Wednesday evenings. Steve has an 8W peak sync transmitter feeding a Jaybeam Parabeam aerial. This produces an e.r.p. of 80W. Others in the region operate at higher powers. Steve would like to hear from readers in the area interested in receiving the 430MHz transmissions or aligning tuners for the purpose.

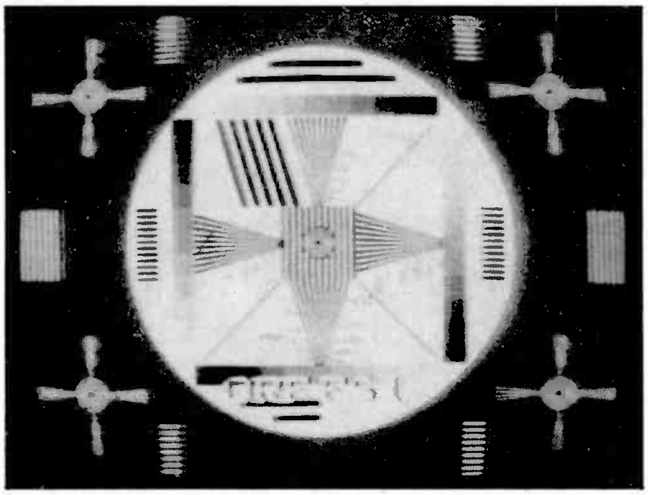
I've obtained one of the new Microwave Modules ATV converters (Model MMC435/600), which lifts the 430MHz signals to ch. E36, and hope to report further next month.

News Items

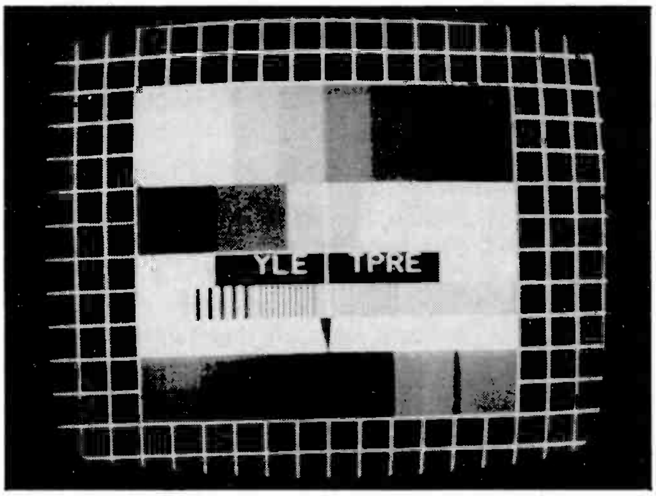
Spain: The main Navacerrada ch. E2 transmitter, which serves Madrid and the central region, failed on December 27th due to heavy storm damage. It was back on air within two days.

Australia: Discussions on the specification for direct satellite transmissions continue, and tenders for a craft with 4-30W and 11-15W transponders have been invited.

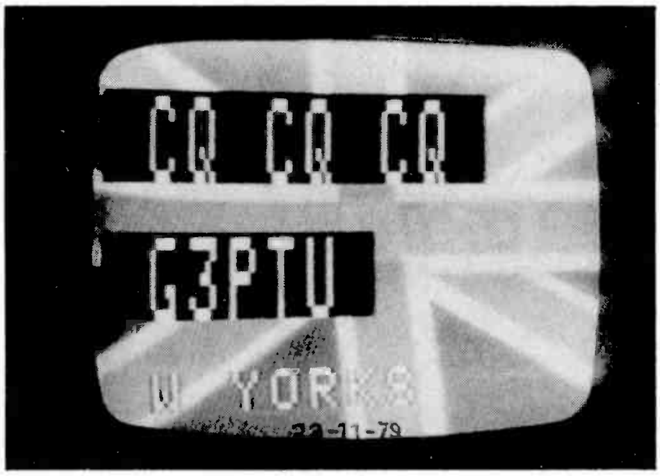
Holland: We've shown pictures of pirate Dutch TV



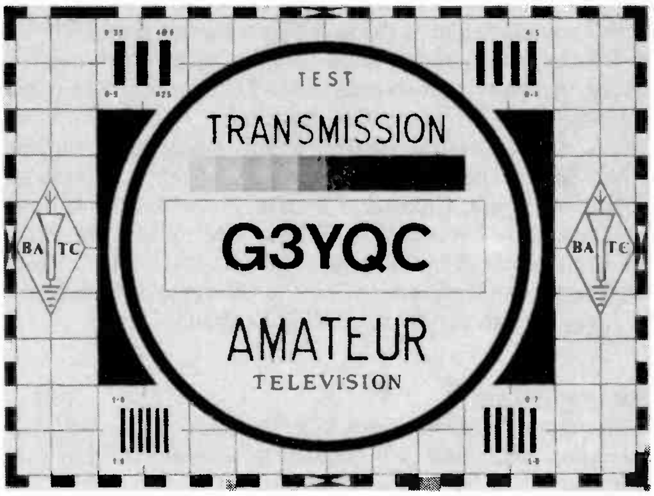
The Telefunken T05 test card used by ORF (Austria). Received on ch. E2a by Andrew Tett (Caversham) using a 7ft. dipole!



Fubk test pattern used by Finland, with Tampere identification (ch. E2). Photo from Petri Pöppönen.



Patriotic ATV call sign/pattern used by G3PTU. The 435MHz transmission was received in Holland by Ryn Muntjewerff.



The standard BATC test card, with John Wood's identification (G3YQC). John transmits in the Rugby area.

transmissions in this column from time to time. Gosta van der Linden reports that such activities are much in evidence at present. There are many f.m. radio pirates operating between 100-108MHz and MW pirates operating between 175-190 metres in Eastern Holland. It seems that there is widespread viewing of pirate TV transmissions via cable networks. When the usual transmissions close down, the cable companies insert a colour pattern. If an off-air transmission is received however the system accepts the new signal, e.g. a pirate. So mobile pirates near cable system aerials transmit their own signals on an empty channel, the relay switching the pirate transmission on to the cable network. Favourite channels to use are E35, when ZDF has closed down, and E62 when BRT has closed. One pirate calls himself "Nederland 3"!

From our Correspondents . . .

David Burton (Tolworth, Surrey) has bought a 14in. Grundig Model P1421GB. This has a BF907 dual-gate mosfet r.f. amplifier stage which performs very well – on most receivers overloading from Crystal Palace is experienced in this area. The gain is high and the sync performance excellent, even on the weakest signals.

I've received two very long letters from Nanda Kumar Sa of Madras, India, who works as a TV technician. Of particular interest is the fact that he can receive reasonably good 714MHz signals from the Russian Stat-T satellite on a daily basis, using a Yagi array and a recently added OM337 wideband preamplifier. His home-made aerial has fifteen X-type directors, a straight dipole and a sheet reflector. Programme times are usually 0630-1020 and 1730-2130, Indian time, but vary, evening transmissions sometimes starting as early as 1500. It seems that a long Yagi array with multiple directors, a masthead amplifier with a gain of 30dB and a low-noise u.h.f. tuner are the basic requirements for successful reception from the satellite. The Stat-T2 satellite is expected to be in operation this year, at 754MHz, and may carry the Moscow second programme. Nanda lives 1km from the Madras TV tower (ch. E4, 50kW), which results in DX-TV problems in Band I at times – Madras uses the RETMA test card. Apparently the Stat-T test card photo included in the March 1980 column (page 264) was shown upside down.

TV-DX System

We're currently investigating a new, simplified DX-TV receiving system. This uses an external tuner/i.f. unit, with signal processing at i.f./video, followed by remodulation back to r.f. so that the signal can be fed into a standard TV receiver – the object being to be able to use an unmodified TV set. The new Ambit 94420 i.f. strip looks as if it could form the basis of the system.

Service Bureau

Requests for advice in dealing with servicing problems must be accompanied by a 75p postal order (made out to IPC Magazines Ltd.), the query coupon from page 325 and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.

SONY KV1810UB Mk II

The picture and sound are perfect when the set is first switched on, but after a few seconds a two-inch foldover develops at the top and bottom of the raster. This opens up to cover the full picture, then flickers back to top and bottom foldover.

Check carefully and thoroughly for dry-joints or print problems in the field timebase – by flexing and probing the timebase panel. If nothing turns up, check the field driver/phase-splitter transistor Q502, the output transistors Q503/4, the coupling electrolytic C522 (22μF), the decoupler C559 (1μF), and the output stage biasing components C523 (470μF) and R543 (12Ω) – preferably by substitution.

THORN 1580

The problem with this hybrid portable is that the picture is moving very rapidly from left to right. Also, there appears to be no sound when the line hold control is moved.

First try a new ECC82 line oscillator valve. If the problem persists, check the values of its anode load resistors R54 (22kΩ) and R57 (56kΩ), and the cross-couplers C50/51 which could be leaky. If everything is in order in this area, check the flywheel sync discriminator diodes W3/4 and the pulse feedback/integrating resistor R45 (68kΩ). The sound fault is probably nothing more than a faulty PCF80 audio valve or a dry-jointed audio output transformer.

GRUNDIG 5010

When the set has been on for some time the field collapses to a bright line across the centre of the screen. A slight tap on the cabinet restores the picture. I assume that this is due to a dry-joint or loose connection, but the field output transistor appears to be soundly soldered.

We suggest you check particularly around the NS pincushion distortion correction transductor PTC1. Gentle tapping and probing in this area of the panel should narrow the field of search. Also check the connections between the field timebase subpanel and the main panel.

THORN 9000 CHASSIS

There's an annoying intermittent fault on this set. When it's been on for about half an hour, the height will suddenly reduce at the top and bottom from anything between just perceptible to 1½in. or so. This is accompanied by a proportional brightness reduction. The effect clears after one-five seconds, and occurs at random thereafter. Since the field timebase and the signal circuits are fed from the 24V rail, I suspect a fault in this area. When the back is removed however the fault refuses to put in an appearance.

We're inclined to agree with your view that the common 24V line is falling when the fault occurs. Try monitoring the line with the back on and the meter leads passed out. The supply is provided by the EW modulator diodes W711/2, the reservoir capacitor being C725. These are the main suspects, and a squirt of freezer during the presence of the fault should confirm the point.

FERGUSON 3787

The trouble with this colour portable is no sound or raster, with the mains present at the set. I'm a bit puzzled since the chassis does not appear to be of either the 9000 or TX9 type. The only clue as to the cause of the fault is that RU05 is smoking. It's a fusible resistor, but hasn't opened – possibly due to lack of tension or the use of the wrong solder.

This set is of W. German manufacture and is quite different from any other Thorn sets – it uses a thyristor line output stage for one thing. It seems to have been imported as an interim measure whilst the TX9 was under development. RU05 is in the soft-start circuit, and the fact that it's overheating indicates that the overload trip is operating. Check for shorts across the h.t. line, see whether the set works normally with the e.h.t. tripler disconnected, and make sure that all joints in the line output stage are sound – particularly around the combi coil UA01.

PHILIPS TS7 CHASSIS

The fault with this monochrome portable is sound but no raster – no line whistle. Any clues as to where to start?

The fact that you've got sound suggests that the power supply is operative, so there shouldn't be anything drastically wrong in the line timebase. As a check for line drive, see whether you can measure –0·4V at the base of the line output transistor TS29. If not, check back to the driver transistor TS28, paying particular attention to the small 3·3Ω safety resistor R231 in its emitter feed circuit, then move back to the oscillator stage TS26/7 as necessary. If line drive is present, the output transistor or the boost diode D22 (U06C) could be open-circuit. A suitable replacement for the boost diode is the BYX71-350.

RANK A640 CHASSIS

The trouble with one of these sets (Bush TV161 series) is that the verticals distort and become wavy when the contrast is increased.

First check the PFL200 video/sync valve and its attendant decoupling electrolytics (2C44, 2C45 and 2C48), then if necessary check the black-level clamp and a.g.c. delay diodes 2MR9 and 2MR2. Note however that this situation is normal on these models with excessive contrast control settings.

SONY KV1330UB

The trouble with this set is pincushion distortion at the sides of the screen. The pincushion control VR504 has no effect but seems to be of the correct value.

The pincushion control adjusts the input to the EW modulator transistor Q505, which is in series with the h.t. supply to the line output stage. The fault is not uncommon in these sets, and is usually due to either the modulator transistor being short-circuit or leaky, or its base signal coupling capacitor C521 (4·7μF) being defective. A further possibility is a faulty automatic width control transistor (Q511, type 2SC926A).

VIDEO CONNECTION

I'd like to feed a standard 1V peak-to-peak video signal from a VTR into a Hitachi CNP192 colour set, bypassing the tuner etc. Any ideas?

Fortunately the Hitachi Model CNP192 contains a double-wound mains transformer, so no isolation problems will arise. A 1V peak-to-peak signal is present at the emitter of the video emitter-follower transistor TR8 (TP1), so you should be able to a.c. couple the video input to this point. If problems arise, we suggest you consult the article on receiver/monitor conversion in the January 1980 issue.

ITT CVC8 CHASSIS

The problem with this set is excessive width. The valves in the line timebase have been replaced and the two width controls are operative, but the width cannot be reduced to provide a normal raster. The h.t. voltage is correct.

We suggest you first check the values of R418/9 (150kΩ each) which link the line output valve's control grid circuit to the width control network, then if necessary check the sample pulse feedback capacitor C303 by substitution. If the fault persists, check the harmonic tuning capacitor C308 and the damping network C306/R422.

RANK A774 CHASSIS

The original fault was no sound or raster, and was traced to the HT2 smoothing resistor 3R76 being open-circuit. On replacing this there was only a faint, unrecognisable picture – just very faint flickers of light – while the sound seemed to be coming from a foreign station.

The 6MHz "babble" and vague vision flutterings are commonly due to tuner failure or a.g.c. faults. First check that the 20V supply is present across 3C48 – it's derived from the line output transformer. Then check the d.c. voltages in the a.g.c. and i.f. circuits – as a quick check, override the a.g.c. voltage on 3C4. The probable cause of the trouble is failure of one or other of the transistors (3VT2/3) in the a.g.c. circuit or the associated diode 3D3.

TANDBERG CTV2-4 CHASSIS

The power supply is running at a low, clearly audible, frequency, and is producing very low outputs. There's no sound or raster of course.

The switch-mode power supply goes into this "purring" mode when an overload is present. This is usually due to leakage in the field output transistors Q806/7 or an overloaded line output transformer. To check for the latter condition, disconnect the tripler and shift choke L752 one at a time, switching on to see whether the overload has then disappeared. The line output transformer or line output transistor Q751 could be faulty, but this is rare on these sets.

GRUNDIG 6011GB

The cutout operates when the set is switched on. I've replaced the thyristors in the line output stage and checked the diodes and capacitors, but the problem is still present. Disconnecting the scan coils and the e.h.t. tray also made no difference.

This effect can be caused by some most unexpected components in the line timebase! Check the miniature chokes L501 and L515 which feed the gates of the two thyristors. You might find one open-circuit or dry-jointed. Check the associated components R501, R515 and C515, and ensure that there are no dry-joints at the tags of any of the wound components in the timebase. If necessary, check the tuning capacitors C516 and C518 by substitution.

THORN 3000 CHASSIS

The problem is cramping at the top of the raster – it can't be removed by any adjustment of the field timebase controls. The regulated h.t. supply is present and correct.

First check C432 (250μF) which decouples the supply to the field output stage, then check the field output transistor VT424. C429 (16μF) in the damping network across the field output transformer is another possibility, also the field scan coupling capacitor C705 (400μF). The latter is mounted on the convergence panel.

BUSH TV161 SERIES

I've had trouble with the small choke in the boost diode's anode circuit bursting into flames, though everything else seems to be in order. Unfortunately no details of the coil are given in the manual.

The choke's there to prevent parasitic oscillation and can be replaced with almost any small one, e.g. an RS 1A suppressor choke. It shouldn't burst into flames however! Check the PY88 boost diode, the boost capacitor 3C18, which is returned to chassis, and make sure that there are no blobs or burns around the PY88's anode connection (pin 9).

THORN 8000 CHASSIS

The tuning knob has to be adjusted to obtain a picture whenever the channel is changed to ITV. Also the colour control has to be fully advanced to get a picture with reasonably good colour balance. The picture often changes to black and white, with loss of field lock – mainly on ITV.

First check that there's adequate signal from the aerial. If the fault proves to be in the set, the first suspect is the tuner. We've also known this trouble to be due to slight misadjustment of one of the traps at the input to the i.f. amplifier, or alternatively to misalignment of the vision detector coil L108. Don't adjust the traps without the full equipment specified in the manual.

GRUNDIG 3010GB

There's an intermittent fault on this set. The picture is perfect when the set is first switched on, but after anything from five minutes to an hour the picture goes slightly out of focus, a misty band appears across it, and the top three inches of the screen go very dark with flickering. Turning the brightness control to maximum lightens the dark part, but of course the picture then can't be seen. The picture will sometimes return suddenly to normal if the set is left on for three hours or so.

We've traced this fault to C385 (10μF) which decouples the brightness voltage fed to the base of the black-level clamp transistor Tr385. Unfortunately however it could be due to a fault in any one of several semiconductor devices in the clamp and the luminance driver/output section. The use of a freezer aerosol and heat from a hairdryer should help localise the source of the trouble.

RANK A816 CHASSIS

The initial problem was a narrow picture. Then the tube heater went out and a high-pitched whistle came from the vicinity of the line output transformer. Also the HT line is very low, with the dropper resistor getting hot. The sound is normal, and the line oscillator i.c. has been changed.

We suggest you change the flyback tuning capacitor 3C61 (2,200pF), which must be of the approved type. Unfortunately the line output transistor could also have been damaged. The c.r.t. heater is fed from a winding on the line output transformer.

ITT CVC5 CHASSIS

There are various intermittent troubles with this set. For example loss of line sync at switch on and subsequent loss of signals with strange colour bands. The faults sometimes clear, a slight tap beneath the cabinet often helping.

The four tags which earth the line output transformer to its subpanel are probably dry-jointed. Clean them and resolder and your problems should be over.

THORN 1400 CHASSIS

There are four separate pictures, equally divided, across the width of the screen. Can you explain the reason for this and the likely cause?

The reason for the display you describe is simply that the line oscillator is running at the wrong speed. The most likely culprit is the 30FL14 flywheel line sync d.c. amplifier valve. Other possibilities are the 30FL2 line oscillator valve, the timing capacitor C53 (250pF, silver mica), the flywheel sync d.c. amplifier's anode load resistor R60 (56kΩ), and the flywheel sync discriminator diodes W5/6.

HITACHI CNP190

There's no colour for a quarter of an hour or so after switching on from cold, though there's a monochrome picture. The colour then slowly builds up until an excellent colour picture is present.

The first suspects are the initial chroma/burst amplifier transistor TR19 and C503 (10μF, 25V) which decouples its base bias. The a.c.c. amplifier, which biases the emitter of TR19, could also be responsible. The things to check here are the two transistors TR24/25 and the electrolytics C509 (1μF, 50V) and C511 (47μF, 16V). If these stages are in order, you will have to override the colour-killer and follow up whatever clues you obtain. This can be done by connecting an 18kΩ resistor between the 12V rail and terminal J on the power/signals board.

TEST CASE 220

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

The saga started, as most do, with a telephone call. "A Bang and Olufsen colour set" the voice said, "with no picture at all, though the sound's there." It was a busy time, and to save the expense of a home call the customer agreed to bring the set to the workshop for attention. It turned up half an hour later, and proved to be a Beovision 3400. We were glad this was to be an 'inside' job – no picture on this complex hybrid set can be caused by many things, most of them expensive, while we'd much prefer practising our diagnostic skills in the well lighted and well equipped workshop than crouched behind the set in the chimney corner!

With the back off and the power on, the rustle of the e.h.t. build-up could be heard. Its presence was confirmed by bristling hairs on a hand held in front of the blank screen. The timebase and e.h.t. sections were probably o.k. therefore. Our next suspicion was that the c.r.t. was maybe cut off by excessive voltage at its cathodes. On checking this however a normal reading of 200V or so was obtained. Switch up two ranges on the meter and check the c.r.t.'s first anode voltages – pins 4, 5 and 13. Several hundred volts apiece, so no problems here. Maybe the grids had gone negative? A high-impedance voltmeter proved that each grid was reasonably close to the specified 100V. More and more puzzled, we found an e.h.t. meter and set about checking the focus voltage – complete absence of the focus supply can cut off the tube. 4·7kV was recorded – fiendish set! As the e.h.t. voltmeter was now to hand, we decided to confirm the e.h.t. at the tube's final anode. Even with the set switched off, a spark leapt from under the plastic e.h.t. "flower" to greet the probe. Under running conditions, 24kV was recorded.

Ten minutes later there was a picture on that set and we were kicking ourselves. What had we overlooked? All will be revealed next month – plus another test case item.

SOLUTION TO TEST CASE 219
– page 269 last month –

Our line driver stage last month (Thorn 3500 chassis) was failing to turn on the line output stage. We'd discovered that the waveform at the collector of the driver transistor was wildly incorrect – and remained so despite our replacing almost everything in the line driver stage. Disconnecting L505 in the line output transistor's base circuit made no difference either. Had we been wiser, we'd have realised that disconnecting L505 *should* have made a difference to the drive waveform – because of the loading effect of the line output transistor on the secondary of the driver transformer. In fact the cause of the trouble was simply that the line output transistor's base-emitter junction was open-circuit. We won't be caught out by that again!

Incidentally L505 and the associated 47Ω resistor are fitted on the 3500 chassis only – on the smaller-screen 3000 version, the line output transistor's base is fed directly from the line driver transformer (though very early production used a two-transistor line output stage).

QUERY COUPON

Available until 22nd April, 1981. One coupon, plus a 75p (inc. VAT) postal order, must accompany EACH PROBLEM sent in accordance with the notice on page 323.

TELEVISION APRIL 1981

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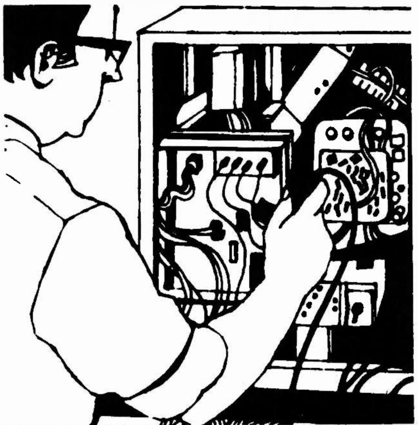

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VIDEOCRAFT TELETEXT DECODER, Infrared control. Ready to insert in colour set. £100. Cheltenham 0242-23638.

TEXAS TIFAX XM11 TELETEXT MODULE with connection data. £50. Telephone Farnborough (0252) 516647.

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New circuit supplied. CVC panel with pots and main switches 250K, 100K, 423 500K. **£1.00**

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Decca focus unit.
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4 push button for varicap with pots. **50p**

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Pye 147+260r. **40p**
(731) 3+56+27r. **50p**

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Tuner unit **£3.50**
Touch button unit with I.C. **£3.50**

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Both 12KV.

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GEC 1040 **£4.00**
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1500 5½×2½ 3 3500 7×3 80
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3500 5×3 80
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Circuit supplied.

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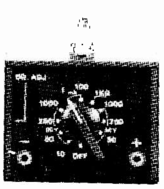

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1K Ω/V on DC/AC

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TBA560Q	£1.00
TBA570	£1.00
TBA625	£1.00
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TBA950Q	£1.00
TBA990Q	£1.00
TCA270	£1.00
TCA270Q	£1.00
TCA270SQ	£1.00
TCA4500A	£1.00
TCA640	£1.00
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BC109	7p
BC116	7p
BC139	7p
BC142	15p
BC147C	7p
BC148B	7p
BC149C	7p
BC154	7p
BC157	7p
BC158	7p
BC171	7p
BC171B	7p
BC173	7p
BC173C	7p
BC174	7p
BC182L	7p
BC183	7p
BC183LB	7p
BC207	7p
BC212LT	7p
BC213LA	7p
BC237B	7p
BC238	7p
BC238A	7p
BC238C	7p
BC245	7p
BC250	7p
BC251A	7p
BC252C	7p
BC257	30p
BC300	30p
BC303	30p
BC307	7p
BC308B	7p
BC327	7p
BC336	20p
BC337	7p
BC350	20p
BC365	10p
BC413C	7p
BC454	7p
BC455	7p
BC460	20p
BC462	7p
BC463	7p
BC546	7p
BC559	7p
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BD131	30p
BD132	30p
BD136	10p
BD207	30p
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BD238	20p
BD239	12p
BD331	25p
BD332	25p
BD253B	35p
BD416	25p
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BD595	35p
BD596	35p
BD681	25p
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BF137	20p
BF157	20p
BF180	20p
BF181	20p
BF182	20p
BF185	20p
BF195	7p
BF198	7p
BF200	20p
BF237B	7p
BF240	7p
BF245A	7p
BF263P	25p
BF264	20p
BF273	7p
BF274	7p
BF337	24p
~~BF355~~	~~30p~~
BF234 PNP	7p
BF458 NPN	12p
~~BF458T~~	12p
BFR79	15p
BFT34	20p
BFT43	20p
BFY50	15p
BFY90	15p
BR100	30p
BSS68	20p
BSX20	5p
BSY79	7p
BT100	30p
BT106	£1.00
BT106 special	50p
BT109	£1.00
BT116	£1.00
BT119	£1.00
BT138/10A	70p
BT146	25p
BT151/800R	70p
BTT822	£1.00
BTT8124	£1.00
BTT8224	£1.00
BTY80	20p
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BU105/04	£1.00
BU108	£1.00
BU124	50p
BU126	£1.00
BU137	60p
BU204	40p
~~BU205~~	~~£1.00~~
BU208	60p
BU208A	£1.00
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BU326	60p
BU407	50p
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CA270	50p
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BY206	10p
BY210/400	7p
BY210/800	10p
BY233 5A/1500V	25p
BY226	10p
BY296	10p
BY298	12p
BY299	10p
BYF3123 wire end	50p
BYF3126 wire end	50p
BYF3214 20Kv	50p
BYX36/600	10p
BYX38/600	50p
BYX55/350	10p
BXY71/350	25p
2N390	7p
2N2222	7p
2N3055	35p
2N3566	7p
2N4355	7p
2N4442	60p
2N4444	£1.00

2N5983	30p
2N6099	25p
2N6348	50p
2N6399A	30p
2SK30A	7p
TIP29C	20p
TIP29A	20p
TIP30A	20p
TIP31A/B	20p
TIP32	20p
TIP33B 10A/80V	25p
TIP41A·42 pair	50p
TIP100	30p
TIP2955.S	40p
NPN TIP130 60V/8A	25p
IN60	3p
IN3899	50p
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IN4004	5p
IN4005	5p
IN4006	5p
IN4007	5p
XK3123 4000 Thorne Diodes	£1.00
IR106	40p
Y716	20p
Y827	30p
1 amp/400V	20p
1 amp/1600V	7p
3 amp/100V	7p
3 amp/300V	10p
3 amp/1200V	7p
W04 bridge	15p
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ITT bridge 1½A C73	20p
3 amp bridge	25p
B30C 600A6	12p
B30C 500	12p
1 amp/100V	20p
NKT279, AC128	12p
MC7724CP	40p

Condensers

4700/25	25p
470/25	10p
220/40	5p
1500/40	10p
1250/50	10p
220/63	10p
1000/63	15p
700/250	35p
800/250	30p
4/350	5p
8/350	8p
22/350	8p
33/350	8p
400/350	50p
33/450	10p
220/450	50p
10/500	10p
33/500	10p
.1/800	10p
.047/1000	10p
.01/1000	10p
.47/1000	30p
.0047/1500	10p
1N8/1500	10p
2N2/1500	10p
.1/2000	15p

8 mixed gun switches	£1.00

Various Mixed Packs

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100 Mixed EHT Rectifier Sticks	£1.00
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20 Slider Pots	£1.00
30 Presets	50p
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300 Resistor	£1.50
150 Electrolytic	£2.00
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100 diodes	£1.00
100 20mm fuses	£2.00
100 W/W resistors	£1.50
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200 ceramic and plate condensers	£1.00
2·7 meg & 4·7 meg 10% resistor 100, OFF	50p
300 Carbon film ¼W 1R to 2M ITT	£1.50
20 slider knobs	£1.00

1800/4KV	5p
4·7NF/5KV	10p
180PF/6KV	10p
210PF/8KV	10p
270PF/8KV	10p
330PF/8KV	10p
1000PF/10KV	10p
1200PF/12KV	10p
1000PF/12KV	10p
6200PF/2000V	10p
BYW56 1000V/2A BDX32	£1.20
TIC126N Thyristors 800V/12A	65p

Sale Condensers

220/10	4.7/63
330/10	33/63
4700/10	47/63
100/16	330/63
220/16	.01/100
160/25	33/100
330/25	.47/160
470/25	2.2/160
680/25	22/160
33/35	.47/250
10/40	1/250
22/40	3.3/250
47/40	10/250
8/300	
680/40	.1/4000
1/63	.0005/1500

All at 6p each.

9000 Thorn Line O/P Transistors with Heatsink T903 8V	~~£1.00~~
SW150 Surface Acoustic Wave Colour T.V. Filters	£1.00 each

SENDZ COMPONENTS

63 BISHOPSTEIGNTON, SHOEBURYNESS, ESSEX, SS3 8AF

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