SEPTEMBER 1978 Australia 85c; Malaysia $2.50; New Zealand 85c **50p**

TELEVISION

SERVICING · VIDEO · CONSTRUCTION · DEVELOPMENTS

SERVICING THE THORN 3000/3500 CHASSIS

Also:

UHF Reception Problems

Cruciform Pattern Generator

TELEVISION

September 1978

Vol. 28, No. 11
Issue 335

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

BINDERS AND INDEXES
Binders (£2.85) and Indexes (45p) can be supplied by the Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF. Prices include postage and VAT. In the case of overseas orders add 60p to cover despatch and postage.

BACK NUMBERS
Some back issues, mostly those published during the last two years, are available from our Post Sales Department (address above) at 70p inclusive of postage and packing to both home and overseas destinations.

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

this month

Held over: Due to shortage of space in this issue, the article we had planned to publish on the Sanyo CTP370 has had to be held over. The diagnostic pattern generator PCB details will appear next month.

OUR NEXT ISSUE DATED OCTOBER WILL BE PUBLISHED ON SEPTEMBER 18

TELEVISION SALE

DISCOUNT FOR QUANTITY

MONO
Rotaries 19" & 23"

	£
GEC	3.00
Thorn 950 etc.	3.00
K.B.	3.00
Pye	3.00
Thorn 1400	4.50

D/S P/B 19" 23"

	£
Thorn 1400	7.00
Bush 161 etc.	7.00
Baird 660 etc.	7.00
Philips 210 etc.	7.00
Pye Olympic etc.	7.00

D/S P/B 20" 24"

	£
Bush	10.00
GEC	10.00
Philips	10.00
Pye	10.00
Thorn	10.00

S/S 20" 24"

	£
Bush 313 etc.	12.00
Pye 169 chassis	12.00
Thorn 1500	12.00
GEC series 1 & 2	12.00
Decca MS series	12.00

S/S COLOUR

	19"	20"	22"	25"	26"
	£	£	£	£	£
GEC	40	45	45	45	50
Philips	–	–	45	45	50
Thorn	65	–	65	65	85
Bush	60	–	65	65	75
Kort	–	–	65	–	75

D/S COLOUR

	19"	25"
	£	£
Decca	20.00	25.00
Bush	20.00	25.00
Baird	20.00	25.00
GEC	20.00	25.00
Philips	–	25.00

PLEASE NOTE THERE IS 12½% V.A.T.

Please note all mono sets sold as 100% comp. No broken masks, no broken panels etc.
Colour sets sold with good c.r.t.s and 100% comp.
Working Mono £3.00 extra.
Working Colour £10.00 extra.
Supplied in 1's or 100's

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TYPE	PRICE £
AC107	0.23
AC113	0.17
AC115	0.17
AC117	0.24
AC125	0.20
AC126	0.18
AC127	0.19
AC128	0.17
AC131	0.13
AC141	0.23
AC142	0.19
AC141K	0.29
AC142K	0.29
AC151	0.17
AC165	0.16
AC166	0.16
AC168	0.17
AC176	0.17
AC176K	0.28
AC178	0.16
AC186	0.26
AC187	0.21
AC188	0.20
AC187K	0.34
AC188K	0.34
AD130	0.50
AD140	0.65
AD142	0.73
AD143	0.70
AD145	0.70
AD149	0.64
AD161	0.41
AD162	0.48
AD161 / AD162	1.30
AF106	0.42
AF114	0.23
AF115	0.22
AF116	0.22
AF117	0.22
AF118	0.40
AF121	0.43
AF124	0.33
AF125	0.29
AF126	0.29
AF127	0.29
AF139	0.39
AF151	0.24
AF170	0.25
AF172	0.20
AF178	0.49
AF180	0.60
AF181	0.30
AF186	0.29
AF239	0.43
AU113	1.29
BA130	0.08
BA145	0.14
BA148	0.17
BA155	0.10
BAX13	0.05
BAX16	0.08
BC107	0.12
BC108	0.12
BC109	0.12
BC113	0.12
BC114	0.14
BC115	0.12
BC116	0.12
BC117	0.13
BC119	0.24
BC125	0.15
BC126	0.09
BC136	0.14
BC137	0.14
BC138	0.24
BC139	0.21
BC140	0.31
BC141	0.22
BC142	0.19
BC143	0.19
BC147	0.09
BC148	0.09
BC149	0.09
BC153	0.12
BC154	0.12
BC157	0.10
BC158	0.11
BC159	0.11
BC160	0.28
BC161	0.28
BC167	0.13
BC168	0.10
BC169C	0.12

TYPE	PRICE £
BC171	0.12
BC172	0.12
BC173	0.15
BC177	0.14
BC178	0.14
BC179	0.14
BC182L	0.08
BC183L	0.07
BC184L	0.11
BC186	0.18
BC187	0.18
BC209	0.14
BC212	0.13
BC213L	0.09
BC214L	0.14
BC237	0.07
BC240	0.31
BC281	0.24
BC262	0.20
BC263B	0.20
BC267	0.19
BC301	0.26
BC302	0.30
BC307	0.10
BC337	0.13
BC338	0.09
BC307A	0.12
BC308A	0.12
BC309	0.14
BC547	0.09
BC548	0.11
BC549	0.11
BC557	0.11
BD112	0.39
BD113	0.65
BD115	0.40
BD116	0.47
BD124	1.30
BD131	0.32
BD132	0.34
BD133	0.37
BD135	0.26
BD136	0.26
BD137	0.26
BD138	0.26
BD139	0.40
BD140	0.28
BD144	1.39
BD145	0.30
BD222/T1P31A	0.39
BD225/T1P31A	0.39
BD234	0.34
BD222	0.50
BDX22	0.73
BDX32	1.98
BDY18	0.75
BDY60	0.80
BF115	0.24
BF121	0.21
BF154	0.19
BF158	0.19
BF159	0.24
BF160	0.23
BF163	0.23
BF164	0.17
BF167	0.23
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	0.23
BF185	0.29
BF186	0.30
BF194	0.09
BF195	0.09
BF196	0.12
BF197	0.10
BF198	0.15
BF199	0.14
BF200	0.28
BF216	0.12
BF217	0.12
BF218	0.12
BF219	0.12
BF220	0.12
BF222	0.12
BF221	0.21
BF224	0.12
BF256	0.37
BF258	0.27
BF259	0.27

TYPE	PRICE £
BF260	0.24
BF262	0.28
BF263	0.25
BF271	0.20
BF273	0.12
BF336	0.35
BF337	0.24
BF338	0.29
BFT42	0.26
BFT43	0.24
BFX84	0.27
BFX85	0.27
BFX88	0.24
BFY37	0.22
BFY50	0.18
BFY51	0.17
BFY52	0.18
BFY53	0.27
BFY55	0.27
BHA0002	1.90
BR100	0.20
BSX20	0.23
BSX76	0.23
BSY84	0.36
BT106	1.18
BT108	1.23
BT109	1.09
BT116	1.23
BT120	2.08
BU105/02	1.87
BU105/04	2.25
BU126	1.40
BU205	1.97
BU208	2.49
BY126	0.09
BY127	0.10
OC22	1.10
OC23	1.30
OC24	1.30
OC25	1.00
OC26	1.00
OC28	1.00
OC35	1.00
OC36	0.90
OC38	0.90
OC42	0.45
OC44	0.20
OC45	0.20
OC46	0.35
OC70	0.22
OC71	0.28
OC72	0.35
OC74	0.35
OC75	0.35
OC76	0.35
OC77	0.50
OC78	0.13
OC81	0.20
OC810	0.14
OC82	0.20
OC820	0.13
OC83	0.22
OC84	0.28
OC85	0.13
OC123	0.20
OC169	0.20
OC170	0.22
OC171	0.27
OA91	0.05
BRC4443	0.65
R2008B	1.50
R2010B	1.50
R2305	0.38
R2305/BD222	0.37
SCR957	0.81
TIP31A	0.38
TIP32A	0.36
TIP3055	0.53
T1590	0.19
T1591	0.19
TV106	1.09

DIODES

1N4001	0.04
1N4002	0.04
1N4003	0.06
1N4004	0.07
1N4005	0.07
1N4006	0.08
1N4007	0.08
1N4148	0.30
1N4751A	0.11
1N5401	0.10

TYPE	PRICE £
1N5404	0.12
1N5406	0.13
1N5408	0.16

VALVES

DY87	0.52
DY802	0.64
ECC82	0.52
EF80	0.40
EF183	0.60
EF184	0.60
EH90	0.60
PC86	0.76
PC88	0.76
PCC89	0.65
PC189	0.65
PCF80	0.70
PCF86	0.68
PCF801	0.70
PCF802	0.74
PCL82	0.67
PCL84	0.75
PCL86	0.78
PCL805	0.70
PCF200	1.00
PL36	0.90
PL84	0.74
PL504	1.00
PL509	2.45
PY88	0.63
PY500A	1.50
PY81/800	0.57

E.H.T. TRAYS MONO

950 MK2 1400	2.26
1500 18" 19" stick	2.37
1500 24" 5 stick	2.48
Single stick Thorn TV 11.16K 70V	0.75
TV 20 2 MT	0.75
TV20 16K 18V	0.75

IC's

SN76013N	1.20
SN76013ND	1.00
SN76023N	1.20
SN76023ND	1.00
SN76226DN	1.50
SN76227N	1.20
TBA341	0.97
TBA520Q	1.45
TBA530Q	1.20
TBA540Q	1.45
TBA550Q	1.60
TBA560CQ	1.80
TBA570Q	1.00
TBA800	1.00
TBA810	1.50
TBA920Q	1.80
TBA990Q	1.60
TCA270SQ	1.45
TCA270SA	1.45
TCA1327B	1.00

E.H.T. TRAYS COLOUR

Pye 691 693	4.50
Decca (large screen) CS2030/2232/2630/2632/2230/2233/2631	5.67
Philips G8 520/40/50	5.66
Philips G9	5.79
GEC C2110	5.50
GEC Hybrid CTV	5.40
Thorn 3000/3500	5.50
Thorn 800	2.42
Thorn 8500	5.23
Thorn 9000	6.10
GEC TVM 25	2.50
ITT/KB CVC 5/7/8/9	5.50
RRI (RBM) A823	5.89
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

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	1.92
AD161	0.88
AD161/162	1.22
AD162	0.71
AF114	0.35
AF115	0.35
AF116	0.41
AF117	0.42
AF118	0.96
AF121	0.88
AF124	0.38
AF125	0.38
AF126	0.36
AF127	0.86
AF139	0.56
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*	†0.16
BC214*	†0.18
BC214L*	†0.16
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*	†0.26
BC267*	0.20
BC268*	0.26
BC286	0.40
BC287	0.49
BC291	0.27
BC294	†0.37
BC297	0.38
BC300	0.62
BC301	0.36
BC302	0.86
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	†0.16
BC328	†0.16
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	0.76
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	0.88
BD160	2.69
BD163	0.67
BD165	0.66
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	1.56
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	0.67
BD600	1.23
BD663BR	0.86
BDX18	1.55
BDX32	2.95
BDY16A	0.63
BDY18	1.55
BDY20	2.29
BDY38	1.36
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	0.48
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	†0.56
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	0.60
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	†0.26
BFR79	†0.30
BFR80	†0.29
BFR81	†0.30
BFR88	†0.42
BFT41	0.48
BFT43	0.55
BFW11	1.02
BFW30	2.56
BFW59	†0.19
BFW60	†0.20
BFW90	†0.65
BFX29	0.36
BFX84	0.42
BFY50	0.36
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	2.85
BU105	†1.80
BU105/02	†1.95
BU108	†2.98
BU126	†2.91
BU204	†2.50
BU205	†2.78
BU206	†3.09
BU208	†4.88
BU407	†1.38
BUY77	2.50
C1060	0.60
C106F	0.43
C111E	†0.46
D40N1	0.64
E1222	0.47
E5024	†0.19
GET872	0.48
MC140	†0.36
ME0402	†0.18
MF0404/02	†0.18
ME6001	†0.16
ME6002	†0.18
MJ2955	1.30
MJ3000	1.56
MJE340	0.68
MJE341	0.72
MJE370	0.74
MJE371	0.79
MJE520	0.65
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	0.62
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	1.96
ON236A	0.94
R2008B	†2.92
R2010B	†2.79
R2322	†0.75
R2323	†0.65
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	0.56
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	†0.26
2N404	1.30
2N696	0.46
2N697	0.46
2N708A	0.33
2N708	0.29
2N914	0.32
2N916	0.46
2N918	0.54
2N930	0.29
2N1164	8.29
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	0.40
2N2401	0.80
2N2484	0.35
2N2570	0.74
2N2646	0.62
2N2784	1.15
2N2869	2.06
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	0.36
2N3633	12.70
2N3703	†0.17
2N3704	†0.19
2N3705	†0.17
2N3706	†0.16
2N3707	†0.16
2N3708	†0.17
2N3715	1.70
2N3771	2.39
2N3772	2.58
2N3773	3.90
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	†0.26
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	†0.56
2N5494	0.65
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	0.76
2SC643A	2.25
2SC930O	1.50
2SC1061	1.45
2SC1172Y	3.55
2SD234	1.48
3N128	1.60
40250	0.98
40251	1.14
40327	0.67
40381	0.48
40362	0.50
40410	0.94
40429	0.88
40530	0.79
40595	1.39
40603	1.13
40636	1.25
40654	0.69

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
FCH161	†2.40
FCJ101	†3.32
LM309K	1.98
LM380N-14	1.65
LM1303N	3.08
MC1307P	†1.82
MC1310P*	†1.94
MC1312P	2.34
MC1327P*	†1.86
MC1330P	†0.93
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
MIC1P	2.58
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	2.22

Type	Price (£)
SN76008KE	1.56
SN76013N	1.56
SN76013ND	1.40
SN76018KE	1.58
SN76023N	1.56
SN76023ND	1.40
SN76033N	2.22
SN76110N	1.20
SN76115N	†1.62
SN76116N	1.78
SN76131N	†2.10
SN76226N	†2.60
SN70227N	†1.61
SN76228N	†1.60
SN76502N	†1.92
SN76530P	†0.97
SN76533N	†1.38
SN76544N	†1.65
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	0.45
TAA560	1.93
TAA570	†2.30
TAA611A	1.67
TAA611B	1.89
TAA621AXI	2.33
TAA630Q	3.91
TAA630S	4.18
TAA661A	2.39
TAA661B	1.75
TAA700*	†2.60
TAA840	†3.38
TAA861A	0.95
TAA930A	1.43
TAA930B	1.43
TAA960	†2.25
TAA970	†2.48
TAD100	†2.66
(Filter)	0.98
TBA120A	†0.90
TBA120S*	†0.99
TBA120SA	†1.02
TBA231	1.12

Type	Price (£)
TBA240A	†3.98
TBA281	†2.07
TBA395*	†2.56
TBA396	†2.40
TBA400	†2.20
TBA480Q	†1.84
TBA500*	†2.21
TBA510*	†2.21
TBA520P*	†3.40
TBA530P	†2.24
TBA540*	†2.86
TBA550*	†3.13
TBA560C*	†3.18
TBA570*	†1.29
TBA611B	2.88
TBA641	2.55
TBA641A12	2.35
TBA641B11	2.61
TBA651	†2.12
TBA673	†2.19
TBA700*	†2.50
TBA720AQ	†2.38
TBA720Q	†2.38
TBA750*	†2.18
TBA800	1.65
TBA810AS	1.69
TBA920*	†3.60
TBA940	†3.52
TBA950	†2.78
TBA990*	†2.90
TCA270A*	†3.55
TCA280A	1.43
TCA290A	3.46
TCA420A	1.98
TCA440	1.67
TCA640	2.76
TCA650	2.76
TCA660	2.76
TCA730	3.54
TCA740	3.04
TCA750	2.53
TCA760	1.52
TCA820	3.29
TDA440	†4.16
TDA1003	1.52
TDA1004	2.73
TDA1005	3.04
TDA1022	6.89
TDA1024	0.97
TDA1034	1.98
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
BA170	0.18
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	0.83
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	0.43
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	3.0-33V	14p each
1/1.3W plastic	3.3-180V	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
E2990D/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	0.46
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	0.76
ECH81	0.63
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	0.80

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	0.66
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%) (†) — Mixes of a minimum of 10pcs of any value:

	Ea	10 of one value	50pc	100pc	500pc
¼W 5.6Ω-330kΩ (E12)	3p	25p	95p	£1.40	£5.40
¼W 10Ω-10MΩ (E24)	3p	25p	95p	£1.40	£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

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 (BEA8)

40mA	£3.88
50, 63mA	£2.55
100mA	£1.66
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 (BEA8)

100mA	68p
200, 250, 315, 500, 630, 800mA, 1, 1.25, 1.6, 2, 2.5, 3.15, 5A	all 58p
2A circuit breakers metal	£1.52
plastic	£1.48

LABGEAR (Details of full range on request)

COLOURTEXT ADAPTOR 7026
Full facility Colourtext decoder to place between aerial and receiver. All you would expect of a quality ready-made unit. Leaflet on request. †£340.20

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. £182.25

AMPLIFIERS (†)

CM6001/PU	Power unit for those marked* below	£9.42
CM6017	Set-back, battery op., single u.h.f. group	£9.21
CM6019/WB	Masthead, wideband u.h.f., with companion CM6020 power unit	£14.69
CM6030/WB*	Masthead, ultra wideband ch. 1-68	£17.68
CM6040/WB*	Masthead, wideband u.h.f.	£17.68
CM6051*	Masthead pre-amp, single group u.h.f.	£9.42

Please state which group required, if appropriate.

P. & P. UK: £0.12 per order. **Overseas:** At cost.
Please add VAT at 8% and 12½% on items marked†.
It is only possible to show part of our range here. Our catalogue (30p refundable) shows Service Aids, 7400 series, CMOS, op amps, SCRs etc., hardware, capacitors, special TV items and many more transistors, diodes, i.c.'s and valves.
Giro A/c 23 532 400. *A/c facilities available*

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	20p
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	250, 270, 300pF	39p
10kV	1nF	67p
18kV	1nF	73p

CONVERGENCE POTENTIOMETERS

5, 7, 10, 15, 20, 50, 100, 200, 500Ω †38p each
Spindles for above 5p each

VHF to UHF CONVERTER CM6022/RA. "Televerta" for DX-ing or uhf receiver use on relay systems, Eire etc. †£24.40

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Too Many Exhibitions?

"Show shock" ran the headline, "and sponsor slates stop outs". Well, he would, wouldn't he? And what is this cancelled show? A Sound and Vision Festival no less. But you'd be forgiven for yawning and saying "heavens, surely not another?" It seems that the only growth section of our industry in recent years has been the exhibition side. There has to come a point where there are too many, and manufacturers are quite right to consider carefully whether it's all worth while.

Whether going into exhibitions is in fact worth while is open to question. Pressure is put on firms to attend through a rather insidious form of blackmail. If a couple of major firms agree to attend, then others will feel they must as well. But what does anyone, the organisers excepted, get out of it? It's very difficult to quantify. The expenditure will probably come out of a sales promotion budget, which again is notoriously difficult to assess in terms of any tangible or even intangible (good will etc.) benefit. You can largely discount the "ten million pounds of orders taken on first day" ballyhoo. Large orders are not placed by people with open chequebooks marching up to a stand. The orders may be publicly announced on a certain day, for the benefit of the exhibition promoter, but that's a different matter.

Going back in time, rather a long time in fact, to before the war, the national papers used to sponsor exhibitions for the sake of the publicity. Subsequently it became clear that if you could charge exhibitors enough and persuade the public to cough up as well you were on to a winner. It worked pretty well for a time, but the public's interest in exhibitions seems to have waned. This is hardly surprising: I've yet to meet anyone claiming to have enjoyed attending a major exhibition. Physical discomfort and a mental clouding over occur before long if you attempt to assess what's there thoroughly – while to be on the other side, manning a stand, is like a combination of madhouse and prison.

This is not to say that exhibitions serve no purpose at all. The annual Radiolympia used to be looked forward to as an annual opportunity to see the latest developments and ranges of equipment. But the tempo changed. Technical developments started to appear at a rather more rapid rate, while on the other hand the cost of tooling up for large-scale production meant that it was no longer feasible to produce a new range annually. The same basic chassis continues in production for several years, incorporating unseen in its innards new developments as they become available from the component manufacturers. The trade continues with its annual, informally organised shindig, but the public lost interest along the way.

Local shows are a useful way of stimulating local interest, and a case could possibly be made out for a permanent "trade centre" type of exhibition where equipment could be examined at leisure. But the latter doesn't seem to tally with the modern approach to distribution or the public's requirements. So far as TV is concerned, the public is happy to rent, or it looks for a special offer – which is never far away – or it settles for what's in the window of the nearest dealer. One can't imagine that many members of the public would nowadays flock to a radio and TV exhibition, because radio and TV equipment has come to be accepted as just one of those things that happen to be about the house. They're taken for granted.

Not very exciting of course, and you could argue that the public's lack of interest is one reason why the trade is in such a poor way, and that exhibitions are all a part of putting that right. One finds it difficult to be convinced though. It could just as well be that past excesses in salesmanship have led to the present age of *Which?* reports and consumer protection legislation.

Meanwhile, if the audiovisual exhibition tide has turned as well, it'll at least be better for our feet and tempers.

COVER

This month's cover shot shows a Thorn 3000 chassis being tested at Ingertone's workshops at 24 Dames Road, London E7. The company specialises in supplying the Trade with de-controlled mono and colour TV sets, and we would like to thank the company and its employees for making their workshop facilities available for the purpose of photographing this month's cover.

Teletopics

TUNING IN TO SPACE TV

Engineers at the IBA's Crawley Court, Winchester engineering centre are now receiving the s.h.f. beacon transmissions from the new European Orbital Test Satellite (OTS). The satellite was successfully launched from Florida on May 11th and was subsequently manoeuvred into position at approximately 11° east. The short-term objective of the IBA's space research is to prepare for Eurovision programme exchange via satellite in the early 1980s, and in the long term to prepare for possible direct satellite broadcasting to homes. The IBA's satellite receiving station was built last year at a cost of £75,000, and has a compact three-metre dish aerial.

When the first OTS launch failed, the receiving station's aerial was directed towards the Italian SIRIO satellite at 15° west. Many propagation measurements were made on the beacon transmissions from this satellite, and during the course of a special joint experiment colour television pictures were received from the Italian broadcasting organisation RAI by means of the large 25-metre dish aerial at the Science Research Council's Chilbolton Observatory. It's believed that this was the first occasion on which high-quality colour television pictures have been transmitted between different European countries via satellite at frequencies as high as 11·6GHz – normal satellite relays via the Intelsat system take place at considerably lower frequencies.

The objects of the European space experiments are to gain experience of satellite television operation, to obtain detailed knowledge of the depolarisation and other effects of weather on s.h.f. signals, to assess the performance of future satellite systems for television distribution and direct broadcasting to homes, and to assess the performance obtained using different forms of modulation, including frequency and digital systems.

At a recent British Aerial Standards Council seminar on aerials for space and data it was said that for satellite reception "aerial rigging will be an exact science", with every obstruction such as a hill, tree etc. resulting in zero signal. The position of the satellite for direct transmission to the UK would be at an elevation of 25°, i.e. where the sun is at 3pm BST on October 10th, and this will cause difficulties in valley locations. Alignment of ±½in. will not be good enough, and the aerial mast must not sway. Microwave ovens are likely to cause interference problems.

PRESTEL

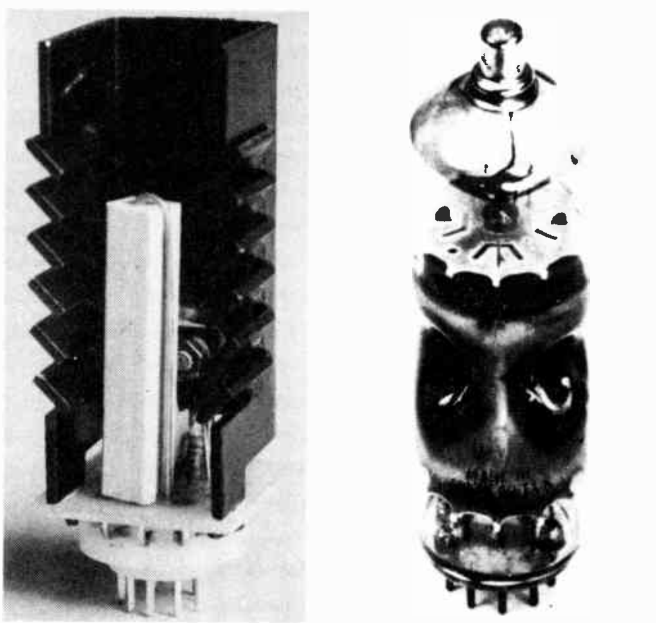
In addition to the stringent requirements the PO laid down before giving any setmaker permission to attach a Prestel receiver to the telephone network a problem arose over servicing. The PO initially wanted Prestel sets to be serviced only by technicians who had been trained in accordance with PO requirements and had subsequently received PO approval. The industry did not consider this practical however, and the solution eventually adopted was to seal the isolation barrier between the receiver and the telephone jack. Thorn, the first setmaker to receive permission to link its Prestel receiver to the telephone system, thereby starting the public Prestel service trial, is committed to producing 550 Prestel receivers. The PO has insisted that each setmaker producing Prestel receivers takes out a £1·5m indemnity against possible damage to the telephone system.

SERVICE TIP

Rank advise that there have been cases where the 1Ω metal oxide line output transistor base current stabilising resistor 5R8 fitted in early production of the T20 colour chassis has increased in value. Typical symptoms are severe horizontal foldover, with the possibility of damage to the BU208A line output transistor. If the transistor has failed therefore the resistor should also be checked. A wirewound resistor (part no. 2252 1331 or 2252 1987) is used in later production.

SWITCH TO SOLID-STATE

In the July *Teletopics* we showed the circuit of a solid-state replacement for the PL802 luminance output pentode. This month we show a photograph of the PL802/T which is available from DR Developments, 14 Granville Road, Melton Mowbray, Leicestershire LE13 0SN, who have registered the design. We've tried one, and it gave excellent results as a direct plug-in replacement. Note the substantial heatsink. DR Developments comment that at a trade price of around £3 plus VAT – quantity discounts are available – the PL802/T is an attractive alternative to the valve. In addition to ruggedness and better reliability, the device can be repaired at little cost and gives improved contrast/gain. Tests have been carried out on sets fitted with regunned tubes that tend to flashover without any ill-effects having been noted. The circuit basically consists of a high-voltage Darlington pair, using selected transistors.



Left, the PL802/T, a solid-state replacement for the PL802, available from DR Developments. Right, what happened to the PY500 boost diode when the thermal cutout failed in a GEC 2040 colour receiver. Photo courtesy Stan Franklin.

We've also heard from the London Electronic Development Co., 62 High Street, Croydon CR9 2UT who inform us that they also supply a solid-state plug-in replacement for the PL802 – and several other interesting replacement parts, including a direct plug-in solid-state replacement for the CDA panel used in Pye group hybrid colour sets, and an i.c. module to replace the LP1162 audio module used in this chassis. They also have under development a solid-state replacement line timebase panel for use in this chassis. It seems that a new lease of life is being offered to the masses of hybrid colour sets still around.

SHADOWMASK TUBE DEVELOPMENTS

One item that seems to undergo continuous development is the shadowmask tube. Refinements that have been chronicled in these pages over the last year or so include the super-arch mask, high-bri tubes, soft-flash to minimise damage to external circuits due to flashovers, and the use of pigmented phosphors to increase the contrast range. The latest development from RCA is the contoured-line screen, in which the vertical phosphor lines towards the side edges of the screen are curved in order to eliminate the step appearance that occurs when straight phosphor lines are cut off to form the curved screen boundary. The mask apertures also have to be curved of course. An added advantage is that a geometric distortion that's been a limiting factor in laying down well defined phosphor lines near the corners of the screen is minimised. You might say who looks at the corners and edges anyway, but the fact is that with the increasing use of TV games, teletext and so on the corners and edges are becoming of greater importance.

The next development will be not inside but outside the tube, by modifying the yoke to obtain increased tube sensitivity and thus reduced consumption. Just look at the power consumption figures already achieved by some 20in. Japanese sets – around 60W.

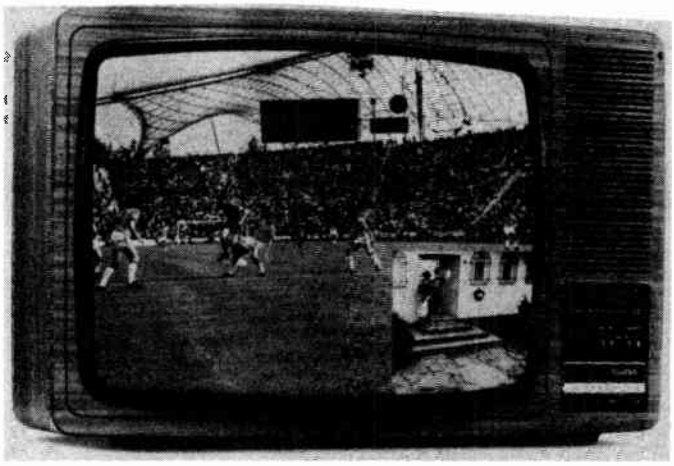
STATION OPENINGS

The following relay stations are now in operation:
Bruton (Somerset) BBC-1 channel 40, ITV (HTV West) channel 43, BBC-2 channel 46. Receiving aerial group B.
Llanfoist (Gwent) BBC-Wales channel 57, ITV (HTV Wales) channel 60, BBC-2 channel 63. Receiving aerial group C/D.
Slapton (Devon) BBC-1 channel 48, ITV (Westward Television) channel 55, BBC-2 channel 66. Receiving aerial group C/D.
Tynewydd (Rhondda) BBC-Wales channel 55, ITV (HTV Wales) channel 59, BBC-2 channel 62. Receiving aerial group C/D.

All the above transmissions are vertically polarised.

PICTURE IN A PICTURE

In reporting on the 1978 radio and television trade shows last month we mentioned the introduction of the Saba Model T6794 with its picture in a picture feature, i.e. two pictures on the screen simultaneously. We have also received details recently of a set of ITT i.c.s for the same purpose, though ITT go about matters somewhat differently. Common to both approaches is the need for separate tuners and i.f. strips to produce the two basic pictures, and the main problem in each case is to maintain synchronism between the two signals. In the Saba system, the centre section of the second picture is inserted in one corner of the main picture. The ITT set of i.c.s actually reduces the size of the second picture before inserting it in the main picture. Because of this, the bandwidth of the r.f./i.f. circuits for the second picture can be substantially reduced. The set of chips consists of an SAA3000 control i.c. and two UAA1000 memory i.c.s. Picture reduction in the vertical sense is achieved by storing every fourth line only, reduction in the horizontal sense being achieved by reading out the stored information at a rate faster than that at which it's stored in the memory. With both systems the second picture appears in black and white.



Picture in a picture, Saba style (Model T6794).

LINE TIMEBASE DEVELOPMENTS

SGS have announced two new high-voltage transistors, types BU806 and BU807, for use in monochrome receiver line output stages. The interesting feature is that they consist of a Darlington pair, thus eliminating the need for a separate driver stage. An efficiency diode is also incorporated, and an extra diode to provide the high switching speed required – it acts to remove the stored charge built up when the output transistor conducts. The devices are available in TO220 plastic packs.

Last month we mentioned the new SGS TDA1180 sync separator/line oscillator i.c. The version of this for use with thyristor line output stages is the TDA1280. An interesting feature here is that the outputs from pins 2 and 3 can be used to trigger the scan and flyback thyristors respectively, greatly simplifying the usual scan thyristor drive arrangement.

INTO AND OUT OF RECEIVERSHIP

Videomaster, the TV games firm that went into receivership earlier this year when its UK produced range was undercut by imported games units, has been sold by the receiver as a going concern to playing card manufacturers John Waddington. The price paid was £686,000. Meanwhile a receiver has been appointed at Vessco Vision and Radio Ltd., which handles the Nordmende range in the UK. The company will continue to trade, and is receiving the support of Nordmende.

THORN'S COLOUR PORTABLE

We've been taking a look at the circuitry and techniques used in the new Thorn 14in. mains/battery colour portable (Model 3787) which is being imported from W. Germany. A thyristor line output stage is employed, with a TDA2590 i.c. as line oscillator/sync separator. The field timebase consists of a TDA1170 i.c. Power on battery operation is provided by a d.c./d.c. convertor which produces a 280V output. The decoder is of the Philips three-chip variety – TDA2560/TDA2522/TBA530 – driving class AB RGB output stages.

The Decca Schools' Monitor/Receiver

Nick Lyons

THE Decca ILEA (Inner London Education Authority) monitor has been used by a number of other authorities and went through several generations, starting life as a dual-standard set and later being pruned for single-standard operation. The timebases have much in common with the Decca DR1 series, which was covered by Les Lawry-Johns in the October and November 1975 issues of *Television*. It's not the intention of the present article to go over the basic faults on that chassis, but rather to concentrate on the peculiarities of the ILEA monitor. A very similar set, the Decca "Professional 23", was on sale to the public around 1967/8.

The model dealt with here is the first single-standard version, though many of the comments apply to most of the series. The amount of modification from the dual-standard version was minimal, viz. removal of the system switch and little else – in fact the holes into which it fitted remained. The set consists basically of three large subassemblies – four if the video/audio input/output board is fitted. The panel at the bottom of the set contains the sync separator, line and field scan circuits and the power supply section, the mains isolation transformer being mounted adjacent to this panel on the main chassis member. The top panel, which hinges down, reveals itself as being the i.f., video output and audio department. The front panel escutcheon assembly holds the usual customer controls and the tuner. Finally the matching board (video/audio, input/output), if fitted, is behind the little door on the set's side. On this panel are the input and output sockets for audio and video, and two controls. The top control is a three-position switch which selects the "modus operandi" of the set, the positions being: r.f. input (aerial) with video and audio output to slaves; video and audio in and terminated; and finally video and audio input and looped out to slaves. The lower control, a potentiometer, is the video input contrast control and is not operative for slaving.

If you've never met one of these sets before, getting the back off can be a frustrating experience. It doesn't simply come away when the screws are removed, but must be tilted outwards about 30 degrees at the top. The back can be withdrawn when it's in this position. A large lip along the bottom of the back prevents its removal in the usual way.

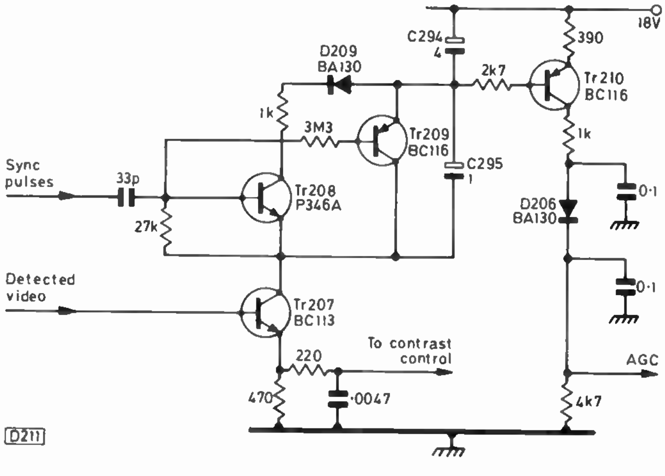


Fig. 1: The a.g.c. circuit. Tr208 provides gating, C294 being the a.g.c. reservoir capacitor.

The Tuner Unit

Once inside, panel identification is a simple matter. We'll start at the front end, literally in fact, with the tuner. This is a turret tuner for Bands I and II – yes, Band II to suit certain types of Post Office relay equipment. Though rather unusual the tuner has proved reliable in service, the main problems being due to dirty contacts which can be cleaned in the usual manner. The transistors used are two AF106s and a BF166, and we've not had any failures yet. If the tuner is suspect however, before returning it to Decca just check L203 at the input on the i.f. strip for a dry-joint, and it's prudent to check the output coil in the tuner as well. Some of these Decca sets have u.h.f. tuners fitted for direct off-air reception. These are usually of the Prestomatic variety – do I hear a gnashing of teeth?

Signal Circuits

The i.f. panel is interesting. It's spacious and has a layout similar to that of the circuit diagram. The panel is fully transistorised and includes the audio and the video stages (less sync separator) as well as the i.f. strip. There's an interesting anomaly here in the service manual. The circuit diagram is captioned 'ILEA 625-only schools i.f. circuit diagram' while above the table of voltages is printed ". . . set to 405 operation"! In view of this I've produced a voltage table measured on 625 lines on a correctly adjusted set. Brief checks on other sets have shown these to be typical.

As far as faults are concerned, the first i.f. amplifier transistor TR201 (BF163) seems to fail fairly frequently, but its end may be due to something being amiss in the region of TR207/8/9/10 (the a.g.c. circuit, see Fig. 1) where the culprit in chief seems to be TR209, odd though this may appear. If the set displays violent overloading and instability it's most likely that TR209 is at fault.

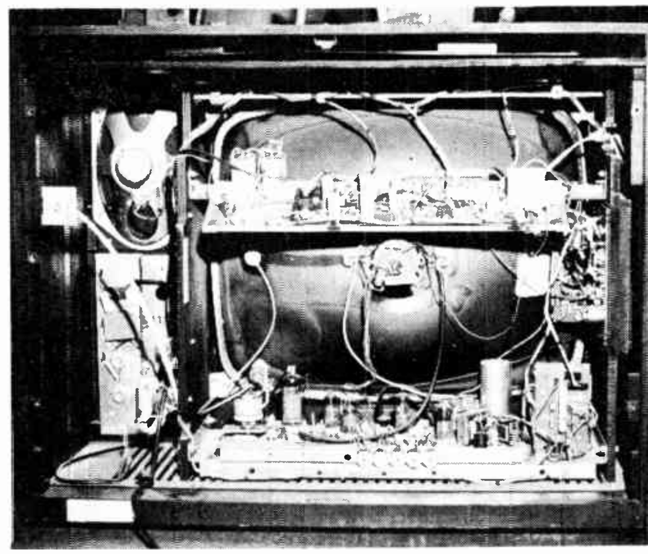
The intercarrier sound is often rather poor, but fortunately there is usually little amiss except that L231 in the first video stage has drifted off tune, a thing at which it is remarkably proficient. A half turn usually restores normal operation. There is no discriminator balance potentiometer on this set, so if you want perfection fit a 5kΩ potentiometer in place of R231 – you may need this all the more if you've replaced the diodes.

To the audio stages next. If any of the four output/driver transistors fails replace *all* the others as well. The reason for this is that the audio amplifier is one of those d.c. coupled "death or glory" jobs with under-rated transistors. The failure of one almost invariably damages the others, but the damaged transistor may not show up as faulty until your replacement is in place and the supply is turned on, when more death than glory is witnessed. We now replace the output transistors with BD131s which can be easily fitted with 6BA bolts to the existing heatsink and wired to the terminal block thereon. Keep the leads as short as possible – this amplifier will take off given any chance – then reset the quiescent current adjustment potentiometer VR279 consistent with minimum current and no audible distortion.

The audio matching board is a bit of a joke (see Fig. 2). The fact that Cannon connectors are fitted implies that the set is wired for balanced line audio input and output. A glance at the circuit shows the absence of any transformer, R711 (600Ω) forming a cheap if unbalanced substitute. The Cannon connectors themselves are not without fault, as they are connected in reverse order – not the pins, the sockets. The input socket should be the output socket and vice versa. This is not so much unsafe as a pain in the neck because all our standard leads have to be fitted with back-to-back connectors for use with the Deccas.

The Line Timebase

Now to the bottom panel and seasoned campaigners will note that it looks more than a little DR1ish. This panel carries among other things the line output transformer, which is the real bête noir of the set. It would be fair to say that the transformer seldom lasts long enough to wear out a PL504. Decca issued a letter saying that the Plessey line output transformer used in Models DR21 and DR24, type 525212, could be used on these sets provided the following modifications were made: change C137 (scan correction) from 0·15μF to 0·1μF 400V and, because this transformer has no pulse winding, connect the yellow lead to the anode of the sync separator valve (EF80). Having said this however I must admit that we've never tried one because when we ordered some Decca sent another type which is a direct replacement and requires no modification. This type is distinguished by the fact that it has a red overwind and that the third harmonic tuning capacitor is changed from 270pF to 35pF. We've not had these new types long enough



Rear view – showing the new line output transformer modified for use with an e.h.t. stick rectifier.

to make any valid comment, but they look promising. The line output transformer's demise is almost invariably exhibited in one of two ways, either two-thirds width with a dark picture which does not balloon, often with a vertical bright-up line around the middle of the picture, or alternatively with violent ballooning and again with the bright-up line. One fortunate fact is that the transformer is of the plug-in type and can be changed in a few minutes. After a replacement has been fitted check the boost reservoir capacitor C134 and then set the boost voltage (VR171) which should be 890V+50–30V. This is more easily expressed as 900V ± 40V! In the interests of getting maximum life from the transformer, keep the boost voltage

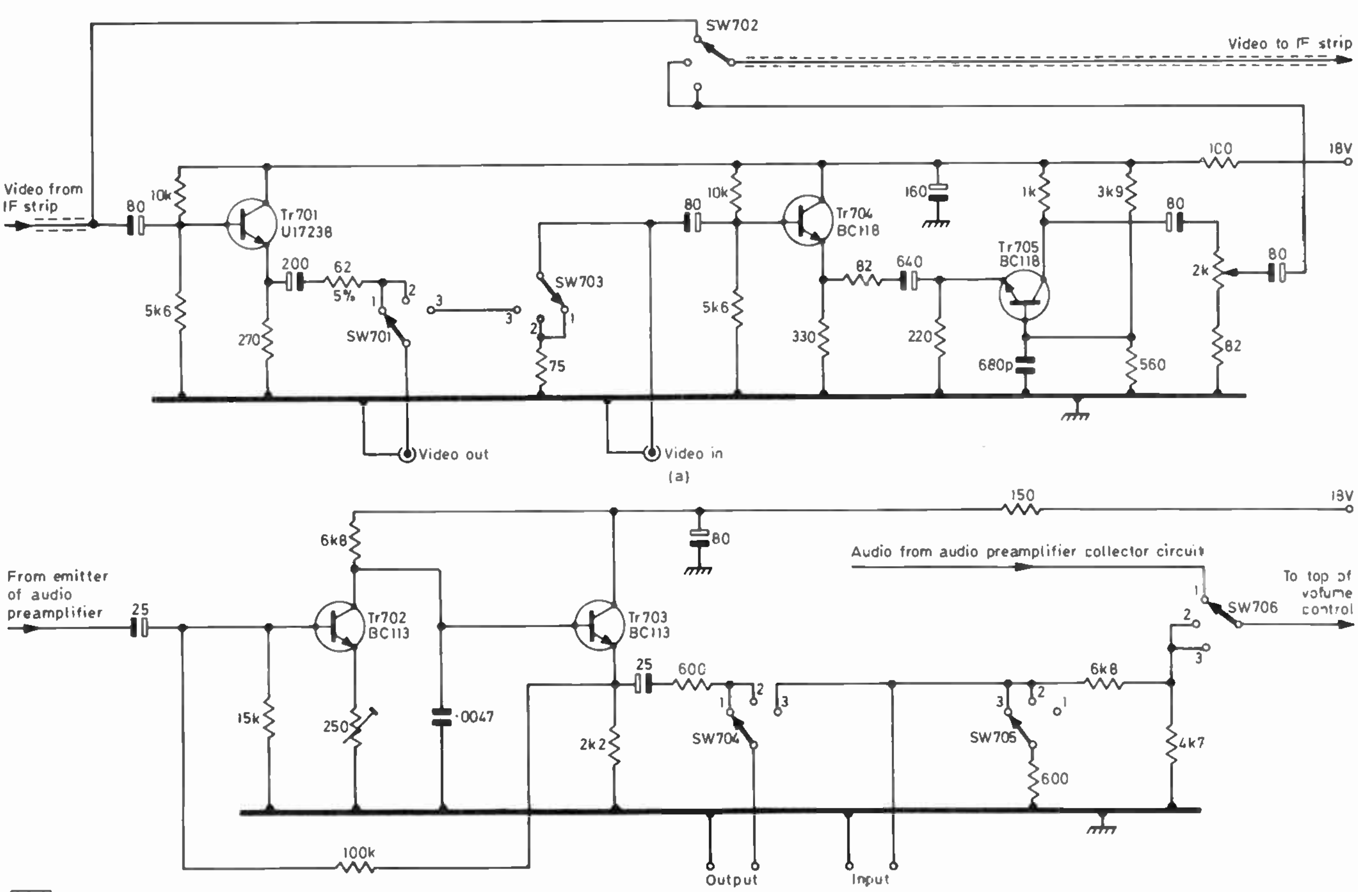
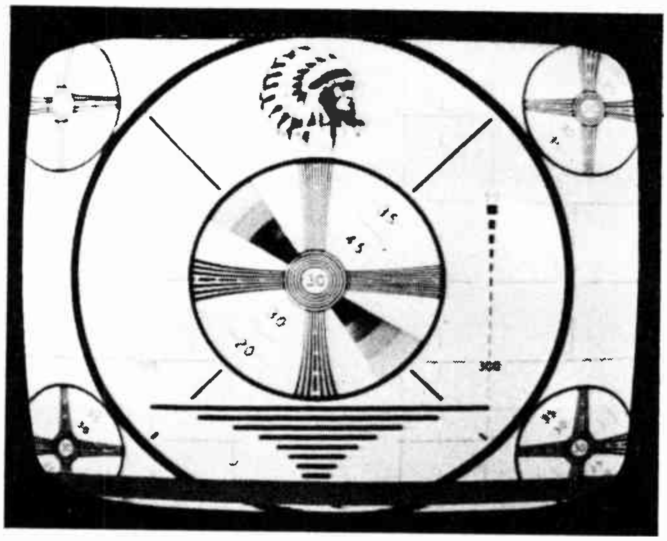


Fig. 2: Circuit of the video (a) and audio (b) input/output board.



Since Decca gave 405-line voltages for a 625-line only set, we thought we'd be really awkward by showing one of these sets displaying a 525-line, 60Hz signal!

as low as possible consistent with sufficient width. Another ruse to improve line output transformer life is to fit an e.h.t. rectifier stick, thus removing the valve's heater loading. This modification also gives improved regulation, particularly important if the set is adapted for underscan. To modify the set for underscan all that's required is to change R169 from 1MΩ to 3·3MΩ, then readjust the boost control VR171 for the desired width. Underscan may be desirable for various reasons, in our case the main one being that some of these sets are used on a computer graphics display and without underscan the axes of the graphs are partly missed off.

The line oscillator is not without its troubles – the ECC82 is connected as a multivibrator. Faults manifest themselves as diving off frequency, poor range of hold control and of course failure to oscillate. Line pulling and similar faults should draw attention to the flywheel sync department, i.e. the ECL80 (not one of my favourite valves) and its peripheral components, especially the electrolytics C109 (2μF) and C113 (1μF).

Sync Separator

The main difference in comparison with the DR1's timebase panel is the sync separator. Sync separation is provided by an EF80 which is fed with video from the video output transistor on the i.f. panel. The EF80 sits in effectively the same configuration as the sync half of the PFL200 in the DR1.

Power Supplies

A big difference with these sets is the use of a mains isolation transformer, making servicing that bit safer – but don't get clever! This means the removal of the mains dropper, including of course the 17Ω section, Les Lawry-Johns will be glad to know! Before the jubilation becomes excessive however I should point out that a thermistor (R407, VA1015) was put in the heater chain. If nothing else this means that the valves take rather a long time to warm up. Since the audio stages are transistorised and come on instantly, you sit there in sound only for two-three minutes. Rather naughty people have been known to short the thermistor out or replace it with a fixed resistor, but we'll say no more of that.

On the mains transformer is mounted a paxolin panel which carries the mains tapping adjustments and the rectifiers, the outputs of these being connected to the appropriate stage/panel by a plug and socket arrangement – also on this panel. Besides the heater supply the other mains transformer supplies are for the sound output stage, the i.f. panel, and finally the main h.t. The latter uses a bridge, the other two using two diodes and centre-tapped transformer windings. The h.t. from the bridge goes through a choke, mounted in a similar position to the DR1 dropper, then into basically the DR1 h.t. supply circuit which consists of another choke and a 200 + 200 + 100μF multisection capacitor together with a separate 16μF capacitor mounted on a tagstrip under the scan panel. This capacitor has a diameter sufficient to make it just catch on the chassis member when the scan panel is carelessly withdrawn, usually pulling its leads adrift. In the event of the main smoothing block failing we fit a Rank chassis 200 + 200 + 100 + 32μF can. The separate 16μF capacitor can then be removed and the wires taken to the 32μF section in this block, which is of exactly the same diameter and of only fractionally different height to the original, causing no mounting problems. Also on the mains transformer is a thermal cut-out assembly which is fitted to the windings. This consists of a metal strip assembly which is soldered down to a contact at one end. One should note that it's quite common for this to spring open for no reason other than long term solder corrosion.

Field Timebase

The field department is a standard type of circuit with a rather rare (now) valve (the 30PL14/PCL88) standing in for the more common but less reliable PCL85. This stage is most reliable under normal circumstances, i.e. when used with off-air signals. Problems can arise however when VTRs or VCRs are used in conjunction with these sets. With the increased use of such equipment in schools the following modification will be found necessary. The problem stems from the fact that any spurious peak or transient in the video signal within about fifteen lines of the field equalising pulses will cause mistriggering of the field timebase. This results in bounce on alternate fields which cannot be cured by adjusting the field controls. Such disturbances can of course be caused by VTR head switching or the drop-out produced on some omega formats. A cure for all but the worst cases is to change C405 from 300pF to 0·1μF. This capacitor, in the sync separator's control grid circuit, is located on a tagstrip under the scan panel, near the main smoothing block.

TRANSISTOR VOLTAGES

Voltages for the Decca schools receiver, taken with an AVO Model 8 on the most suitable range, with a correctly adjusted receiver displaying a pulse and bar signal and 1kHz audio modulation, are as follows (all voltages with respect to chassis, contrast normal, volume at minimum):

Transistor	*Emitter V*	*Base V*	*Collector V*
TR201	5·9	6·6	11·9
TR202	2·7	3·4	10·0
TR203	1·9	2·6	14·5
TR204	2·1	2·8	10·5
TR205	3·3	4·0	12·3
TR206	2·8	3·3	108·0
TR207	2·8	2·9	11·7
TR208	11·7	11·6	13·8
TR209	14·3	13·5	11·7
TR210	15·0	14·3	9·5
TR219	4·05	2·6*	4·2

*Affected by the loading of the meter.

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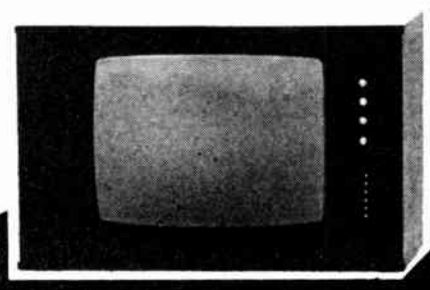

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BD136	40p
BD137	40p
BD139	38p
BD140	40p

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CA3088	190p
CA3089	210p
CA3090AQ	400p
CA3130	100p
LM300TO5	170p
LM301AN	65p
LM307N	65p
LM308TO5	130p
LM308N	130p
LM309K	100p
LM310TO5	160p
LM311TO5	260p
LM317K	325p
LM324N	150p
LM348N	200p
LM380N	110p
LM555	28p
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NE556	100p
NE562B	400p
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SN76013N	160p
SN76013ND	125p
SN76023N	160p
SN76023ND	125p
SN76033N	160p
SN76227N	150p
SN76228N	160p
SN76666N	100p
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Thyristor Line Timebases

Luke Theodossiou

THYRISTOR line output stages have not entirely lost favour with setmakers, despite the wide use of the BU208 transistor approach in current chassis. Indeed the recently introduced Rediffusion Mk III chassis is the first UK-produced set to use a thyristor line output stage.

One reason for the continued interest in thyristor circuits is that Mullard have not cornered the market with their 20AX system. When you limit the discussion to 22in. and 26in. sets, RCA with their PI tube appear to be enjoying a fair amount of success. One fundamental difference between these two tubes is that the RCA PI yoke is a torroidal design which results in both a low inductance and a low resistance. This in turn means that the line output stage has to deliver high deflection currents, although the voltage requirements are reduced. With around 600V across the line scan coils, the peak current required is 6A. This is well outside the capability of a BU208. Several transistors have been developed to meet this requirement however, examples being found in the Thorn 9000 and 9600 chassis.

If a BU208 was to be used to drive the PI yoke, it would have to be operated in the high-voltage low-current mode, and the deflection energy would have to be transferred to the line scan coils via a transformer with an approximately 2:1 step-down ratio. The transistor would be operating under very similar conditions to the 20AX saddle yoke approach therefore. For economic reasons, a separate step-down transformer is not generally used. Instead, the line output transformer is arranged to act as an auto-transformer. This results in greater losses and needs a bigger core and more complex windings. There are several disadvantages in doing things this way therefore. Low-voltage, high-current transistors overcome this problem, but with any transistor line output stage a well-regulated h.t. rail is necessary.

The thyristor approach is in fact the ideal way of driving the PI yoke, since it's easier (and cheaper) to manufacture high-current, low-voltage thyristors than transistors. Also thyristors, like our old friend the valve, can withstand substantial overloads without damage. And width/e.h.t. stabilisation can be carried out relatively simply within a thyristor line output stage.

Thyristor line output stages have been used by several continental setmakers for some years now, and quite a few sets of this type are currently in use in the UK. Service engineers were at first sceptical about them, but they've proved reasonably reliable and when they do break down fault-finding is not as difficult as it might at first seem.

The principles of operation have been covered in these pages before (see the June 1976 issue) while fault-finding on specific chassis has also been discussed in past issues. It's worth noting that the basic circuitry has remained substantially unchanged since its first introduction in the mid-sixties. It's only recently that a solid-state regulator has replaced the control transductor, and this is the subject of the present article.

The control circuit shown in Fig. 1 is used in Körting 20in. sets equipped with 90° PI tubes. Rediffusion use a very similar circuit in their Mk III chassis, which uses the 110° PI tube. The principle of operation is identical.

The main 270V h.t. line is applied to the input/commutating coils in the line output stage via the BY199 diode, charging the now famous capacitor T network during the second half of the scan (i.e. when the scan thyristor is on). Once the capacitors have been charged, the 40869 control thyristor is fired, returning the surplus energy to the reservoir capacitor. The timing of the pulse which triggers this thyristor determines the charge on the capacitors and thus the picture width.

The triggering circuit senses the h.t. voltage and changes in beam current. It then adjusts the timing of the trigger pulse to counteract these, thus stabilising the width of the picture.

To generate the trigger pulse, 55V negative-going line flyback pulses are first limited by the 150Ω resistor, 680nF capacitor and the 22V zener – see waveform (a) in Fig. 2. They are then integrated by the 2k2 resistor and 68nF capacitor, producing a sawtooth voltage whose amplitude is independent of the amplitude of the line flyback pulse (due to the action of the zener diode). This is fed to the base of the npn transistor via the 68nF capacitor – see waveform (b) in Fig. 2.

A d.c. voltage is also fed to the base of this transistor. This is derived from two sources. Positive-going line flyback pulses are rectified, smoothed and injected at the top of the 1kΩ preset control, which is also fed from the h.t. line via the 220kΩ resistor. Thus the voltage at this point is the sum of the rectified flyback pulses and the h.t. line sample. This composite voltage will of course vary according to the h.t. voltage, which depends on the mains voltage, and the peak value of the flyback pulses. The latter will vary in sympathy with the beam current: the greater the beam current demand, the lower the flyback pulse amplitude.

The preset control determines the value of the d.c. voltage at the base of the transistor – the 12V zener is used for level shifting. The sawtooth signal derived from the

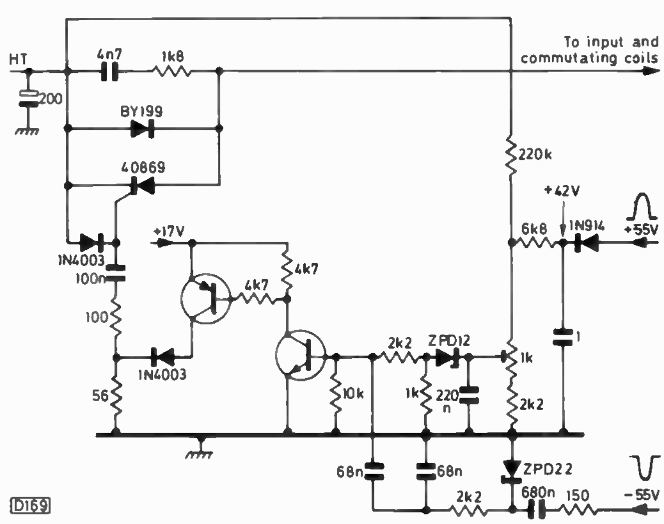


Fig. 1: Solid-state regulator circuit for use with thyristor line output stages.

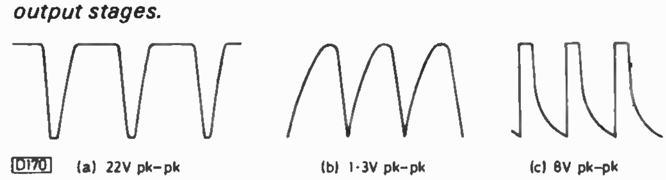


Fig. 2: Waveforms. (c) Control thyristor gate waveform.

negative-going line flyback pulses sits on this d.c. voltage and is used to switch the transistor on. Clearly then the d.c. voltage at this point determines the time during the sawtooth when the transistor turns on.

The resultant pulses at the collector of this transistor are fed to the pnp transistor, which acts as a buffer, and then to the gate of the control thyristor. We thus have a simple way of adjusting the width and, once adjusted, keeping it constant by monitoring changes in beam current and mains voltage. The width is determined by the amplitude of the flyback voltage of course, and by adjusting this we are also adjusting the e.h.t.

This circuit enables the set to operate from mains input voltages down to around 180V, while width variation versus beam current is reduced to 2mm on a 26in. screen for a change of 1mA beam current. ■

Service Notebook

G. R. Wilding

Loss of One Colour

The most common cause of loss of one of the primary colours in receivers using RGB drive is undoubtedly failure of the relevant output transistor to pass collector current. Since the relevant collector voltage and c.r.t. cathode voltage will approach the h.t. rail voltage, the gun concerned will be cut off. As well as the loss of a primary colour, white will be unobtainable.

A disconnection or base-emitter short-circuit within the transistor is the usual cause of the fault, but quite often the preceding driver transistor, if direct coupled, is responsible. This is because the driver develops the forward bias as well as the signal drive for the output transistor. The effect produced by a faulty driver depends on whether it's an npn or a pnp device however. As can be seen from Fig. 1, a non-conductive npn emitter-follower will result in the output transistor being cut-off while a non-conductive pnp emitter-follower will leave the output transistor saturated so that the picture will be flooded by the colour concerned. Occasionally the driver is a common-emitter stage, and in this case the effect will be the same as with a pnp emitter-follower.

The driver stage is sometimes within the matrixing i.c., though the same principles apply. Workshop statistics however show that the failure rate of such i.c.s is very low.

Tracing the cause of primary colour loss in a receiver using RGB drive is simple therefore – merely a matter of checking voltages, working back from the output stage. You don't even need service data: a comparison with the voltages in the working RGB channels will show the conditions which should be present. High collector voltage with no emitter voltage and correct base voltage indicates a defective output transistor. Absence of base voltage with an npn emitter-follower driver means that the driver is probably failing to conduct, though there's always the possibility of a dry-joint.

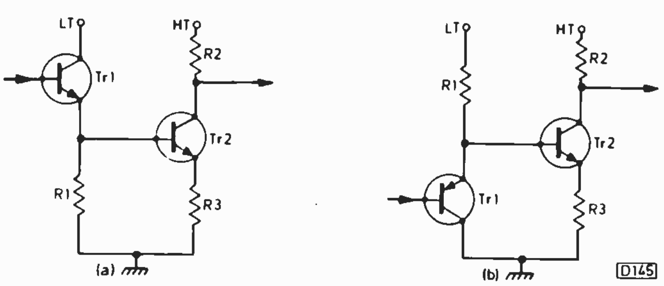


Fig. 1: Basic direct-coupled driver/output circuits, (a) with npn driver, (b) with pnp driver.

If the c.r.t.'s cathode voltage is correct however the next check should be for low first anode voltage.

In the many hybrid receivers using PCL84 or PCF200 colour-difference output stages complete loss of a primary colour is quite rare while when it does occur white is left unaffected. The latter occurs because the trouble would be due to the signal amplifying stages, the triode clamp continuing to maintain the correct d.c. conditions at the appropriate c.r.t. grid. Triode clamp troubles usually concern change in the value of the anode load resistors, as a result of which you get intermittent or gradual change in the grey-scale tracking. Even if the clamp pulse feed was to fail, the trouble would be a higher than normal anode voltage with in consequence excessive conduction by the relevant gun. The only possible way in which the c.r.t. grid could be biased off in such a circuit would be due to a short-circuit in the associated miniature spark gap on the c.r.t. base panel.

With colour-difference drive therefore loss of one colour is generally due to the pentode section of the PCL84/PCF200 or, less often, a defect in the preceding transistor preamplifier circuitry.

Assuming that the appropriate c.r.t. first anode voltage is normal, loss of one colour in such sets should direct attention first to the appropriate PCL84 pentode and to the associated resistors. Working from the component side of the board often makes it difficult to contact suspect resistors of course – and indeed valveholder connections. To check that anode and screen grid voltages are being applied to a valve, it's sometimes helpful to remove the valve and check directly at the valveholder sockets. Naturally the voltages found will be well above normal, h.t. in most instances, but at least resistor continuity will be confirmed.

The great disadvantage is that with such a small meter current consumption an open-circuit wirewound resistor can be shown as being intact due to leakage at the break. An example of this came our way recently, in an Ekco hybrid set which had suddenly lost all blue. The PCL84 was o.k., and on removing the valve ample h.t. was recorded at the anode and screen grid sockets, suggesting that the feed resistors were in order. A resistance check from pin 7 to chassis confirmed that the 270Ω cathode bias resistor was intact, these checks implying that the valve must be operational. On plugging the valve in again and switching the set on however only a very small voltage was recorded at the anode – and there was no leak to chassis. It was then found that the 12kΩ wirewound anode load resistor really was open-circuit, though it gave a considerable deflection on the ohmmeter's times 100 range. Apparently a high-resistance contact was linking the broken ends of the very fine resistive winding. Anyway, a replacement resistor restored normal colours and normal anode voltage.

Weak Field Sync

Complaints of weak field sync in dual-standard KB/ITT monochrome receivers are generally due to a major increase in the value of the resistor feeding the screen grid of the sync separator and the anode of the field sync pulse amplifier. In both the Thorn 1400 and 1500 chassis, weak field sync with acceptable line locking is again commonly due to an increase in the value of the sync separator's screen grid feed resistor. Exactly the same fault came up recently on a couple of GEC monochrome sets fitted with the Series One chassis. There must be many thousands of such failures, yet we have seldom come across any significant value change in the anode load resistor or the lower, chassis connected resistor where the screen grid is fed by a potential divider. The latter of course is of much smaller value than the upper, h.t. connected resistor in the potential divider network, in order to get the low screen grid voltage required by a pentode sync separator. Anyway, whenever confronted by a case of weak field hold in a hybrid chassis, make a bee line for the sync separator's screen grid feed resistor.

Resistors which pass a constant drain current and are of high value are notorious for changing value in an upwards direction. Other examples are resistors feeding the field timebase charging circuit, and resistors in width stabilising circuits.

Erratic Brightness Variations

There was a good picture on a Bush monochrome set fitted with the RRI A774 chassis, but after half an hour's use the brightness level would vary erratically. This could be due to a voltage change at the first anode, grid or cathode of the c.r.t., so the first step was to check voltages to find out where the variation was occurring. It was found that the trouble was in the grid circuit, throwing suspicion on the brightness control network. The resistors and v.d.r. proved to be in order however, but on examining the circuit it was noted that two sets of pulses from the line output transformer are fed to the grid circuit (see Fig. 2). 3C51 and 3R71 apply negative-going pulses to the grid for line flyback blanking, while 3C9 feeds positive-going pulses to 3VDR2 which rectifies them to provide switch-off spot suppression. The capacitors were obvious suspects, and it was discovered that 3C9 had an intermittent leak.

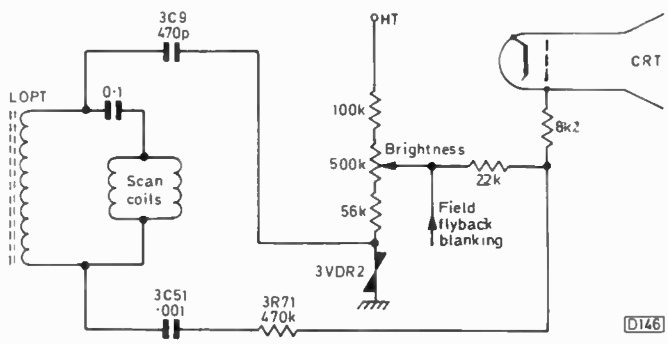


Fig. 2: Flyback blanking and switch-off spot suppression circuitry, Rank A774 monochrome chassis.

Odds and Ends

Les Lawry-Johns

QUITE often we come across slightly unusual faults during the servicing day (the nights are for sleeping these days, er, oh never mind). These snippets often go unrecorded, which is a pity because they could be of value to someone or other or could be of general interest.

No Picture, Buzz on Sound

When Mr Dumpling brought in his Philips 210 we thought it would be another faulty line output transformer or shorted boost capacitor.

"There's no picture. The sound is o.k. except for a buzz." And off he went with Mrs Dumpling to get some shopping.

Taking the rear cover off and switching on, our attention was directed to the right side line output section and, allowing time for the set to warm up, we inserted out trusty neon through one of the holes in the screening cover between the two valves and were mildly surprised to see it light up to proclaim an operative line output section. Peeping through we could also see the glow of the DY802 e.h.t. rectifier. This meant that full e.h.t. – barring accidents – was being applied to the tube's final anode.

We then looked at the end of the tube, before taking tube base voltages, expecting that the first anode voltage at pin 3 would turn out to be absent. We didn't get that far however because the tube heater wasn't glowing. Since the tube heater is the final one in the chain, this could mean only that there was a short to chassis before the heater current could reach the tube. The alternative would be that the tube vacuum was lost, but if this had been the case there would have been fireworks from the final anode etc., and since the e.h.t. appeared to be o.k. this was not the case.

Which heater preceded that of the tube? The PCL82 audio output valve's. Of course, hence the buzz or hum. Out PCL82: you stand accused of having a heater-cathode short and probably damaging your cathode electrolytic if not your bias resistor. How say you?

The PCL82 admitted full guilt, and was sentenced to be detained in the waste bin awaiting the pleasure of the refuse collector (dustman). A check upon its bias resistor and capacitor showed no damage, so all that was required was a new valve and on came the tube heater with a good picture and hum-free sound.

Lucky Mr Dumpling.

Gooey Capacitors

One thing about this place. We do have people coming in with lovely names. Like Mr Charge for example. Just close your eyes and you can see six hundred brave horsemen rushing into the valley of death. Guns to the right of 'em, guns to the left of 'em, on they charged to their doom and everlasting glory.

Mr Charge had the voice to go with it. Loud and incisive, no messing.

"I have a complaint to make," he boomed.

"Hallo Mr Charge" I greeted him, resisting the temptation to call his Dis. "Haven't seen you for a long time. Still rushing around I see."

"That set I bought from you, the damned thing's gone wrong."

My brows were just starting to knit together trying to think when we had sold him a set when his face broke into a smile.

"Fifteen years ago that was, my boy. Shouldn't have gone wrong as quick as that surely?"

It was true. Fifteen years ago we had sold him an Invicta 7007 as a second set. "We do apologise Mr Charge. Fancy it letting you down like that. Can't rely on anything, can you?"

Now the 7007 was one of the first dual-standard sets to emerge from the Pye group, being a Pye V700D in a white ivory plastic case. By and large these nice little sets have had their fair crop of troubles, mainly droppers, valves and the like, but this one had never required attention, probably due to only occasional use. Apparently Mr Charge now wanted to give it to a maiden aunt but found that on trying it out there was severe lack of height etc. The weak link on these sets, developing as the years go by, is leakage in the waxed paper capacitors, mainly in the field timebase. This could possibly be aggravated by their close proximity to the e.h.t. cap. Longer capacitors cannot be used as they would actually touch the cap. As it was, those fitted looked a sorry sight, the brown wax severely blackened, with spikes of goo sticking toward the e.h.t. cap.

In the event every one of the capacitors of this type, of which there are about seven in the field timebase, recorded leakage. They are not particularly easy to replace. Whilst this tedious job restored normal field scan, the sync was very poor, both field and line, leading us up to the top centre panel where the $0{\cdot}1\mu F$ sync coupler C89, of the same type, was also leaky. This cleared up the poor sync, but for good measure we checked up on other capacitors of the same construction. Every one showed leakage to some degree. It was well worth the effort however, as the tube was as good as new.

Tuning Troubles

We've had a fair number of the nice little ITT portables (VC300 chassis) in for service and few have caused us much heartache. One did however.

Normally the complaint is that the picture is distorted, with a severe hum bar, or that this develops after a short time. The bridge rectifier is usually responsible and replacement with a more reliable type presents little difficulty.

Some time ago however one came in with the complaint that the signals would be intermittently lost, leaving plenty of noise on the screen and sound.

It didn't take long to find that the tuning voltage (Mullard ELC1043 varicap tuner) at the 32V end of the $8{\cdot}2k\Omega$ supply resistor R3 (see Fig. 1) was varying, although the 90V end (derived from the line output stage) was steady. The resistor appeared to be o.k., so we suspected the zener IC1 of not zenering. This proved to be correct, a TAA550 sorting that one out. Upon inspection however the 12V mixer supply resistor R28A seemed to be in danger of coming apart, so this was replaced for good measure. On test the set behaved itself for a couple of hours. It was duly wrapped up therefore and later collected.

After a week it was back. "Same thing," he said.

We checked on what we had done but found no fault. On test the little fellow behaved faultlessly for hours on end.

Again it was collected, and we explained that we could not fault it. A week later, back it came. "Same thing," he said.

On test it worked all right for some time, then suddenly the picture became very grainy and faint and the sound hissy.

This was not the same at all. So we turned our attention to the main board, where the tuner lived (the tuner voltage selectors etc. are on a separate panel with the bridge rectifier, fuses etc.). The slightest touch on the panel in the vicinity of the tuner restored normal reception, and at first it appeared as though the aerial input cable to the tuner was at fault. Not so.

The voltages applied to the tuner were correct and remained so. We've known similar symptoms to be caused by faulty panel connections to the first i.f. stage: this avenue was explored since although the tuner was suspect the customer would probably not expect any further charge as he considered that the original fault was still present – and a new tuner would have to be chargeable. As the probing continued it became possible to bring on the fault condition almost at will, now by applying pressure to the tuner although this had not been the case earlier.

We removed the tuner from the panel and inspected it closely on the bench. This failed to show up any shorts, and the transistors read right. This time we fitted the tuner back minus its side panels and took voltage readings.

When the fault was present there was no voltage supply to the r.f. amplifier section of the tuner. The track which feeds this section runs along the top of the tuner panel from the mixer stage, where the voltage was present. Whilst there was no visible break in the track, a wire connected along its length restored permanent operation. Due to the proximity of the peripheral components, the tuner had to be removed once more to fit its side covers.

Mishetsfaulty

Deeply sun tanned, he carried the ITT CVC8 in as though it was a toy.

"Just got back from the Gulf and the telly's popped off. Can I pick it up later on?"

"Certainly Percy" we assured him. "Leave it a couple of hours and we'll have a quick shufti."

"KataKerrack mate," he thanked me. "Shufti inter bardine."

I didn't know then that when I did see him later he would be considerably the worse for wear.

The set itself was no trouble. Blown line timebase supply fuse due to a shorted 0·47μF 1kV boost capacitor. In they went and the set was as right as ninepence in no time at all.

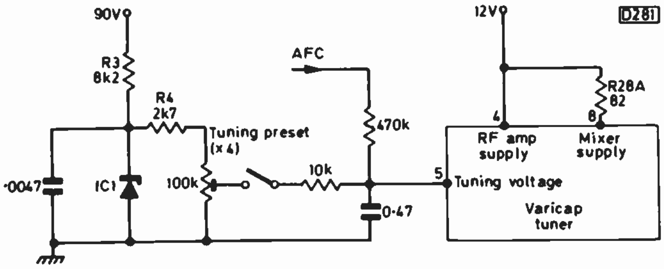


Fig. 1: Varicap tuner supplies, ITT VC300 chassis.

Which is more than we can say about Percy when he came back.

"Ish my shet ready?" he enquired boozily. "I've been up the club wish my mates. Haven't had a good drinkinmumfs. Goinbackther inaminit." He saw the worried look upon my face.

"I'm all right," he proclaimed. "I'll jush puththesetinthecar."

"I'll put it in for you and I'll drive you home" I said firmly.

He held up a large hand. "Stannaswire, my friend. I'm not drunk." Whereupon he picked up the set and staggered to the door.

"Don't worry about me mate" he bawled. "I'm as sure footed as a mountain goat."

Funny sort of goat. More like a beserk bear I would have said, as he fell on to one knee and the set went crash on its end.

"Oh dear, oh dear," mumbled Percy. "I've gone and dropped it."

So back on the bench went the set and Percy ambled off, promising to return later when he felt better.

When the set was tried it appeared to function all right except that the sync was lost. Bearing in mind the sudden blow it had been dealt, we concentrated on connections rather than components. Nothing appeared to be adrift between the large left side and smaller lower centre panels however.

Much time was lost until we tried a lead made up with a crocodile clip at each end, connecting one end to the main frame and the other to an earthy bit of the print around the centre of the lower centre panel. This restored normal working, so we then had to follow the tracks around, remaking anything suspicious and for good measure using the heavy Weller iron to remake the main frame tabs to the board. After this everything was straightened out and on test the set performed well until we helped a sober and subdued Percy to put it into his car.

Another ITT Hybrid

After this it was inevitable that the next set would be another ITT one of the same ilk (hybrid CVC5 variety).

In waltzed this pretty little thing, smallish with all the curves in the right places for a few short years, depending on the diet later. For now she was a picture. Lots of personality, bubbling over with fun and confidence.

"My boyfriend said you would take care of me" she bubbled coquettishly. "Our TV won't go and mum and I do depend on it when we haven't much on in the evening."

Senile decay dropped from me like a cloak falling from an unveiled statue, revealing the drooling wolf that lurks in all of us.

"I'll pop round to have a look at it, say ten or eleven this evening?"

She gurgled with laughter. "Isn't that nice of you. Actually it's in the car though. Gerald put it in before he went to work this morning."

This stumped me for a duck. She must have a very modern mother. I whipped over the pad. "Could I have the name, address and telephone number please," I asked. "For the records you know."

"The name is Take." "Mum and I live at 29 Spring Lane, but the 'phone hasn't been connected yet as we've only just moved in."

So I wrote on my job pad: Miss Take ITT.

I'll spare you the rest of the dialogue. Anyway, Gerald would collect it later. Off she trotted, taking her sparkling eyes, teeth and hair with her. Oh what it is to be young and sure that the world is your oyster.

So to the set. What a mess. Again no sync and the convergence was so far out that it didn't need a picture to tell you so. With the previous set in mind we checked the earthing on the lower centre panel etc. Nothing doing. It was evident however that this panel had suffered some damage in the past and had been patched up. Carefully checking around the sync separator section seemed to produce one or two things that didn't add up, so we removed the sync separator transistor to enable us to measure the associated components more accurately.

The transistor taken out should have been a BF117. It was a BC142, which has a much lower voltage rating, but was perfectly in order. With this out however we were able to measure the 3·3MΩ collector-to-base bias resistor which proved to be high. Replacing this and the BF117 restored some semblance of lock, although both the line and field timebases took time to settle down. To cure this necessitated a new PCL805 and PCF802, and we were then left with the severe misconvergence.

Viewing the three separate rasters with some trepidation, we first set the static magnets to get them somewhere near correct. In seconds the convergence was perfect all over, only the static needing adjustment. Lucky me. But why? I wonder if Percy knows Miss Take?

Pye 725/731 Chassis

Just for the record (again), the Pye 725 chassis seems to be showing its weaknesses. One or two are: the focus unit, which goes up in flames; the 0·1μF 1·25kV capacitor C563 across which the c.r.t. first anode supply is developed – it's above the line output transformer and behind the focus unit; and of course the inevitable mains filter capacitor (0·22μF, C915) which shatters the 3·15AT mains fuse. By the way, was it really necessary to insert the two screws which secure the front end of the line output transformer cover so tightly, and couldn't the cover have had the screws at the rear and the clips at the front, just to make things a bit easier? C563 goes short-circuit, overloading the line output stage with the result that the h.t. fuse F971 (1A) blows.

Letters

LACK OF HEIGHT

In *Your Problems Solved* in the July issue the problem of lack of height with the Thorn 1590/1/3 series of monochrome portables came up. I've had considerable experience of dealing with these sets, and have found that the usual cause of this condition in practice is either variation in the value of R86 which is in series with the height control, or the flyback diode W5 becoming leaky. – **P. F. Bardsley,** *Stalybridge, Cheshire.*

COMMON-EMITTER VARIANT

I've found the series on *Transistors in TV Circuits* very interesting but would like to query the account of the bootstrap arrangement in the field driver/class B output stage given in the June issue, where it's stated that both stages are common-emitter circuits. One of the properties of a common-emitter circuit is that there is a 180° phase reversal between the input and output. But in this case – see Fig. 1(a) – the a.c. voltages at the inputs (bases) of the complementary output transistors TR2/3 are in phase with the output which is taken from the emitters, with the collectors grounded, i.e. the circuit is an emitter-follower.

S. W. Amos goes on to say that if this were so "a very large voltage swing" would be required to drive the bases. Surely this is in fact the case, since bootstrapping the driver's collector load (R1) means that the a.c. voltage at the top of this resistor is in phase with that at its lower end so that the driver "sees" a much higher load impedance than the actual resistor value, thus allowing a large voltage gain to be obtained.

The two output transistors then match this high impedance to the low impedance of the scan coils, providing current gain with negligible voltage loss, which of course is one of the advantages of using an emitter-follower.

The output transistors could in fact be considered to be voltage driven. If they were mainly current driven as suggested, the bias resistor R3/4 might need to be bypassed to a.c. since there would otherwise be a considerable voltage drop across it due to the potential-divider effect of the resistor itself and the input impedance of the upper, npn transistor in parallel with the load resistor. The high input impedance of an emitter-follower plus the apparently high value of the driver's collector load resistor means that this voltage is negligible however so that a bypass capacitor is unnecessary. – **R. Wallace,** *Teignmouth, Devon.*

S. W. Amos comments: R. Wallace is correct in saying that the input and output signals of a common-emitter amplifier are in antiphase – but only when the output is taken from the collector circuit as shown in Fig. 1(b). If the output is taken from the emitter circuit as in Fig. 1(a) and (c) the output signal is in phase with the input signal. Fig. 1(c) is probably a better way of showing a common-emitter circuit than the usual way – Fig. 1(b) – because it's so clear that the emitter terminal is common to the input and output circuits. Perhaps my explanation of the circuit's behaviour would have been clearer had I said "if TR2 and TR3 were emitter-followers their high input resistance would have made it difficult for TR1 to drive adequate current into them. In fact the voltage drop across R1 would probably have equalled the supply voltage before full output was obtained from the amplifier. But by making TR2 and TR3 into common-emitter stages their input resistance is reduced to a value at which TR1 can supply the input current with ease and the voltage developed across R1 and the input of TR2 and TR3 would be only a fraction of the supply voltage even when the amplifier is delivering maximum output."

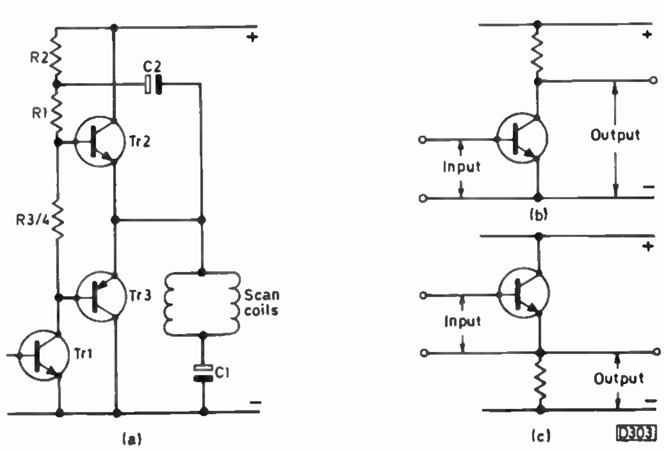


Fig. 1: Common-emitter or emitter-follower circuit?

I agree that the bootstrapping makes R1 effectively larger than its physical value. Indeed this is another way of putting what I've just said – because of this increase in the value of R1, TR1 needs to supply a smaller current than if TR2 and TR3 were emitter-followers.

Since TR2 and TR3 are common-emitter stages, R. Wallace is probably right in suggesting that there might be some advantage in bypassing R3/4.

SMALL PICTURE AND SOOTY SMELL

As a freelance TV technician I was recently called to see a Decca colour set fitted with the series 10 hybrid chassis. The complaint was a small picture and a sooty smell. On entering the house the sooty smell was immediately obvious, and on removing the back of the set the first thing that struck the eye was one of the old finned selenium metal rectifiers, bolted to the shielding behind the line output valve! There was a lead running from this to the posistor in the degaussing circuit, and another down to the field output transformer – the ends bared and wrapped around the tags!

My first inclination was to replace the back cover and bow quietly out, but curiosity got the better of me. So I switched on. The set came on all right, but the picture was a small, misconverged pulsating blob, a frying bacon sound coming from the metal rectifier. Between two of the rectifier's vanes a small twinkling glow could be seen. This was obviously the sooty smell generator!

I switched off and dismantled this stick-on bodge-up, advising the customer to remove it to the dustbin promptly. The 2A mains fuse had blown, but several turns of about 22 gauge wire had been wrapped around it to keep things going. This was removed and the correct fuse fitted. Switch on again and I found that the 3·9Ω surge limiter resistor was open-circuit. It now started to dawn on me what the metal rectifier had been there for. A new surge limiter resistor produced a badly misconverged picture with severe lack of width and striations. Replacing R450 and R452 in the width circuit and R487 across the line linearity coil – all had gone open-circuit – plus convergence and one or two other adjustments produced a reasonable picture, though the tube was obviously slightly low.

I was still curious about that metal rectifier however, so I asked the customer who'd put it there. It transpired that the chap was a furniture salesman who had taken the set away, presumably when the surge limiter had gone open-circuit. He'd had the set for about two weeks, but had brought it back working. Evidently, confronted with a dead set and an a.c. source, he'd decided to rectify it and feed it into the h.t. supply via the field output transformer! Quite a stroke of genius really for someone who'd obviously no idea about the workings of a colour set but a fair knowledge, somewhat outdated, of basic electronics! – **G. J. Rogerson,** *Eva Avenue, York.*

TV SERVICING: WHAT IT TAKES!

I'd like to comment on R. Morris's letter in the July issue – as a TV engineer with thirteen years' experience "on the road" and a further year in the workshop. With a B.Sc. in physics, R. Morris is clearly no fool. But to go it alone in this trade after a year's full time tuition makes him a brave man indeed! He must not expect to know all the answers though – no one does! Otherwise, I feel that his comments summarise the general situation. The telly-man in fact is one of a strange breed – and a scruffy one at that due to all that kneeling behind huge CTVs! An ex-REME engineer friend of mine used to say that a TV man needs the driving ability of Stirling Moss, the brain of Einstein, the strength of Charles Atlas and the patience of Job!

In the City and Guilds practical (course 48) one had to find four faults, given 20 minutes each including writing the report. That sorted the men out! I went as far as the City and Guilds colour endorsement, passed with a credit and then called it a day. I find the setmakers' short courses of particular help – you learn the stock faults before you start. This saves time: forewarned is forearmed!

Finally, thanks for a great magazine – Les Lawry-Johns is my hero, Oven Dawe and all! – **Kenneth Wells,** *Liverpool, Merseyside.*

PROJECTORS – AND THE INDESIT BACK

Chas. E. Miller always gives some useful tips on servicing procedures. But, Charlie boy, I think your memory's playing tricks when it comes to your recollections of cinema projection!

One does not erect a projection booth for 16mm film shows, since 16mm film is non-flammable. Projection booths – cumbersome metal structures – had to be erected for 35mm shows only. Two projectors were used in these boxes in order to give a continuous performance, with the maximum film on each projector not to exceed 16 minutes' playing time.

I know of no 16mm projector having valves near the lacing up section, though I believe Bell and Howells had a sound exciter lamp in the area of the sound gate. If such a projector did exist however and the film got laced around it the film would buckle from the heat and would not transport via the sprockets.

35mm Gaumonts were designed to prevent the possibility of fire hazard, even when handled by inexperienced operators.

Finally, those Indesit back covers. Simple: lay the receiver face down, place the back in position with the top holes just below the clips, and give the bottom of the back (lower edge) a hefty blow with the heel of your hand. The clips will then spring into place.

Keep up the good work, and regards to Les. – **W. Harvey,** *London NW2.*

PHILIPS G8 CHASSIS FAULT

With reference to Andy Denham's mention of one of the TBA530 output stage external 39kΩ load resistors going open-circuit (Philips G8 chassis), my experience has been that these don't usually go open-circuit at the drop of a hat. They tend to increase in value. So I feel that either the resistor had become disconnected from the printed circuit or that the customer had put up with a poor picture for some time.

The usual picture fault caused by these resistors (R7326/7346/7363) could be mistaken for an intermittent convergence error. It will be observed on fine detail highlights, and is initially more noticeable on monochrome than colour.

If R7326 (red channel) becomes faulty for example, the white highlights of the fine detail will no longer be resolved and become cyan in colour. If test card F can be observed and the blue and green guns are switched off, it will be seen that the 5·25MHz frequency grating on the red raster is not being resolved. This will extend into the 4·5MHz grating, and as R7326 increases in value will also be apparent on the vertical lines of the white background squares. – **A. M. Sheppard,** *Winch Wen, Swansea.*

UHF Reception Problems

Roger Bunney

DURING the long period I've been writing the monthly *Long-Distance Television* column I've received a steady trickle of letters asking for advice on various TV reception problems. The requests fall into three basic categories. First, attempts to receive programmes at extreme distances, in particular those in southern Eire wanting to receive UK mainland transmitters. The distances involved may be 100 miles or so, i.e. very deep fringe area reception. Secondly many people want to receive a second ITV channel. And finally there are those within the accepted service area suffering from ghosting effects and other local difficulties.

Where possible TV transmitters are built on high ground, with high masts to give maximum signal coverage. At u.h.f. the signal coverage extends basically from the transmitting array to the optical horizon, with a slight extension due to tropospheric diffraction. Good reception should be obtained at most locations within the optical horizon, exceptions being shadow areas, valleys etc. The farther the distance from the transmitter, so the signal strength (field strength as it's called) falls, the field strength at a given location also being dependent on frequency and transmitter power. The formulae at the end of the article enable the field strength at a given distance to be calculated.

The field strength drops to a quarter when the distance from the transmitter, within the radio horizon, is doubled. So the farther you are from the transmitter, the greater the gain required from the receiving aerial. For colour reception the signal level delivered to the set should be 700μV minimum: a monochrome receiver however will resolve quite acceptable pictures at signal levels down to 200μV. Below these signal levels, noise becomes apparent.

The use of low-noise u.h.f. tuners allows a margin below these figures, but with the old valved (PC86/PC88) u.h.f. tuners the above figures were the absolute minimum. Quite remarkable improvements could be made in the overall signal/noise performance of the receiving system when a masthead amplifier was used in a difficult area ahead of a valved tuner. In a modern receiver however it's not unknown for a masthead amplifier to provide little or no improvement, since the signal/noise performance of the tuner is better than that of the external amplifier. Indeed with modern sets it's best to use such amplifiers simply to overcome signal loss due to a long cable run.

Fringe Reception

In considering extreme fringe reception it must first be appreciated that the transmitting and receiving sites are far beyond the accepted distances for regular reception, i.e. for entertainment quality pictures to be received all the time. At such distances the signal will be subject to tropospheric (weather) changes, and although a signal of sorts will be present most of the time it will be there due to tropospheric scattering. The phenomenon of tropospheric scattering depends on tropospheric irregularities which reflect and scatter incident signals, giving trans-horizon reception, though very weak. To exploit this mode of signal propagation successfully very high-gain receiving systems are essential. Very elaborate arrays are in use professionally.

Signals in deep fringe areas can rise at times to relatively high levels, due to tropospheric enhancement, for example during a settled anticyclonic weather system, fog, etc. Unfortunately the UK's weather pattern is not settled, so we must plan on the basis of the worst signal levels.

A very high-gain aerial system and matching low-noise amplifier are essential. A quadruple stacked aerial system such as the Jaybeam 4MBM88 must be regarded as the minimum, feeding a masthead amplifier with high gain and very low noise. The aerial system should be for the appropriate channel group of course, and mounted on as high a mast as possible. It's not unknown for lattice masts to reach 100ft, even for individual domestic installations, in parts of southern Eire.

There comes a point however where the cost per foot of height is not matched by a corresponding improvement in delivered signal strength. At this point an improvement will be obtained by doubling the aerial system, i.e. with two systems mounted one above the other and phased/matched into the masthead amplifier before connection to the main cable. There are advantages with vertical rather than horizontal stacking. Over a long signal path there can be considerable fluctuations of signal strength with height – the effect can be quite dramatic, particularly over a sea path. Vertical stacking tends to smooth out such fluctuations.

Incidentally, I recall an experiment Ian Beckett carried out at Buckingham some years ago whilst monitoring the signals from Lille, northern France, on ch. E21 at a distance of 120 miles. The aerial was progressively lifted from 30 to 60ft, but far from gradually increasing with height the signal actually passed through several points where it fell to virtually zero, whilst at 60ft it was not much better than at 30ft.

The point at which to stop increasing the height and use stacked systems instead is difficult to define. It depends on the local and medium-distance terrain, and on how exposed the site is (extra guying and deeper foundations may be required). Reports from southern Eire suggest that an aerial height in the region of 60ft generally gives acceptable results when used with quadruple stacked arrays and both masthead and setback amplifiers. One hundred foot masts have been used, and in one case a 200ft mast was constructed using 32 stacked Wolsey Colour Kings!

Receiving Extra Channels

Many of the points already made are relevant to the second type of problem – obtaining regular reception of a fourth channel. An additional factor however is the increased possibility of co-channel or adjacent-channel interference.

A glance at the transmitter list issued by the IBA will indicate possible alternative transmitters in adjoining programme areas. In some cases only one alternative transmitter will be possible, but there are places where two or more may be received, for example in a fringe area or on very high ground.

In the case of a single alternative transmitter, assuming that the receiving site is suitable, i.e. no obstructions in the required direction, and that the alternative transmitter uses a different channel group, go for a high-gain aerial and masthead amplification (particularly if a long cable run is necessary). Run the feeder individually, i.e. don't use diplexing, with a two-position aerial selector switch. Feed the power to the amplifier via the cable.

Problems arise when the distant transmitter uses the same channel group as the local one. One then has to devise a system which will receive a relatively weak signal on one particular channel while minimising pickup of strong adjacent-channel signals. This is difficult since the aerial will have a relatively level response over the channel group – as indeed will the amplifier if it's designed for the same channel group.

If the wanted signal comes from the opposite direction to the unwanted ones an aerial system with a high front/back ratio can be used. Single in-line multiple-director director Yagi arrays with a front/back ratio in excess of 30dB are available. Stacking two arrays horizontally will improve the front/back ratio by some 5dB, while improving the forward gain by 3dB. An added bonus is the reduction in the aerial system's forward acceptance angle, of up to half at the −3dB points. Additional screening could be introduced at the rear of the aerial system, but care is necessary with respect to both the mechanical stability of the aerial and its electrical properties. It would be wise to mount such an earthed screen some feet behind the aerial to minimise undesirable changes in the aerial's performance. A front/back ratio of 30dB should be achieved in a domestic installation without the need for such screening, which should be adopted only if all else fails. For mechanical stability, extra screening implies the use of a lattice mast.

Rear pickup can be considerably reduced by using the Jaybeam "infinite front/back ratio" system (see Fig. 1). This has two similar arrays stacked vertically, but with the upper one mounted a quarter wavelength in front of the lower one. The phasing harness must then have an additional quarter wavelength in the feeder connected to the upper array. Signals arriving from the front then still combine in phase at the junction, whereas signals from the rear arrive at the junction phase shifted by 180°, thus cancelling.

When the unwanted signal arrives from the side of the array, the spacing of two horizontally stacked arrays can be varied to obtain a rejection null in that particular direction. More about this later in connection with ghosting.

Problems may arise with the masthead amplifier, particularly with strong local signals which may cause overloading effects on the weaker signal. The overloading (cross-modulation) may be so severe that one of the local transmissions is transferred on to the weaker signal, producing a floating picture or break up of the signal by the stronger sound channel. If this problem arises, the amplifier will have to be mounted adjacent to the receiver, preceeded by a filtering system (see Fig. 2). The filter shown will give a rejection figure of 15dB on adjacent channels whilst adding a relatively low insertion loss of 2dB on the required channel. Further improvement can be obtained by using a narrow band amplifier with a tuned line instead of a wideband amplifier (see Fig. 3). Other suitable circuits have appeared in this magazine from time to time.

An alternative approach is to modify a standard four-gang u.h.f. tuner (see *Television* March 1975). Varicap tuners should be avoided because of the inherently low Q of their tuned circuits.

The more enthusiastic may feel inclined to experiment with the receiver's i.f. bandpass characteristics. I suggest using an additional i.f. board at the tuner's i.f. output rather than trying to adjust the alignment of the existing i.f. strip

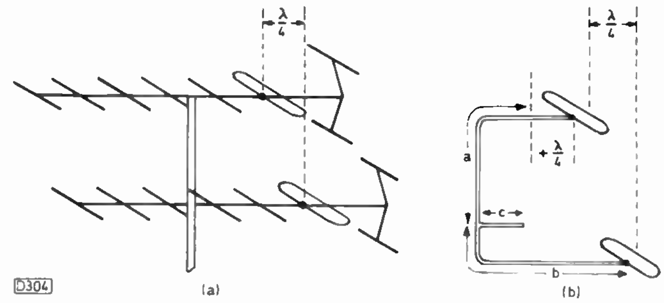


Fig. 1: Jaybeam's infinite front/back ratio system: the upper array is mounted a quarter wave forward. Normal stacking harness dimensions: a and b, equal lengths of 75Ω coaxial cable; c a quarter-wave matching section of 50Ω coaxial cable. The electrical quarter-wave length is found by multiplying the free space quarter-wave length by the velocity factor of the cable (usually approximately 0·8). The 75Ω coaxial downlead is connected to the output from the matching section c.

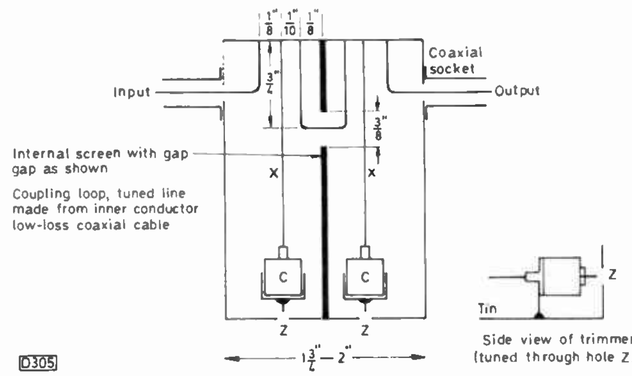


Fig. 2: A u.h.f. bandpass filter. C is a 2-10pF concentric trimmer; x is 2in. for Band IV, 1¼in. for Band V. For the case, use a tobacco tin or something similar.

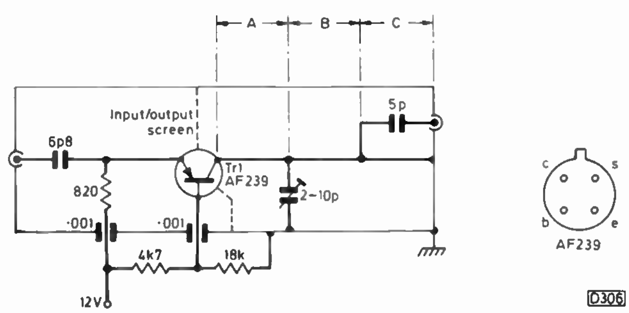


Fig. 3: An inexpensive u.h.f. preamplifier which could be incorporated within the bandpass filter case if there's enough room. The tuned line A/B/C consists of the inner conductor of low-loss coaxial cable. For Band IV A and B are 0·8in. and C 0·4in.; for Band V A and B are 0·6in, C 0·3in.

which, presumably, is giving good results on the local channels. One way to do this is to use a surplus vision selectivity module from the Philips G8 chassis: the module can be switched into circuit for reception of the distant signal and out of circuit for the local signals. It's wise not to restrict the i.f. bandwidth on local reception, particularly with colour transmissions since reduced burst amplitude could well affect the colour in various ways. Monochrome reception allows greater flexibility. This approach is something of a compromise however and experiment and observation will be required to see what can be achieved. The G8 module will give improved adjacent-channel rejection if appropriately aligned, and with no insertion loss or noise degradation on the wanted signal.

Table 1 : Decibel/microvolt conversion.

dB	μV	dB	μV
1	1.12	21	11.2
2	1.26	22	12.6
3	1.41	23	14.1
4	1.59	24	15.9
5	1.78	25	17.8
6	2	26	20
7	2.24	27	22.4
8	2.51	28	25.1
9	2.82	29	28.2
10	3.16	30	31.6
11	3.55	31	35.5
12	3.98	32	39.8
13	4.47	33	44.7
14	5.01	34	50.1
15	5.62	35	56.2
16	6.31	36	63.1
17	7.08	37	70.8
18	7.94	38	79.4
19	8.91	39	89.1
20	10	40	100

Note: 0dB = 1μV across 75Ω.

Table 2 : Stacked Yagi spacing for ghost elimination.

Degrees from transmitter bearing	Spacing in wavelengths	Degrees from transmitter bearing	Spacing in wavelengths
5	5.7	50	0.654
10	2.88	55	0.61
15	1.97	60	0.578
20	1.54	65	0.553
25	1.18	70	0.533
30	1.0	75	0.518
35	0.874	80	0.508
40	0.78	85	0.501
45	0.71	90	0.5

$$\text{Wavelength (m)} = \frac{300}{\text{frequency (MHz)}}$$

Mount the higher-gain aerial above the local one and use separate cable runs – the best low-loss type must be used for the high-gain system.

In a fringe area you may find that a number of signals are available at usable signal strengths. One can either erect fixed arrays for each transmitter required (with selection of the appropriate aerial via switching at the receiver) or use a wideband array with an aerial rotator. In the former case it's cheaper to use a single indoor amplifier after the selection switch. High-gain aerials will then be required, particularly to compensate for the cable loss. With a wideband aerial on a rotator a low-noise, wideband masthead amplifier should be used: such amplifiers are available with extremely low cross-modulation, gains in the region of 20dB, and noise figures quoted at under 3dB. Both Antiference and Wolsey have excellent wideband aerials (the XG range and the Colour King respectively) while the Jaybeam range can be exploited for group E operation (chs. 39-68).

Service Area Problems

Within normal service areas there are many locations where difficulty is experienced in getting a satisfactory television signal. The main problems are screening, e.g. from tall buildings or in valley locations, and varying degrees of ghosting from the annoying to the impossible.

Many of the remarks already made apply to screened locations, but with modifications to suit particular problems.

A recent example concerned a reader whose cottage was on the steep valley floor of a north Cornish village. The local u.h.f. transmitter was only a few miles away, but the screening effect of the valley resulted in a very weak signal. The "open end" of the valley faced the north Atlantic, so no other alternative transmitter was available. Of the three local channels, one was received "with snow" while the other two were at noise level and thus unusable. An eight-element array was in use, with a masthead amplifier. Whilst general advice can be given in such a situation, it's important to realise that in practice some experimentation will be necessary in order to obtain adequate signal strength.

The situation is shown in Fig. 4. The signal present at the bottom of the valley will arrive mainly through edge diffraction at the valley rim. As a result, the signal strength will fluctuate considerably throughout the valley, undoubtedly accounting for the wide variation in signal level between the three channels at a given location. It was obvious that higher gain plus vertical stacking was required. Rear-mounting aerials are easier to install, and two high-gain multiple-director assemblies on a suitable mast mounted one above the other, spaced at least two wavelengths apart and coupled to the masthead amplifier via a conventional matching/phasing harness, were recommended. Signal pickup would be maximised by inclining the arrays at an angle corresponding to the valley rim.

An alternative approach would be to use two Wolsey Colour Kings (a wideband u.h.f. array consisting of four stacked dipoles assembled and stacked vertically), thus achieving a very good capture area. The ultimate would be to use four such stacked arrays.

The physical stability of the mast is important in such a situation, since the wind funnelling action of the valley, especially in winter, could produce violent aerial movement and picture flutter. The mast height depends on the position in the valley, a greater height being necessary on the shadow side. On the other side, a high mast could raise the aerial into a lower level of scattered signal field.

Ghosting, the reception of one or more reflected signals in addition to the wanted, direct one, can be a difficult problem. The ghost appears as a second image to the right of the wanted one, and in some cases the reflected signal can be stronger than the direct one, e.g. where the direct path is obstructed. The distance between the main and secondary images on the screen is a measure of the extra path length travelled by the reflected signal, but this depends on screen size of course and on whether the reflection comes from the side or from behind. In many cases the cause of the reflection will be visible, but particular difficulties can arise with the rise and fall of large gasometers and with moving crane jibs.

Once the cause of the reflection(s) is known, remedial action can be taken. If the primary signal is very strong the least expensive and simplest solution is to use a log-periodic aerial. This type of aerial possesses an extremely clean polar response, with absence of the minor side lobes associated with conventional Yagi aerials. The idea is to orientate the array to discriminate against the unwanted signal.

Unfortunately there are occasions where the signal is of marginal strength (the gain of a log-periodic aerial is comparatively low) or where the two signals arrive at such a

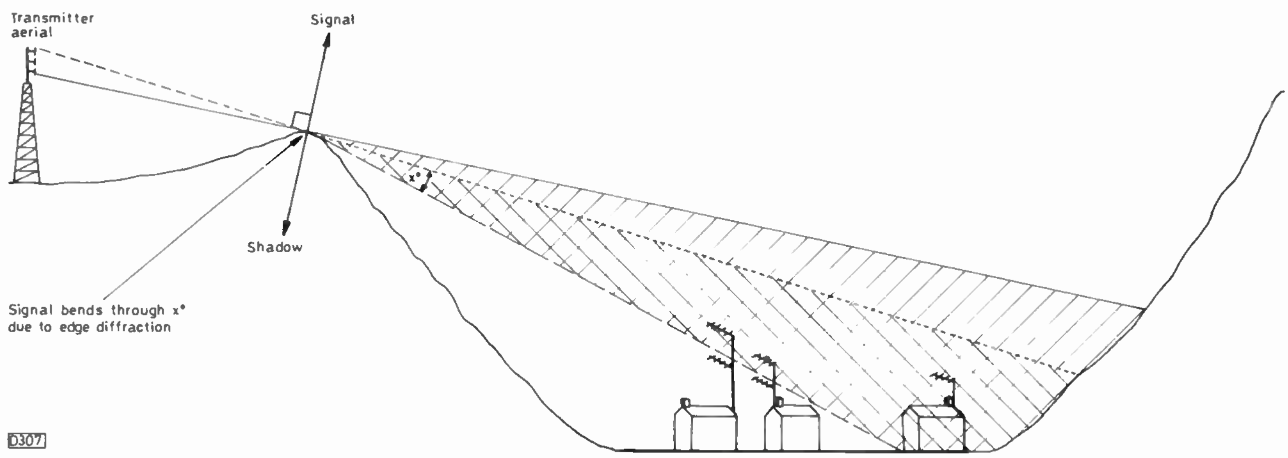


Fig. 4: Signal propagation in a valley location by edge diffraction – not to scale!

narrow angle that such discrimination is not possible. It's possible to use two Yagi arrays stacked horizontally however, adjusting the assembly to minimise reflected signal pickup. The spacing of the two arrays requires adjustment: the idea is that the wanted signals picked up by the two aerials should add, whilst the unwanted signals should be 180° out of phase so that they cancel. Table 2 indicates the spacing required for ghosts at various angles from the transmitter. This table is based on the use of aerials with single director elements: multiply the spacing by three or five if multidirector aerials are used (this is because of the inherently higher gain and correspondingly larger capture area of the latter).

Another problem that can arise is signal reflection from water. We've already mentioned long-haul reception (UK–Eire), but there are times when lesser expanses of water and higher signal levels result in unusual effects, particularly at sites near the water. Reflection can occur from the surface of the sea when it's smooth, with scattered reflections when it's rough. This can be further exaggerated by tidal variations, the effects being apparent only at certain times, such as high tide. The signal reflections can cause phase reversal, partial cancellation of the main signal and other undesirable effects.

As with ghosts, we want to differentiate between the direct and reflected signals – but here they're both coming from the same direction! What's required is to reduce the aerial system's vertical acceptance angle. As we've already seen, this can be done by vertical aerial stacking. Two stacked bowtie (Wolsey Colour King) systems could be used. It may be helpful to have an upward tilt of say 10° – 15° relative to the horizontal, provided this does not adversely affect reception of the wanted direct signal.

Scattering often occurs when the signal path lies through trees. The problem can be greater when the foliage is wet, and is often seasonal. We require both high-gain and a wide capture area, a vertical stacked system suggesting itself – once again the Wolsey Colour Kings seem suitable.

One of the most trying situations is where reception difficulties are experienced close to a transmitter. This can occur particularly where the terrain is hilly. The transmitter, particularly if it's a high-power type, will be built atop the tallest hill, but obtaining good reception in the valley directly beneath will often be a considerable problem. I can recall visiting the village of Chillerton in the valley below the Chillerton Down transmitter on the Isle of Wight. Though the transmitting mast towered above the village, all manner of high-gain Band III aerial systems were being used in an effort to obtain satisfactory reception – even double-elevens were to be seen. The problem here is not too little signal but too much – both in terms of strength and numbers. The problem will be even worse if the receiving location is screened from the transmitter by a hill or rising ground. Due to the extremely high field strength there will then be both reflected signals and direct signals diffracted over the hilltop. Because of the extremely short distances involved and the possibilities of multiple echoes, the ghost images will tend to produce smearing and ringing, with the result that the picture may be unviewable.

Single in-line Yagis will rarely give satisfactory results in such situations, and thought must be given to stacked systems ranging from the conventional to the improbable (try stacked log-periodics). If all else fails, it may be possible to receive the signals from a more distant transmitter, suffering the irony of receiving an inferior signal when living perhaps a mile or so from the local transmitter.

Field Strength

The field strength within line of sight distance is given by:

$$E\,(mV/m) = 88 \sqrt{W \frac{Ht\,Hr}{L\,D^2}}$$

where W is the radiated power in watts, Ht the height of the transmitting array in metres, Hr the height of the receiving array in metres, D the distance between the transmitter and the receiver arrays in metres, and L the wavelength in metres, a dipole radiator being used. When the transmitter power is given in e.r.p. the formula becomes:

$$E\,(mV/m) = 2{\cdot}85 \sqrt{W \frac{Ht\,Hr}{L\,D^2}}$$

Acknowledgements and Addresses

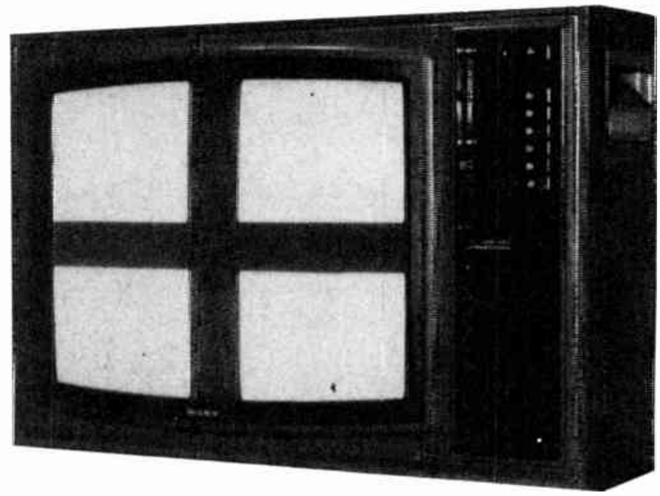
Our thanks to Jaybeam Aerials Ltd., Antiference Ltd., Rediffusion Engineering Ltd. and Wolsey Electronics for their assistance.

Addresses: Jaybeam Aerials Ltd., Moulton Park Industrial Estate, Northampton NN3 1QQ. Antiference Ltd., Bicester Road, Aylesbury, Bucks HP19 3BJ. Wolsey Electronics, Cymmer Road, Porth, Rhondda, Glamorgan CF39 9BT. Labgear Ltd., Abbey Walk, Cambridge CB1 2RQ.

A u.h.f. bandpass filter is available from Teleng Ltd., Arisdale Avenue, South Ockendon, Essex. Known as type 358, it's fitted with standard coaxial sockets, has an insertion loss of 2·5dB and adjacent channel rejection reaching 20dB. ■

Cruciform Pattern Generator

Malcolm Burrell



Off-screen photograph of the cruciform pattern.

MOST sync pulse generators provide line drive, field drive, mixed sync and blanking pulse outputs. As their names imply, the first two drive or provide individual pulse trains to keep timebases, oscillators or counters in picture sources in step with the sync pulses.

Mixed Syncs

The mixed sync pulses are normally added at the final stage of processing the vision information. Being negative-going with respect to the video signal, the receiver or monitor can extract them and use them to keep its own timebases in step with the picture source.

Blanking Pulses

The blanking pulses are used to reduce the edges of the picture to black level before and after the sync pulses – putting a frame around the picture in effect. As a result, the sync and vision signals start at the same level at the beginning of each line. The video, blanking and sync periods are shown in Fig. 1. The rather long interval following the sync pulse, called the back porch, enables the scanning circuits to complete the flyback without producing any illumination on the screen to spoil the picture.

★ Components List

Resistors:
- R1 5·6k
- R2 27k
- R3 18k
- R4 5·6k
- R5 6·8k
- R6 8·2k
- R7 5·6k
- R8 390
- R9 120
- R10 390
- R11 5·6k
- All ¼W 5%

Capacitors:
- C1 10 16V tantalum bead
- C2 0·47 polyester
- C3 0·22 polyester
- C4 10 16V tantalum bead
- C5 0·0047 ceramic plate
- C6 0·001 ceramic plate
- C7 10 16V tantalum bead
- C8 10 16V tantalum bead
- C9 500 16V electrolytic
- C10 100 16V electrolytic

Integrated circuits:
- IC1-4 74121
- IC5-6 7400
- IC7 7805

Miscellaneous:
- D1 BY127
- T1 8V bell transformer
- F1 1A anti-surge

Cruciform Signal

If you've just built a sync pulse generator – several designs have appeared in *Television,* for example in the May 1977 and June 1978 issues – and grown tired of staring at a blank raster, the next challenge is to build a picture source. A suitable start is a cruciform pattern, which is easy to produce and can be done cheaply. The pattern takes the form of a simple black cross on a white background, and was once a familiar sight on our screens, known by some in the BBC as "art bars".

The dark areas form a check on the l.f. response of the system, while the h.f. response can be judged by the transition from white to black and vice versa. When transmitted by a licensed amateur, the pattern has the advantage that it can be easily identified through noise.

Circuit Description

The cruciform generator circuit is shown in Fig. 2. The field drive signal is *RC* coupled to trigger the monostable multivibrator i.c. IC1, whose time-constant is set by R2 and C2 to provide a pulse which ends short of half the field scan period – see Fig. 4(a). This output pulse in turn triggers IC2, which produces a shorter pulse to provide the horizontal bar of the pattern.

In a similar manner the line drive pulses trigger IC3, which provides the vertical spacing pulse on the left-hand

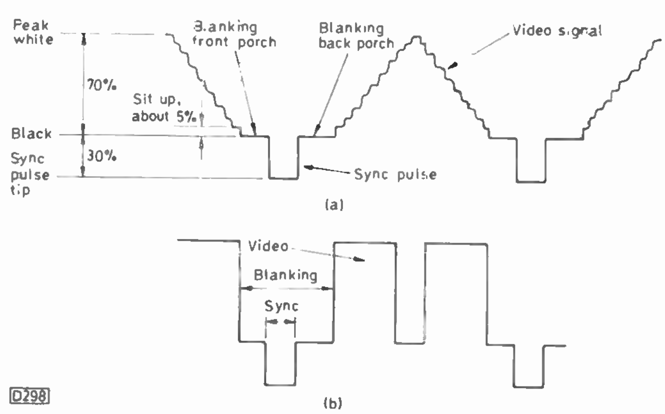


Fig. 1: (a) Broadcast vision signal waveform; (b) simplified cruciform video waveform.

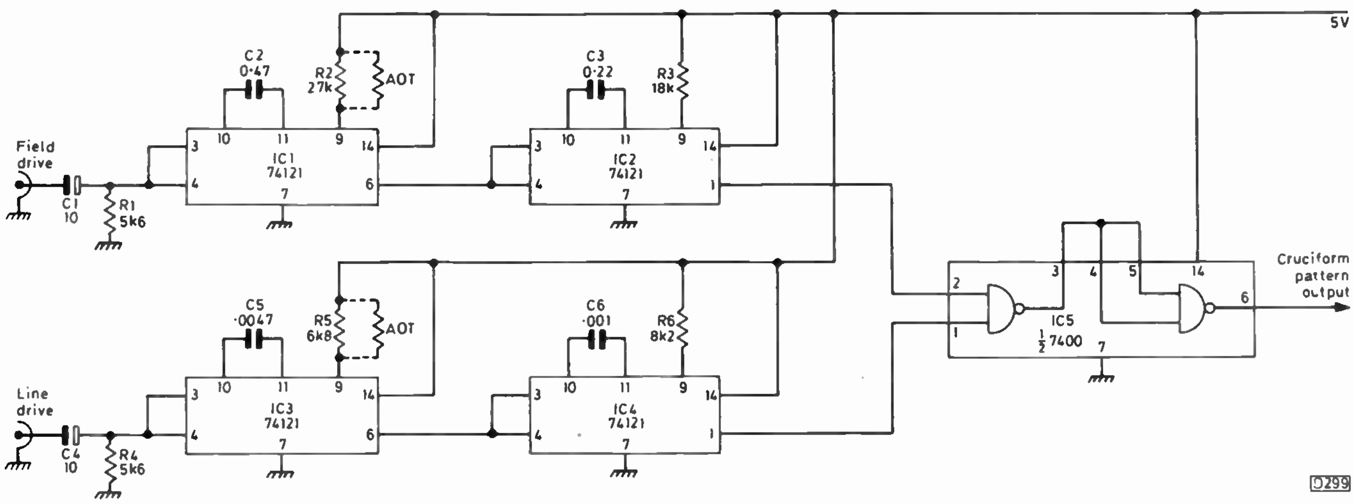


Fig. 2: Cruciform pattern generator circuit.

side while IC4 provides the vertical bar signal – see Fig. 4(b).

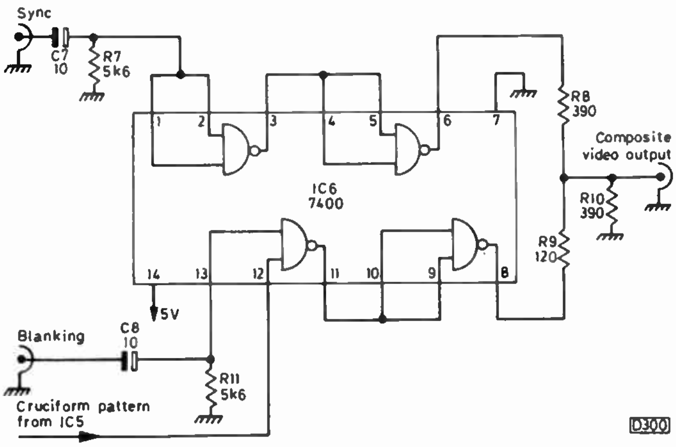


Fig. 3: Simple video processing amplifier.

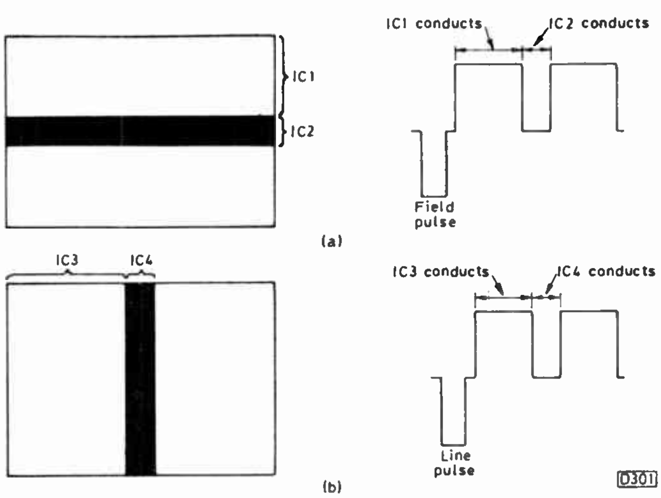


Fig. 4: How the cruciform pattern is built up.

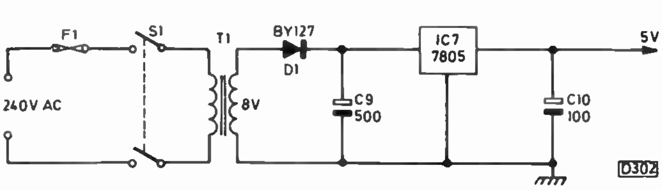


Fig. 5: Suitable power supply circuit.

Should component tolerances make it necessary, R2 and R5 can be shunted by higher value resistors to centre the patterns within the raster.

The positive-going outputs from IC2 and IC4 are added together in one of the NAND gates in IC5 and are then inverted in a second gate.

To be of practical use sync and blanking pulses must be added to the signal. The simple circuit shown in Fig. 3 can be used for this purpose – a few more gates. The circuit works effectively for black-and-white images, but not where there are intermediate tones, though a variation on it was used in the simple test card generator featured in the May 1978 *Television*. Note also that whilst in a professionally produced waveform the black level sits a little above the blanking level, see Fig. 1(a), this is not the case with our simplified system. This is not of practical importance however.

The circuit can be built up in a couple of hours or so. It requires a stabilised 5V rail which can be provided by the circuit shown in Fig. 5. Since the current consumption is low, an 8V bell transformer can be used to power the 7805 regulator i.c.

Operation

The output can be used as a video signal to drive a monitor, or can be fed to a domestic TV receiver via an r.f. modulator to provide a u.h.f. signal. A way of doing this was shown in the diagnostic pattern generator design published last month. If you don't have line or field drive signals, just sync and blanking pulse trains, or if you wish to rationalise the external connections, the approach used in the diagnostic pattern generator can be adopted. ■

WORKSHOP SAFETY

An area in which there's been a lot of confusion is workshop safety – Robin Smith in a recent issue raised some questions to which there don't seem to be any ready answers. So it's good news that the Radio, Electrical and Television Retailers' Association (RETRA) has in preparation a code of practice on workshop safety. The code is being prepared in conjunction with the electrical branch of HMS Factory Inspectorate, and will describe workshop supply and protection systems, layout and safe working procedures to comply with the various acts in force.

Servicing the Thorn 3000/3500 Colour Chassis

Andy Denham

THORN was the only UK setmaker that never produced a hybrid colour chassis. Their initial dual-standard colour chassis was the 2000, which was superseded by the single-standard 3000 in 1969. The 3500 has modified convergence circuitry and pincushion distortion correction and is used in sets fitted with the larger c.r.t. sizes. A feature of all these chassis is the use of high-current, low-voltage line output transistors – two in the 2000 chassis and early versions of the 3000, a single R2008B in the 3500 and later versions of the 3000. As a result, a relatively low-voltage, stabilised h.t. supply is required. In the 3000/3500 chassis it's 58-65V, and the problem is how to obtain this without a lot of wasteful dissipation. The solution adopted in the 3000/3500 chassis is the use of a switch-mode power supply, of which more later. In addition, there's a 240V rail for the RGB output stages, and stabilised 30V and 12V rails. The switch-mode power supply incorporates overvoltage and excess current protection.

The entire line scan and e.h.t. current pass through a wirewound 1·5Ω resistor (R907) on the beam limiter board, the voltage across this component being used as the limiting reference voltage. The field timebase is unconventional for its year, the output stage consisting of a single BD116 transistor operating under class A conditions with an autotransformer as its collector load. It's driven by a BC116A emitter-follower stage. Both the field and sound output stages are powered from the 58-65V rail. The sound output stage consists of a class B pair of transistors (BC142/BC143) which drive an 80Ω loudspeaker.

Signal Circuits

The decoder in general follows normal practice for discrete circuitry. The set pulse width control R354 sets and shapes the burst gating pulse. There's a conventional BF194 4·43MHz crystal oscillator, with a BC183LB d.c. amplifier in the control loop, and the usual four-diode bridge synchronous demodulators for the chrominance signals. The only unusual feature is the absence of a bistable circuit in the PAL switch. Instead, the ident signal is squared and used to drive the two-diode PAL switch. The latter also produces the colour turn-on bias.

The video panel houses the RGB circuits. It's fed with luminance from the i.f. board, the demodulated B – Y and R – Y signals from the decoder, and power and clamp pulses from the wiring harness. The sync separator is situated on this board. The i.f. panel also carries the degaussing circuit. There are separate luminance and chrominance/sound detectors, and the first, gain-controlled chrominance amplifier is also on this board. The circuitry is quite straightforward. Which brings us round to the power supply again (Fig. 1).

Power Supply

The stabilised 58-65V rail is produced by a series chopper circuit. The chopper transistor is VT604, its load consisting of the inductive reservoir L603 which is in series with the circuits supplied. VT604 is switched on and off at line frequency by a squarewave generated by a monostable multivibrator (VT603/VT606). When VT604 is switched on, energy is stored in L603. When VT604 is switched off, the efficiency diode W616 switches on and the current flow in the load is maintained. Stabilisation is achieved by varying the on/off time of the chopper transistor, i.e. by varying the mark-space ratio of the waveform produced by the monostable. The output voltage is sensed by the feedback amplifier VT608, whose collector voltage is used to adjust the time-constant of the monostable circuit.

Why go to such lengths to obtain a 60V supply? Well first a chopper is pretty efficient. When the transistor is switched on its collector-emitter voltage is low, so even with a high current the dissipation is low. Likewise when it's off the leakage current flowing through it is (hopefully) only a few microamperes, so even with a collector-emitter voltage of 300V or so the dissipation is again low. Hence the only time when energy is wasted is when the chopper transistor is being switched on and off, and the squarewave drive should ensure that this takes place very rapidly. Secondly the output impedance is low, improving the regulation. That, we believe, is why the circuit is used. Imagine the size and wattage that would be required to obtain a 70V, 2·5A supply: according to my reckoning, about 47·5Ω at 475W!! A mains transformer in a colour TV set's cabinet would cause problems due to the magnetic fields, while its weight and cost would be appreciable. And both these alternatives have source impedance and regulation problems. Of course, Thorn could have bought BU105s to start with . . .

Start-up Sequence

What happens when we switch on? The half-wave rectifier W601 produces the 240V rail. As a result, the 30V zener diode W605 comes into operation, biased via R608. The 30V series regulator transistor VT601 can then come into operation. Once the 30V rail has been established, the line oscillator will start up, supplying trigger pulses to drive the monostable circuit. So the last supply to appear is the chopper-regulated rail. No 30V rail means no chopper drive therefore. The delay switch transistor VT602 makes this doubly certain: unless W605 conducts, VT602 remains cut off and the monostable cannot operate since VT603's emitter is virtually open-circuit. Thus if the 30V zener or VT602 or VT601 is open-circuit, or C609 is short-circuit, there's no chopper drive and no e.h.t., field scan or sound!

Protection Circuits

Since the chopper transistor's collector is at around 300V, produced by the half-wave rectifier W602, protection must be provided in case it goes short-circuit. This is done by the 72V zener diode W617 and the crowbar trip

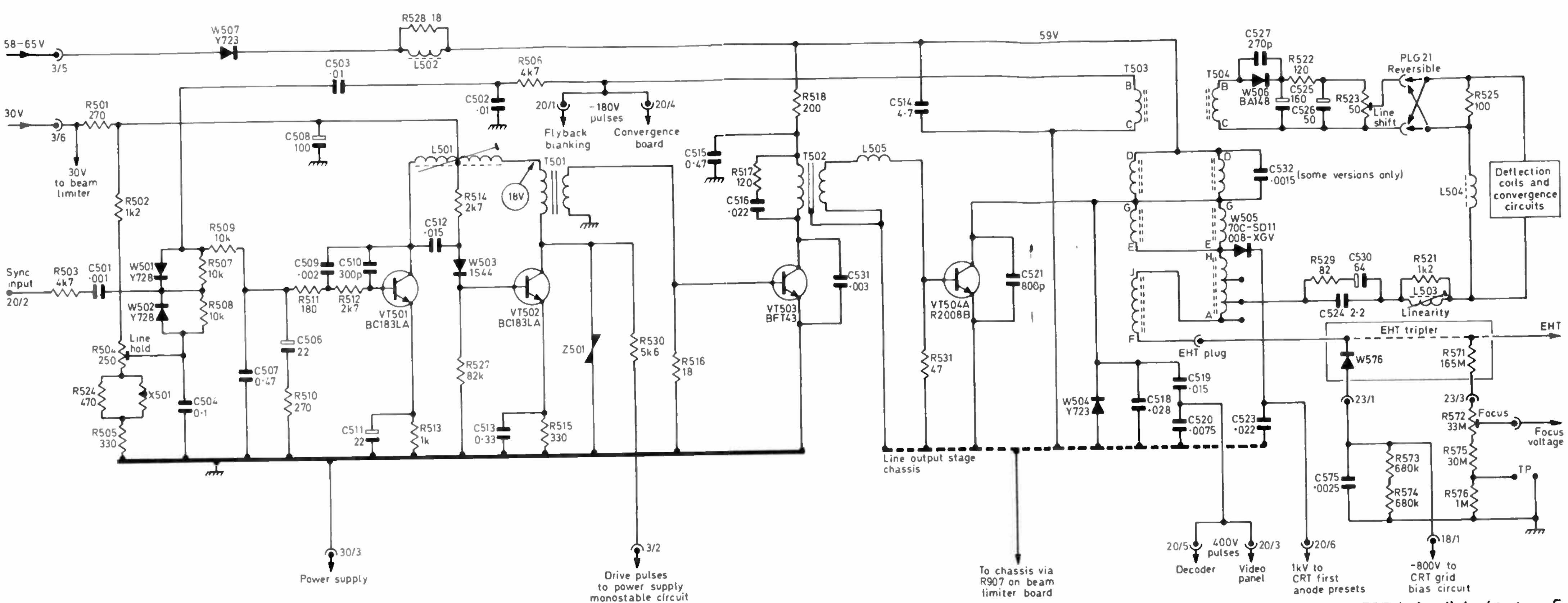


Fig. 2: Line timebase circuit. In the 3000 chassis L505/R531 are omitted, R572 and R575 are 25MΩ, and the wiring between the line output and e.h.t. transformers differs, J of T503 being linked to tags E instead of tag A of T504. In later production 3500 chassis tag J of T503 is connected to tag H of T504 instead. The transformers are coded to indicate the correct connections.

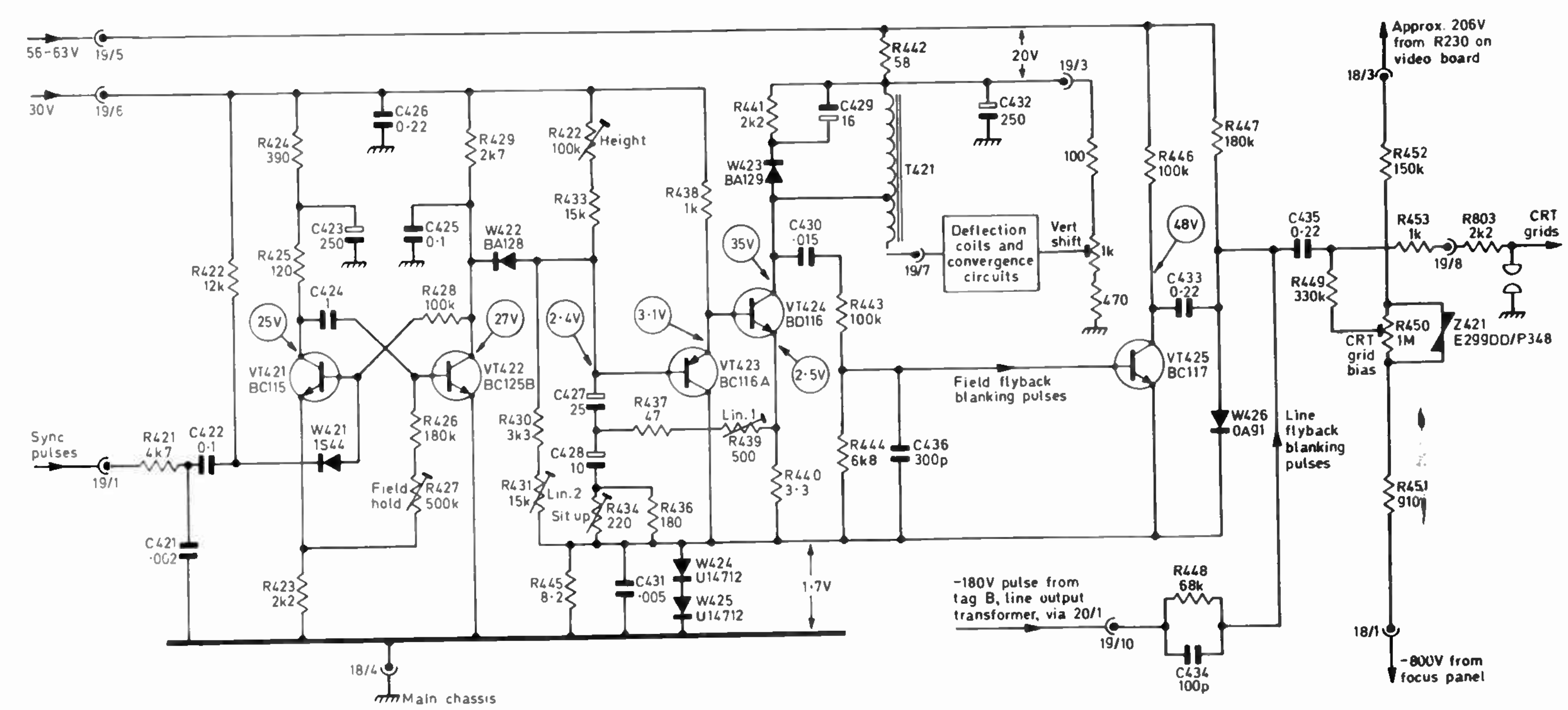


Fig. 3: Field timebase circuit. The voltage shown at the collector of VT424 applies at 60V h.t.

thyristor W621. Should the chopper output rise to 72V, W617 conducts and the voltage developed across R626 fires W621. This short-circuit across the 300V supply in turn trips the cutout.

With such a low-impedance supply, excessive current could be drawn in the event of a fault. So excess current protection is required. In the event of excess current demand the ripple at the collector of the chopper will increase. This is bypassed by C610 and R610, and if the ripple is excessive the negative-going excursion of the waveform appearing across R610 will be sufficient to fire the dynamic trip thyristor W622. This virtually short-circuits the collector of the chopper driver transistor VT605, removing the chopper drive. The circuit continues to trip, at line frequency, so long as the excessive current demand is present.

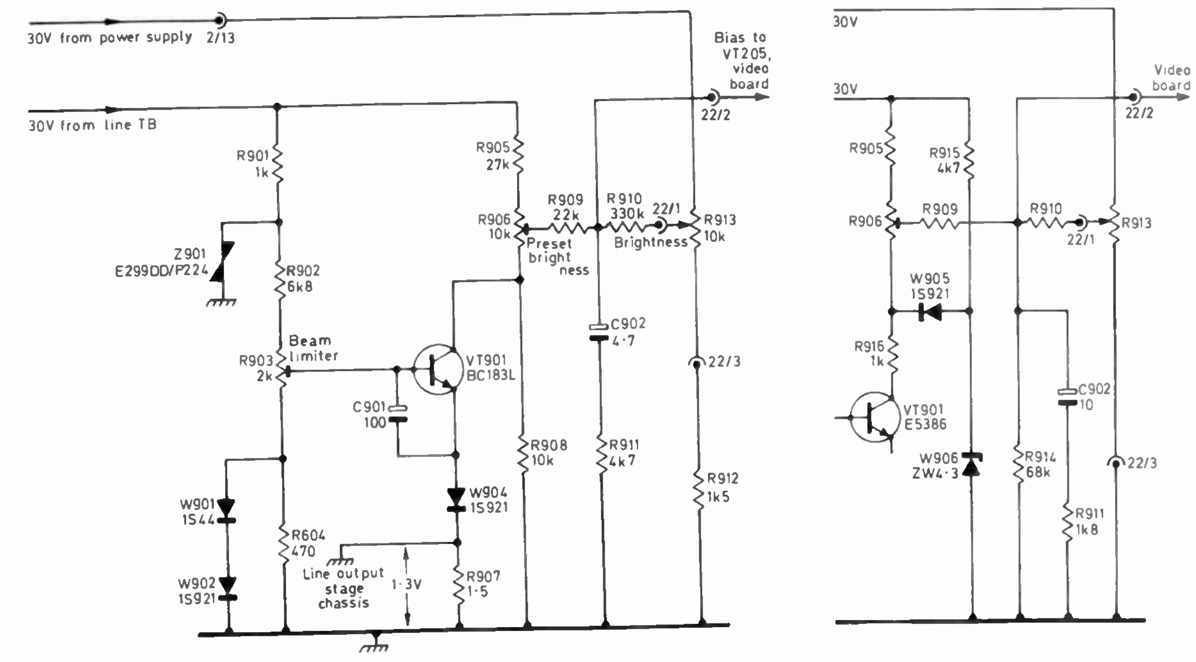


Fig. 4: The beam limiter circuit. 3500 chassis changes on the right.

Power Supply Faults

Such a complicated power supply means that a careful approach to servicing is required. Let's take the various possible symptoms.

Dead set, cutout tripping: Check the rectifiers on the top of the power supply unit. If R609 smokes as the cutout trips, the crowbar thyristor could be firing. Check W617 and W621. If these are not short-circuit, the chopper transistor may be. Alternatives are W616, C610, C629 and C634. If these are all o.k., the monostable may be holding the chopper on too long. Disconnecting one end of W615, the bias on which controls the mark-space ratio of the monostable's output, should reduce the chopper rail to about 30V. If W615 is not faulty, check the feedback amplifier circuit. The mains transformer can be responsible for the cutout tripping, while the cutout itself is sometimes faulty.

Intermittent cutting out is often caused by C618 being faulty. This capacitor is present to prevent short-term spikes at the output operating the crowbar.

There are also mechanical possibilities. The lead from W609 to the reservoir inductor L603 can short to chassis where it passes through the chassis, the chopper transistor's isolating washer can break down, and leakage from the electrolytics, e.g. C607, can be present on the print around W621.

Dead set, c.r.t. heaters alight: Check the voltage at each end of the 30V zener W605. If both sides read about 40V the zener is short-circuit and VT602 will be damaged. The 30V rail will be high. If the cathode is at around 10V, suspect C607 of being open-circuit – the 30V rail will be low. If there's no voltage at the cathode, check at R602 to make sure that the 240V supply is present, then check R608 for being open-circuit or C609 for being short-circuit.

Correct voltages are 30·7V at the cathode and 0·7V at the anode of W605.

If these voltages are correct, check for 30V at F602. If missing check VT601. If the 30V rail is in order check whether the line oscillator is operating, by monitoring approximately 18V at the anode of W608. If lacking, check the line oscillator circuit. If present, check the voltage at the collector of the chopper driver transistor VT605. If the voltage is around 3V either the monostable is not running or the dynamic trip is faulty, holding the monostable off.

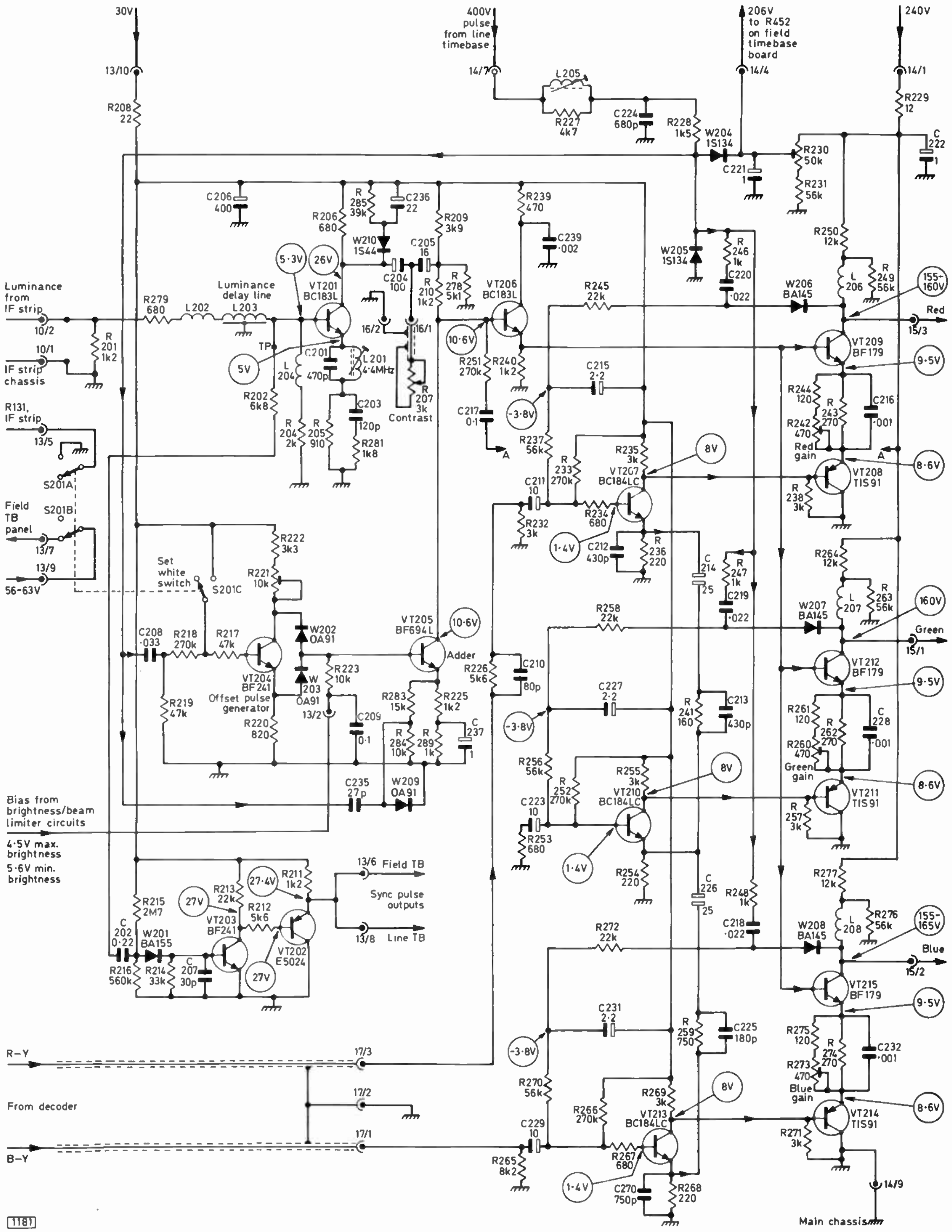


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Fig. 5: Circuit of the video panel.

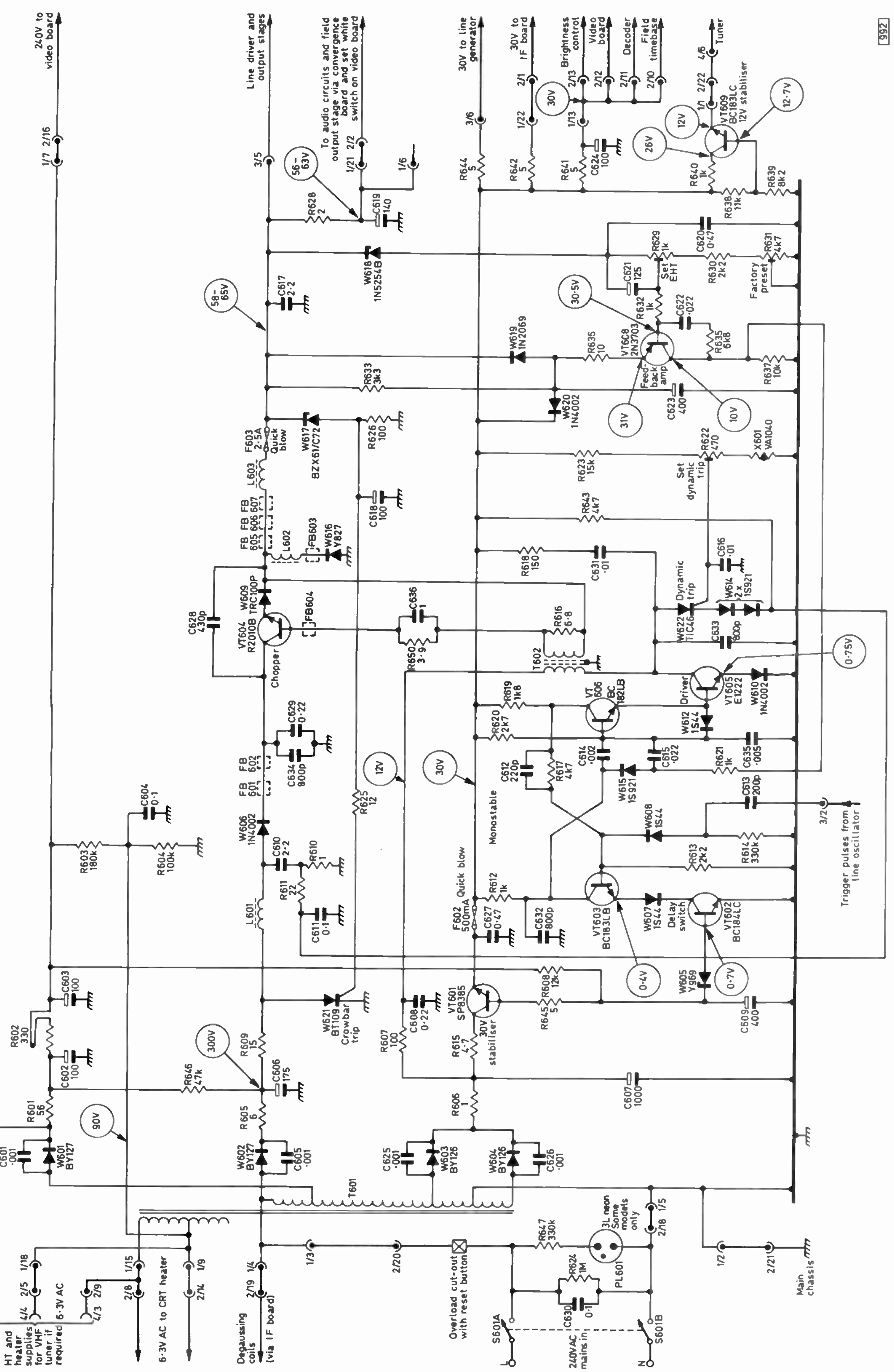


Fig. 1: Circuit diagram of the switch-mode power supply used in the Thorn 3000/3500 chassis. In the 3000 chassis W602 is fed from the same tap on the mains transformer as W601 and the voltage at the junction of R605/R609 is 235V.

If all is well here check the chopper drive with a scope. W616 is also suspect. Don't overlook the possibility of a burnt 60V fuse holder, but of course you've checked the fuse, haven't you?

Ringing: Distorted verticals, a sort of cog-wheeling effect, can be due to C619 being leaky. Use a 220μF type as a replacement, rated at 75V or above. There are alternative causes on the line timebase panel however. The feed coil

L502 may be dry-jointed or may have lost its core, or its parallel resistor R528 may have burnt out. Similar trouble can be caused by C631.

Low h.t.: This can be a confusing fault, as effects similar to the dynamic trip operating are displayed on the screen. The 60V line drops to around 40V, the field folds up, the edges of the reduced line scan are curved, there's hum on sound and the voltage at VT604's collector will be around 120V instead of 260V. C606 is the usual culprit and, being part of a can, the whole lot needs to be replaced.

Blown h.t. fuse: The cause of F603 being open-circuit is usually in the line timebase, where favourites are a defective driver transistor VT503 or the c.r.t. first anode supply's reservoir capacitor C523 being short-circuit. In the latter case the associated rectifier W505 will probably have to be replaced.

Miscellaneous faults: C609 drying up causes ragged verticals. C624 drying up causes loss of colour with a hum bar.

The Line Output Stage

The line output stage (see Fig. 2) is quite straightforward, but note that there are two output transformers: one drives the e.h.t. tripler while the other drives the line scan circuit. If it's not operating and the h.t. supply is present check the voltage across R907 in the beam limiter circuit. If this is more than about 2V the line output stage is probably drawing excessive current. Possible causes are: the line output transistor VT504A leaky; shorting turns on the line output transformer T504 (rare); shorting turns on the e.h.t. transformer T503 (not uncommon); efficiency diode W504 short-circuit (very rare); C514 faulty (will blow the fuse if short circuit – caught fire on early sets); tripler leaky; c.r.t. first anode supply components leaky (W505, C523); shorting turns on the a.c. blocking choke L504. Disconnect these various items while monitoring the voltage across R907. Note that we said the line output stage may probably be drawing excessive current if the voltage across R907 is high. Alternatively, R907 may have risen in value to cause loss of brightness.

C514 is a special type, and can also be responsible for lack of width. C530 going open-circuit is another possible cause of lack of width. A far more common cause however is the core falling out of L504. Also check around L502/R528 for this fault. W507 was omitted on later sets incidentally, and the e.h.t. transformers are spot colour coded for the different c.r.t. sizes.

C523 has been known to go short-circuit with W505 going open-circuit: the symptom then is e.h.t. but no raster.

A common fault in the line output stage is C520 going short-circuit. This removes the pulses to the decoder and video panels. The symptoms are no colour with excessive brightness and the brightness control inoperative.

Poor focus is generally due to the 165MΩ resistor in the e.h.t. tripler. Varying focus means a clean up around the focus electrode's spark gap is required, and possibly widening the gap slightly with a file.

Line Stability

Line jitter seemed to plague these sets from the first. Anything badly soldered on the line timebase board seems to give rise to the jitters. Apart from dry-joints, any of the following components can be responsible: R504, C506, C511, W501/2 (use 1N4148s), W504, C525/6, R523, VT501/2 or T502.

Line drift is generally C506, C511, VT501 or VT502, less often R524. Slow line drift can sometimes be cured by adding a 220Ω resistor in series with X501.

Field Timebase Faults

The field timebase, audio and c.r.t. grid bias/flyback blanking circuits are all on one panel. In the event of field collapse, check whether the output stage h.t. feed resistor R442 is hot or not. If it's cool, the oscillator is usually at fault and either transistor (VT421/2, see Fig. 3) may be the culprit. The driver transistor VT423 can cause field collapse or field foldover, while a short-circuit BD116 output transistor causes R442 to heat up no end. The latter also occurs should C432 go short-circuit of course. A leak in the BD116 will give foldover just as sufficient height is reached, though the field charging capacitors C427/8 can also be responsible for this. C429 or W423 can be responsible for top cramping or foldover, whilst bottom cramping is usually due to the sit-up control R434. The discharge diode W422 can cause false locking and lack of height. Loss of field hold can be due to C423 or to the sync separator's base bias resistor R215 (2·7MΩ) – the latter is to be found on the video panel.

The field scan current is a.c. coupled to the convergence circuits by a 400μF electrolytic which is mounted on the convergence panel. It's C705 on the 3000 chassis and C762 on the 3500 chassis. If it goes short-circuit, the raster is displaced and there's severe misconvergence. It can also be responsible for intermittent field collapse and bottom cramping.

The Audio Circuit

The sound circuit was shown last month, where some of the problems that can occur were mentioned. The electrolytics can give trouble, C409 (100μF) and C407 (32μF) sometimes being responsible for low output, C401 (4·7μF) producing distortion when it leaks and C405 (250μF) removing the sound and cooking R405 when it goes short-circuit.

Flyback Blanking

The transistor and diode in the flyback blanking circuit can give trouble. Note that the c.r.t. grid bias potentiometer R450 is connected between a −800V supply which is obtained from the clipper diode in the e.h.t. tripler and a 206V supply which is set by R230 on the video panel. If R452 goes high-resistance or open-circuit (not very likely) or C221 goes short-circuit (not unknown) the c.r.t. grids will be swung negatively and there'll be low or no brightness.

Setting up the Decoder

The decoder is fairly reliable when set up properly. An excellent meter/scope method is given by Thorn. The meter method is simple and can be carried out in the field. Select a colour transmission and set the a.c.c. preset R308 fully anticlockwise. Connect the meter (Avo Model 8) to the anode of the a.c.c. rectifier W301 and adjust the burst discriminator coil L301 for the maximum negative output – alternatively scope the collector of the final burst amplifier transistor VT302 and adjust L301 for maximum burst output. Then adjust R308 for −7V. Next connect the meter to the end of R311 nearest the rear of the receiver. Disconnect the aerial, set the local/distant control on the aerial panel fully anticlockwise, and tune the oscillator coil L302 to the peak obtained near the top of the can. Alternatively scope the collector of VT304, tuning L302 for maximum output (5V peak-to-peak). Reset the gain control on a colour transmission.

Override the colour-killer by connecting an 82kΩ resistor between the anode of W305 and chassis. Open-circuit links A and B and make link D. Adjust the a.p.c. control R315 for near stationary colour. Make links A and C and adjust R309 for near stationary colour, then remove link C and adjust R312 for near stationary colour. Remove link D, restore links A and B and remove the 82kΩ resistor.

Connect the meter to the end of R339 nearest the rear of the set and tune the ident coil L303 for the dip which should occur when the core is nearly flush with the top of the former – the reading should fall from about 26V to 23V. If using a scope, tune for maximum output (20-30V peak-to-peak) at the collector of VT306

PAL Switching

As pointed out earlier, the ident signal drives the PAL switch directly instead of synchronising a bistable. If the switching doesn't occur at the right time, there will be a band of incorrect colour down the right- or left-hand side of the screen. If necessary, L303 should be adjusted to remove this effect – which is sometimes found in sets where the coil has slipped down the former. If there is inadequate output from the ident stage, check the emitter decoupling capacitor C321 ($0{\cdot}22\mu$F). C325 which decouples its collector supply can short, removing the collector voltage.

Decoder Faults

Pulses from the line timebase are fed to a polarity-splitter transistor (VT308) which provides anti-phase pulses to drive the burst blanking diodes and, from its emitter, the pulse used for burst gating. So if this transistor fails there's no burst, no ident, and no colour. Other transistor failures I've had to cause no colour have been the final burst amplifier VT302, the reference oscillator VT304 and the ident amplifier VT306 (the latter was an intermittent fault). Another cause of no colour is C330 ($4{\cdot}7\mu$F) across which the colour turn-on bias is developed going short-circuit or leaky (there should be 17V at TP2).

A problem that's sometimes encountered is intermittent loss of colour sync. This may be due to a delayed or mis-shaped burst gating pulse. The components to suspect are the two OA91 diodes W315 and W323 which clip the pulse, and the two pulse coupling components R351 (220kΩ) and C334 (82pF). The pulse width control R354 in this circuit is normally set fully anticlockwise: turn slightly clockwise if there's loss of colour at the left-hand side of the picture – colour will be lost completely if the control is rotated too far clockwise.

The demodulated B – Y and R – Y signals are fed to the video panel via filters. The coils can go open-circuit to remove one or the other signal (L304 no R – Y, L308 no B – Y).

The Video Panel

The video panel (Fig. 5) tends to be less reliable. Nearly every stage has given me trouble at some time or other. Let's start with the luminance circuit. A close look at the symptoms displayed is invaluable here. If the timebases are synchronised and there's only colour on the screen the fault must lie in the circuitry following the luminance delay line, usually one or other of the BF179 RGB output transistors short-circuit base to emitter, or VT201. If there's no sync, look closely for luminance by trying to lock the timebases. If there's no luminance the chances are that the delay line driver transistor VT105 on the i.f. panel is defective. If luminance is present one or other of the sync transistors VT202/3 is suspect.

If the brilliance control has no effect and the tube looks suspect, either VT204 or VT205 may be defective.

Conventional feedback clamps are used in the RGB circuits, clipped positive-going line frequency pulses switching on W206/7/8 during the line sync pulse back porch. The resultant negative potential stored by C215/227/231 adjusts the bias applied to VT207/210/213. Now obviously if one of these capacitors is leaky there'll be an excess of the colour concerned. This is a not uncommon fault on these sets. The same fault occurs if the clamp diodes go short- or open-circuit.

If you suspect one of the transistors in the RGB channels, monitor the relevant output transistor's collector voltage while short-circuiting the base-emitter of the appropriate preamplifier (VT207/210/213). This action should result in the output transistor's collector voltage rising to nearly 200V. If it doesn't, check the other voltages thus obtained. For example, short-circuiting the base-emitter junction of the B – Y preamplifier VT213 should result in its collector voltage being high, the emitter voltage of VT214 being high, and VT215's collector voltage also being high. This checks the d.c. conditions in the circuit.

Clamping failure I've always traced to the line pulse missing at pin 7 of plug 14. The effect is excessive brightness and the usual cause, as mentioned in dealing with the line timebase, is C520 going short-circuit.

The output transistor load resistors R250/264/277 have a habit of increasing in value to give virtually a red, green or blue raster. Two types have been used, wirewound ones and a combined thick-film unit. Separate wirewound ones are best. The output circuit also contains three chassis-connected resistors R249/263/276 which can fall in value to give an excess of the colour concerned.

Other faults on this panel have already been mentioned – C221 and R215.

IF Strip Faults

The i.f. panel gives little trouble. Instability can usually be cleared by slight adjustment of the 33·5MHz coil L113 in the luminance detector's output circuit. A case of normal sound with little luminance and no colour caused me some worry. The second i.f. amplifier transistor turned out to be at fault, letting sync, chroma and sound through but little else. I've found that the easiest way to test the transistors in the i.f. strip is to monitor the collector voltage while short-circuiting the base-emitter junction: the collector voltage should rise – if it doesn't change the transistor. Intermittent sound or colour is usually due to broken print around the relative plugs.

The 10μF a.g.c. decoupling capacitor C179 is a fairly common offender. It usually goes open-circuit, producing lines across the screen – akin to sound-on-vision. In very early sets there's also a 25μF decoupler (C134) which can cause the same fault. If C179 goes short-circuit the first i.f. transistor VT101 is no longer biased on: there's no vision therefore and weak if any sound.

The 180pF capacitors (C158/9) in the ratio detector circuit can be responsible for low, distorted sound. The associated reservoir capacitor C163 (4μF) can cause distortion with the volume remaining normal.

Lack of Degaussing

As mentioned earlier, the degaussing circuit is to be found on the i.f. panel: I've on several occasions found lack of degaussing action to be due to broken print near the plug to the coils.

Convergence Panels

The c.r.t. first anode presets and beam switches are mounted on the convergence panel. Lack of one colour is often due to low first anode voltage, the usual cause being leakage across the appropriate beam switch. Less often the associated 0·001μF decoupler goes leaky or the feed resistor rises in value, the latter possibly due to leakage across the switch or decoupling capacitor.

Cooking on the convergence board can lead to the demise of a whole string of components. The usual cause is either R751 (10Ω, number one suspect) or R752 (18Ω) on the 3500 board going open-circuit or R707 or R708 (both 10Ω) on the 3000 board going open-circuit. The pincushion distortion correction transductor T751 on the 3500 panel sometimes shorts, with smoke, fuse blowing and damage to the associated resistors.

Difficulty with setting up the convergence can be due to noisy potentiometers.

Power Supply Hint

Finally, back to the power supply. It's easier to work on this if it's stood on its transformer end on a piece of hardboard across the chassis. The leads are just long enough, and both sides are then accessible.

Semiconductor Replacements

Some useful diode and transistor replacements for use in the 3000/3500 chassis are as follows:

BC182	BC107, BC147
BC183	BC108, BC148
BC184	BC109, BC149
BF179	BF337
BF241	BF194
BF694L	BC148, BC183
BY126	1N4004
BY127	1N4007
E1222	BFY50
E5024	BC187
R2008	R2010 (don't use an R2008 in place of an R2010)
SP8385	TIP31A, RCA 16040/1
TIS91	BC187
TRC100P	Two 1N4004 in parallel
Y728	BA154, 1N4148
Y969	BZY95/C30
1S44	1N4148
2N3703	BC158, BC187

Long-Distance Television

Roger Bunney

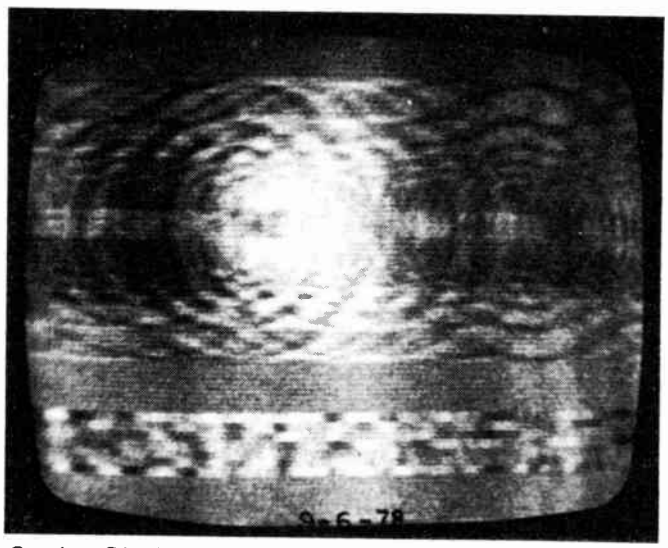
THERE have certainly been a lot of happenings during June – this very evening David Martin rang to tell me that both he and Hugh Cocks had received the Gwelo, ch. E2 Rhodesian transmitter again (at 1650-1730 BST on the 28th). As far as Sporadic E reception is concerned, June has been good, with periods of prolonged reception punctuated by periods of relative calm. The peak days were the first five in June, the 3rd/4th particularly when little could be resolved because Band I was jammed with signals! From the 7th onwards there were signals about almost continually. Of note here at Romsey – and elsewhere it seems – was an unusual signal on ch. E2 at 0810 from the Udine "free" TV station in Northern Italy: NCT – National Centre Television – was clearly visible at the bottom of the test slide. Earlier propagation conditions favoured signals from TSS (Russia), though subsequently the main reception came from a southerly direction – from Italy/Spain with the familiar bullfight spectacle.

Now to review the month's happenings. There were severe lightning storms over the southern UK on the 1st, the resulting ionisation providing strong signal pings (reflections) from various Dutch, French, Belgian and West German stations from Band I through to u.h.f. for those to the north, such as Kevin Jackson in Leeds. In fact West Germany was logged as a new country so far as reception via this mode in all bands is concerned.

June 4th gave a first for distant Band III reception of Italy, when Clive Athowe (Norwich) received RAI-1 on ch. D for twelve minutes between 1216-1228 BST. The signals were fair at times.

On the same day Allan Latham in Abu Dhabi logged good signals from Switzerland on ch. E2 and France ch. F2, the latter lasting for a couple of hours. On the 20th Allan received the BBC-1 test card on ch. B1 at good strengths via multiple-hop Sp.E at 0819-0821 GMT. This is the most distant Sp.E reception of ch. B1 to my knowledge, and was probably a triple hop!

On the 9th Ryn Muntjewerff (Holland) received the low-powered ch. E3 Thessaloniki (Greece) transmitter at 1425 BST.



Gwelo, Rhodesia ch. E2 received in Holland by Ryn Muntjewerff via F2/TE propagation: note the multiple images.

There was an unusual period on the 17/18th. Hugh Cocks logged a N. American 525-line system M signal on the 17th, under a weak RUV (Iceland) ch. E3 signal. On the following day the six-metre ZB2VHF Gibraltar beacon was received in New Hampshire, USA, along with various video carriers.

Rhodesia (chequerboard pattern) and an African ch. E3 programme put in appearance in the southern UK during the 19th-22nd. The latter programme was noted at 1810-1830 on the 19th, its content suggesting Ghana rather than the "usual" NTV (Nigeria).

There have been reports of a ch. E2 chequerboard pattern received from an easterly direction during the early morning period. Any ideas? There have been other mysteries too. During the mid afternoon on the 3rd Kevin Jackson noted ch. E4 signals, with programme material consisting of Arabs, palm trees and associated buildings. This continued for an hour. At 1620 a Marconi No. 1 test chart was seen emerging beneath a JRT (Yugoslavia) programme, again on ch. E4. Kevin comments that the Arabs' language "didn't seem Arabic". I suspect that this could have been Iran – a new transmitter is in operation there – via double-hop Sp.E. A final mystery comes from Hugh Cocks. On the 27th at 0805-0810 he received very weak ch. E2/4 captions from the ESE. At the same time VOA (Voice of America) harmonics were heard at 45 and 60MHz, unusually however in Chinese! I suspect that the harmonics could have been from the transmitting base at Sri Lanka (Ceylon to older readers).

Finally, Kevin Jackson received the Canary Islands on the 25th at 2030. The reception of Izana ch. E3 would normally have been exciting news, but in view of some of the events listed above...

News Items

Satellites: Bob Cooper (Oklahoma City) has sent a list of new TV satellite launchings. It seems that during 1980/1 there will be another direct broadcast to India satellite, suspected at 860MHz again but at 74°E, perhaps too far east for UK reception. There will also be transmissions at 2·5GHz. An Arab States Consortium is to place a satellite at 5-20°E, again transmitting at 2·5GHz.

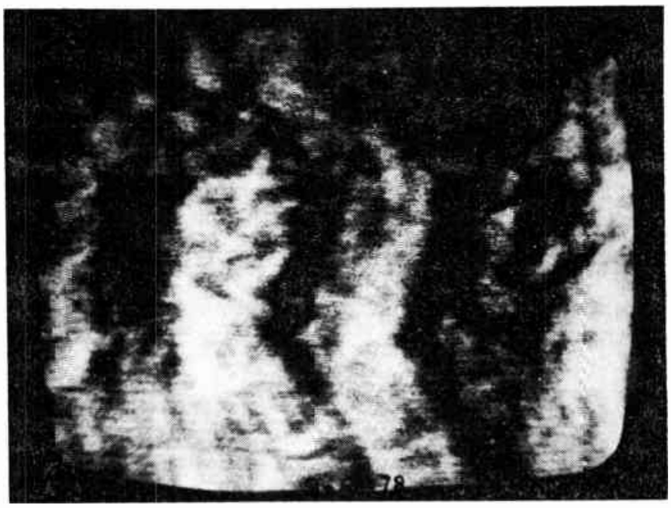
Iran: Several transmitters on chs. E4-11 came into operation during March. There's to be a second colour service at u.h.f.

UAE: A new transmitter has been brought into operation at Fujayrah, "some fifteen times the power of the previous one". It relays Abu Dhabi, covering the eastern part of the Emirates.

Afghanistan: Test transmissions started on March 21st.

Sri Lanka: There are reports that a TV service is to be started in the not too distant future. A Japanese team is carrying out a feasibility study, and TV repair courses in W. Germany are being offered to students.

Sunspots: The predicted peak is February 1980. The count



Gwelo again, but with only part of the video bandwidth being propagated. Again multiple images, but with severe lack of h.f. detail and the tendency to smearing. Photograph courtesy Ryn Muntjewerff.

is increasing rapidly, with predictions of 82 for June rising to 102 in October and 107 in November. The corrected count for January-May is 86·2 instead of 49.

It's hoped in Belgium that from January 1981 there will be a seven day a week BRT-2 service from 1900... The W. German Steinkimmen/Oldenburg (NDR-1) transmitter is operating at half power and is to close down in the "foreseeable future". The Cuxhaven ch. E6 transmitter output will then be increased.

New EBU Listings

The ch. E3 Port Said transmitter has been replaced by a 10kW unit operating on ch. E7. Several other transmitters have been opened, including a 260kW e.r.p. unit at Ismalia.
Spain: Benicasim ch. E59 200kW e.r.p. horizontal. RTVE-2.
Eire: Cairn Hill ch. E40 800/200kW e.r.p. horizontal; Crosshaven ch. E55 1kW e.r.p. vertical. Both RTE-1.
Poland: Pila ch. R24 150kW e.r.p. horizontal, Kielc ch. R28 1,000kW horizontal, both TVP-2. The Lublin ch. R23 TVP-2 transmitter has closed. Jelenia Gora ch. R35 200kW e.r.p. horizontal, TVP-1.

From Our Correspondents...

John Lees of Cirencester has found by experience that if aerials stacked atop a mast are spaced too closely there's a fall-off in their performance. Apparently he heard noises in his rotator and removed all but the u.h.f. array from his mast. The result was a dramatic improvement in u.h.f. reception. In the end he permanently removed the Band III array, leaving just the Band I and u.h.f. arrays on the mast, and has found that the absorption effects at u.h.f. have been greatly reduced. I tend to favour a spacing of at least four feet where possible between arrays (provided the head load doesn't become excessive for the rotor/bearing support). Such wide spacing certainly pays dividends in terms of improved results. John noted numerous signals during May, including TVR (Rumania) on the 5th.

Donald Bassnett (Glasgow) has been logging excellent signals since the end of May, with many unidentified signals during June. RUV (Iceland) ch. E4 was noted for two hours on the 3rd, closing down at 0015. RUV has been a rare signal this year.

P. Brassey (Southport) has been experiencing problems with field locking on weak signals together with pulling on verticals on the Bush Model TV161 he's using. Any ideas? Despite the use of an elderly V type set-top aerial he's managed to log most countries in Europe via Sp.E. He's now constructing an indoor bisquare aerial. These results show that distant signals can be received with even a simple installation. P. Brassey would be interested to hear of any other indoor aerial systems readers have tried. Please write in to the column.

Finally, an envious look at Oriental DX-TV. George Francis (Papua, New Guinea) has written to Anthony Mann (Perth, Australia) listing his reception during February-April. The list includes Malaysia chs. E2 and 3, Korea chs. A2 and 3, China/USSR chs. R1 and 2, Philippines chs. A2, 3 and 4, Hawaii chs. A2 and 3, Japan chs. J1, 2 and 3 (these are in Band II), New Zealand ch. 1 and Samoa ch. A2. It's interesting that these F2/TE receptions include Band II signals up to 108MHz. We may have to reconsider the upper frequency limit for such signal propagation. Already reports of enhanced amateur radio two metre (144MHz) reception have appeared, and there's been a report of a contact at 432MHz in the Americas across the Caribbean. The next three winters should give dramatic DX-TV reception. With the projected end of the BBC's ch B1 transmissions in the early 80s overseas readers are advised to be on the watch out for Crystal Palace.

DX-TV Book

Please note that my book *"Long-Distance Television"* is no longer available from Weston Publishing. It's expected to be available later this year from Bernard Babani (Publishing) Ltd., The Grampians, Shepherd's Bush Road, London W6 7NF. We'll include an announcement as soon as further details are available.

Interference Problems

One of the main problems with DX-TV reception is interference. This is broadly of two types, interference from other transmitters and interference from badly designed or poorly made equipment. The former subject has been covered in these pages in some detail by Hugh Cocks (see the November 1977 *Television*), but in view of the increasing difficulties – when for example a new relay transmitter suddenly opens on a previously empty but fruitful channel – I'm thinking of giving this subject a further airing at a later date.

Electrical interference may come from industrial or domestic equipment. Generally, equipment has to comply with Home Office and EEC Radio Interference regulations which ensure that any radiation is below specified levels. Measurement of either "continuous" or "discontinuous" interference is made at 160kHz, 550kHz, 1·4MHz, 10MHz, 45MHz, 90MHz and 220MHz, the limits being given in terms of decibels relative to 1μV up to 30MHz and to pV between 30-300MHz. Discontinuous interference consists of a click, which is defined as a disturbance which lasts not more than 200ms and is separated from a subsequent disturbance by at least 200ms – a click may consist of a number of impulses. So much for the theoretical aspects of the subject: in practice one can be confronted with a variety of interference sources installed prior to current legislation, or equipment which has subsequently become faulty.

In my fifteen years of DXing I've had interference problems at three separate locations. Fortunately many were resolved without difficulty. I hope that the following notes, based on my own experience, will be of help to others.

Ignition interference is a problem for those living near a main road. There's little that can be done other than to use vertically stacked aerials mounted at the maximum distance from the road. I had considerable trouble at my present location from a fleet of forklift trucks operating indoors. The owners were extremely co-operative however, fitting plug cap suppressors and line suppressors in the coil/distributor circuits. This completely solved the problem.

Domestic Interference

Thermostats can be troublesome, particularly if the contacts are dirty or burnt so that sparking occurs. Such sparking on a dying thermostat has been noted lasting for up to a quarter of an hour. The interference covers a wide frequency spectrum. Suppression components can be fitted (see Fig. 1) to reduce the sparking and wideband radiation. Locating a faulty unit in a residential street or estate can be difficult since the interference is radiated over considerable distances: questioning householders as to interference on their radio/TV sets will usually lead to the source of the trouble however. Vacuum cleaners and electric drills can be similarly troublesome, but in view of their intermittent use (if on domestic premises) this is a problem that may have to be lived with. Filtering as shown in Fig. 1 usually reduces the radiation, provided the modification is made to the unit itself so that the radiation does not come from connecting wiring.

Fluorescent tubes can give trouble at times, often at specific frequencies. A low-value capacitor (say 0·001μF) connected across the terminal pins at each end of the tube should solve this one. Thyristor dimmers have been known to cause interference, due to their chopping action and the resulting harmonics. Filtering should be incorporated at the input and output, to prevent radiation from the mains wiring.

IF Breakthrough

At times i.f. breakthrough occurs. Signals broadcast in the 49 metre (6MHz) band are a particular problem. This is basically a design defect, but it may be possible to reduce the pick up by introducing screening (ensure that this cannot be touched by hand in a.c./d.c. chassis) or by slight adjustment of the a.m. rejection preset usually incorporated. Breakthrough in the 35-40MHz region at the i.f.s used in 405-line sets is now uncommon due to the absence of signals and the improved filtering at the input to the tuner.

Radio Hams

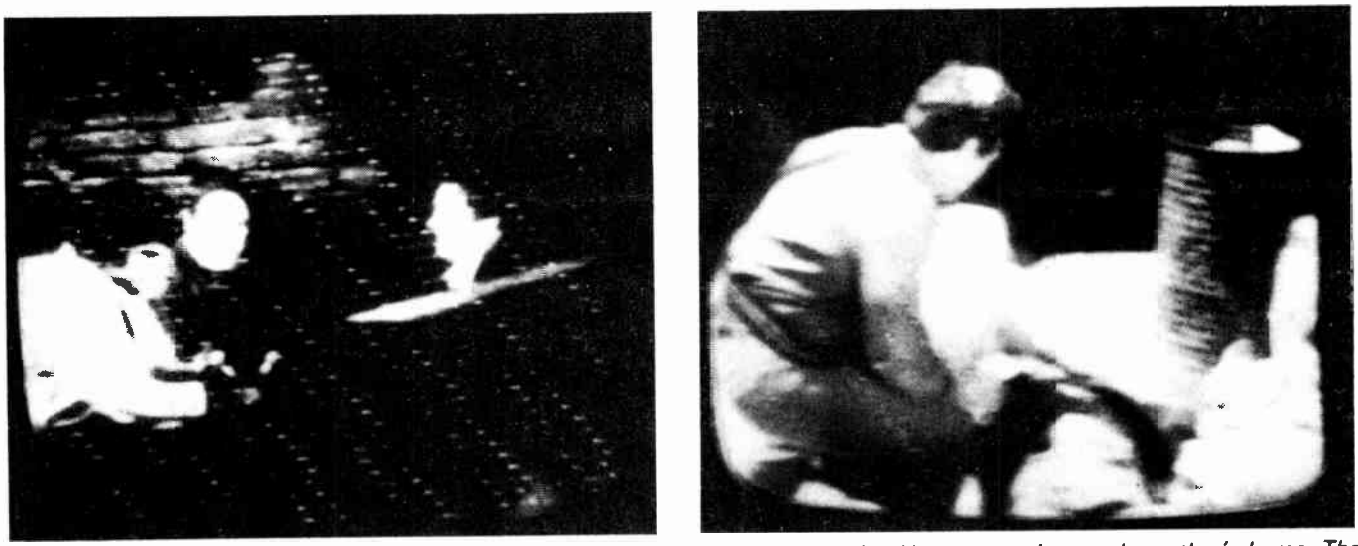
Living near a radio amateur may lead to problems, due possibly to harmonic radiation, or to front-end overloading leading to cross-modulation. In this case informal contact usually leads to the problem being solved. The trouble can be aggravated by the use of a wideband preamplifier. If the problem disappears when the preamplifier is removed, filtering ahead of the amplifier will be needed.

Suppression Capacitor Rating

It must be stressed that in any modification where suppression components are fitted the capacitors must be of adequate a.c. rating – 300V a.c. will normally suffice.

Industrial Interference

I've experienced several forms of interference from industrial sources. At one location Band I through to Band



Off-screen photographs showing pulse information from a nearby line terminal/VDU system, taken at the author's home. The exact source of the interference is not known and the equipment manufacturer has refused to comment further. The signals are from Madrid, ch. E4 (48·25MHz), received via Sp.E.

III was swamped by a curious pattern resembling a broad horizontal bar, with r.f. patterning and a rough humming noise on sound. The source was easy to locate, since the interference put in an appearance on Mondays and Wednesdays. The radiation, breaking through at i.f., came from a local hospital and was easily solved by fitting an F38A Post Office filter.

At my next location severe patterning at strengths sufficient to blot out all signals on ch. E4, with an accompanying hum on sound, occurred between approximately 0715 and 1800. This radiation came from a factory some two miles distant, and consisted of the third harmonic of a class C r.f. welding installation. The power of each welder was about 40kW. The welding process tends to result in frequency drift, so the use of a notch filter was ruled out. The fundamental frequency was set so as to avoid the various harmonics interfering with local broadcasting and communications frequencies. The authorities tolerated this situation and my problem, being of a minority sort, didn't get much sympathy. So I moved.

The welding problem could just be received at my present location, at a distance of some fourteen miles – this gives a good check on improving Trops! We then had the difficulty with the forklift trucks, quickly dealt with as mentioned above. All went well until late 1976, when the relatively clear Band I/II spectrum was completely disorganised by a line terminal data link, radiation from the VDUs (visual display units) producing horrible visual effects and noises every 1·55MHz from below 30MHz to Band III at sufficient strengths to be present on local broadcast TV transmissions while rendering the spectrum useless for DX-TV purposes. When the main VDU installation is switched off there's still sufficient radiation from the equipment to produce a resolvable pattern. The authorities were approached, measurements made and correspondence entered into, but to this day the situation remains much as it was in late 1976. The manufacturer kindly paid for new aerials with vertical stacking to minimise the problem, but it looks as if we'll be moving once again.

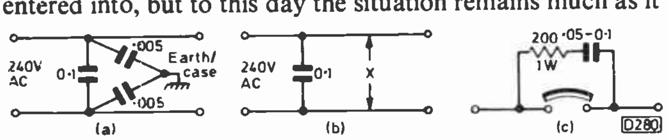


Fig. 1: Typical suppression circuits for use with a.c. mains supplies. (a) For three-core appliances: fit close to the unit. All capacitors 300V a.c. working. (b) For two-core appliances, again fitted close to unit. RS v.h.f. chokes may also be fitted at the points indicated with an X. (c) Circuit for use with a defective thermostat switch.

Unusual Interference

Three forms of interference experienced by other DXers are unusual. An enthusiast in Essex noted a form of tone at irregular intervals, thought to originate from a nearby telephone exchange. Friends in Derby were alarmed to note the local TV services appearing weakly in Band I: the problem was due to radiation from a nearby relay system which distributed the u.h.f. services at v.h.f., with up-conversion at each receiver. The cause of the trouble was that the gains of the line amplifiers were incorrectly adjusted, producing cross-modulation effects and increased radiation. A number of both radio and TV enthusiasts suffer during damp weather from the effects produced by arcing and corona discharge from the insulators of CEGB and local electricity authority distribution lines. This produces a "shash" over a wide frequency band, the intensity depending on the voltage. Approaching the authorities may result in the insulators being examined for cracks and tracking. Otherwise this seems to be a problem one must live with.

Conclusion

The above are just some of the problems we've come across. If there's sufficient interest and/or comment we may be able to give further examples and, hopefully, their solutions.

If you are moving, select your new site with care! The P.O. Radio Services division will undertake to resolve interference affecting one or more local broadcast services, provided an efficient aerial system is being used. This excludes reception of say a second, fringe ITV channel, and certainly the distant signals of interest to the DX-TV enthusiast. I understand that Radio Luxembourg is not regarded as a local broadcast signal. I must say however that within its terms of reference I've always found the local Southampton branch most co-operative and willing to suggest solutions to problems. An excellent range of bandpass, bandstop, notch and other filters is available.

Useful information will be found in the RSGB publication *Television Interference Manual* by B. Priestley.

TV Servicing: Beginners Start Here . . .

Part 12

S. Simon

In considering the passage of the vision signal from the aerial to the c.r.t. in the last two parts we also mentioned that the sound signal in the 625-line system accompanies the vision signal as it passes through the tuner unit, the i.f. strip and the detector. At some point before the c.r.t the sound signal is separated from the vision signal and fed to the sound-only circuitry.

In addition to the video output, the vision detector (if only a single detector is used) produces a sound signal on a 6MHz carrier – 6MHz is the difference between the sound and vision intermediate frequencies (33·5 and 39·5MHz respectively), and occurs as a result of the signals mixing in the detector. An important difference between the vision and sound signals is that whereas amplitude modulation is used for the former, i.e. the original vision signal modulates the amplitude of the vision carrier, frequency modulation is used for the sound signal (again we are referring to the 625-line system), the original sound signal modulating the frequency of the sound carrier. As we shall see, this means that a different sort of detector is required in order to extract the sound signal from the frequency-modulated 6MHz signal. (For reasons that should be obvious, the 6MHz f.m. signal is referred to as the *intercarrier* sound signal.)

The 6MHz sound signal appearing after detection at the end of the i.f. strip is of very small amplitude compared to the vision signal. It requires further amplification therefore before detection to recover the audio signal. In different sets you'll find different methods of amplification. In older sets one or maybe two valves, in later ones one or two transistors, while in most recent sets an i.c. which usually performs other functions as well is employed for the purpose.

FM Demodulation

There are also several ways of detecting the 6MHz f.m. signal. The process may be undertaken within the same i.c. that provides the amplification, it may be done by a couple of diodes in what is called a ratio detector circuit, or in some dual-standard monochrome sets it may be done by a valve specially designed for the purpose – a heptode (five grids) valve referred to as a locked-oscillator detector. What all these circuits have in common is some sort of quadrature system. The term quadrature is one which will come up quite often: it means simply that two signals of the same frequency are 90° out of phase with one another (see Fig. 1). If the 6MHz signal from the i.f. strip is one of these signals, and a locally generated 6MHz signal is the other, mixing the two together will leave us with the audio signal swings. This assumes that the locally generated signal stays at a constant frequency, while the signal from the i.f. strip is varying in frequency in accordance with the original sound signal variations.

One thing we require is good rejection of any amplitude modulation the 6MHz signal may have picked up while it accompanied the vision signal. Otherwise, the sound detector may demodulate both the frequency and the amplitude modulation, which is not at all what we want. If the local oscillator circuit is not tuned to exactly 6MHz, the a.m. rejection will be poor and the result will be not only sound distortion but an unpleasant background buzz as well.

Let's start with something simple, the valve locked-oscillator detector circuit used in a number of GEC/Sobell dual-standard sets. This is shown in simplified form in Fig. 2. The frequency-modulated 6MHz signal is applied to the control grid (1). The locally generated 6MHz signal is produced by the parallel tuned circuit L47/C129/R94 which is connected between the valve's third grid and cathode. The two signals are in quadrature, and together control the current flowing through the anode load resistor R89. The current flowing through the valve and the voltage thus developed across the anode load resistor depend on the phase relationship between the two signals: thus detection occurs, i.e. we get an audio signal across R89. C124 provides de-emphasis – to compensate for the h.f. boost given to the audio signal at the transmitter to improve the overall signal-to-noise ratio.

The EH90 valve V7 has a profound effect on the tuning, and is often the culprit when retuning the coil cores is apparently required to restore optimum (distortion free) sound on the 625-line standard. The real villain of the piece however is the 18kΩ resistor R92, which is next to the EH90. It falls in value and in doing so passes more current, thus dissipating more heat which in turn causes a further fall in value. So the cycle goes on, with rapidly deteriorating sound and also damage to the 5·6kΩ resistor R93. The lower-value cathode resistor R90 usually escapes, as it's not required to drop a lot of voltage in comparison with the other two. Replacement of the 18kΩ and 5·6kΩ resistors is or was a routine chore every time one of these sets needed attention, whatever the reason.

The ratio detector is a less troublesome circuit, but requires careful setting up if adequate a.m. rejection (freedom from buzz) is to be obtained. A typical example is shown in Fig. 3 – used in the Rank A774 single-standard monochrome chassis. 2VT8 is the second intercarrier sound amplifier transistor – the preceeding stage is untuned incidentally. The ratio detector consists of the two diodes 2D2 and 2D3, transformer 2L18-20, and the associated components. The quadrature conditions arise from the simple fact that at resonance the voltages across the primary and secondary windings of a tuned transformer are 90° apart.

The two diodes are connected in series with each other, the load components on the right-hand side, and the centre-tapped secondary winding 2L20. With the input signal at exactly 6MHz, the voltages at each end of 2L20 are of equal but opposite polarity. The two diodes conduct equally therefore and the circuit gives zero output. As the signal deviates from the 6MHz centre frequency, so the voltage

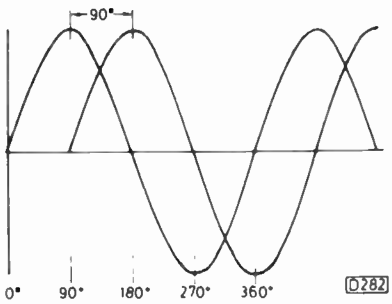


Fig. 1: Two signals in quadrature. The output from a TV f.m. sound demodulator depends on the phase relationship between a fixed and a varying 6MHz signal.

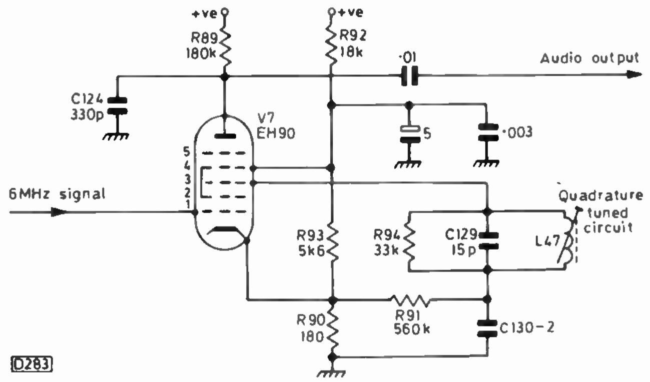


Fig. 2: Locked-oscillator valve f.m. demodulator circuit.

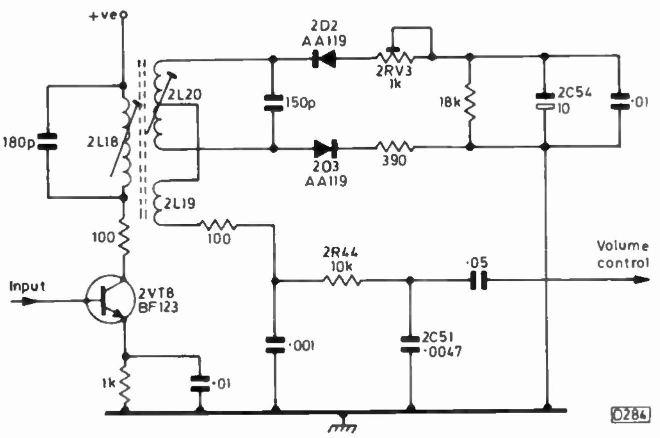


Fig. 3: Typical ratio detector circuit.

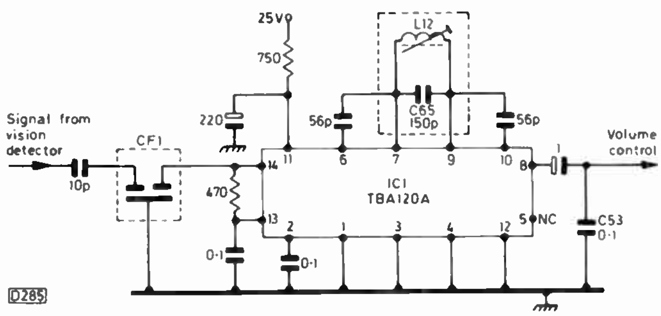


Fig. 4: I.C. intercarrier sound channel.

developed across one half of the secondary winding will increase while that developed across the other half will decrease. One diode conducts more than the other therefore, and an a.f. output is obtained. This is extracted via the tertiary winding 2L19 – different designs vary at this point – and then coupled to the volume control, with 2R44 and 2C51 providing de-emphasis. The circuit is insensitive to signal amplitude variations since these simply cause both diodes to conduct in unison to a greater or lesser extent, while to get an output from the circuit one diode must conduct more and the other less. Ratio detector then because the output depends on the ratio of the voltages developed across the two halves of 2L20. Clearly the resistance of each half of the circuit must be the same if freedom from any output due to variations in signal amplitude is to be preserved. 2RV3 is made variable therefore, so that the resistances can be balanced.

Coming right up to date, Fig. 4 shows the i.c. intercarrier sound channel used in the Thorn 1590 portable chassis. In the entire sound strip there is just one tuned coil, L12, which provides the quadrature signal. The input is selected by the ceramic filter CF1. C53 provides de-emphasis.

The weak point in this circuit is not the chip itself but the capacitor C65 which tunes L12. If this capacitor becomes open-circuit it will no longer be able to tune the coil, whose resonance will then be outside the range of adjustment of the core. If the sound is absent or extremely weak, it's worthwhile shunting a 150pF capacitor across the two active connections of the coil. This could well restore normal sound. If the capacitor is short-circuit this action will be useless and the can will have to be removed in order to replace the capacitor.

Testing the IF Strip

If the 6MHz i.f. strip (be it valved, transistorised or an i.c.) is suspect, a rough idea of its amplification can be gauged merely by touching a lead (test prod or screwdriver blade if need be) to the input (in the 1590 circuit, pin 14 of IC1). The result should be a jumble of shortwave stations. If there's no response, check at the output (pin 8). This should produce a fairly loud hum. If this is present, the audio stages are in order (roughly) and the fault is associated with, if not in, the i.f. strip.

The rule is, as always, to check the supply and any voltage figures which can be referred to before condemning any valve, transistor or i.c. If it's necessary to remove a transistor or an i.c., first note the connections so that the replacement is inserted correctly before removing the solder from the pins. This latter operation must be done neatly so as to preserve the print and the markings. A solder sucker working on the vacuum principle, or a solder wick of impregnated braid, will remove molten solder quite neatly from all pins and allow the item to be lifted out without damage to the panel and print. On receivers using print on both sides of the board (e.g. GEC etc.), care must be taken to ensure that the top print is not removed with the item.

Audio Circuits

Fortunately the sound i.f. and detector stages are fairly trouble free. The vast majority of sound faults occur in the audio amplifier and output stages, particularly the latter since this is required to drive a device which requires a fairly large amount of current – the loudspeaker. In the process of delivering adequate current, a certain amount of heat is inevitably generated. And where there's heat there's the increased possibility of a breakdown.

So as not to leave anybody out, we will consider first the loudspeaker, working back from this.

Most animals have two ears, which can be looked upon as microphones. They are actuated by variations of air pressure.

Most loudspeakers operate by having a cone which when rapidly moved causes a variation of air pressure in its immediate vicinity, thus producing sound waves. The idea is to move the cone of the loudspeaker in exactly the same way as the sounds which originally caused the microphone to respond in say the studio or wherever.

The usual method of doing this (see Fig. 5) is to wind a coil on the centre of the cone, and to suspend this so that it can move inside a magnet. The magnet has a constant flux density, while variations of current through the coil will produce a second, varying magnetic flux. The two fields interact to produce movement, thus producing the variation of air pressure or sound waves.

It will be appreciated that the current required to produce the second, or dynamic, magnetic field is considerable. Hence the wattage rating used to express the power output of a sound output stage. Such is the nature of the construction of a loudspeaker that there is a limit to the number of turns which can be wound to form the "speech" or "voice" coil. This usually makes it a low-impedance device, i.e. four ohms, eight ohms, twelve ohms etc. This low resistance, or impedance since this is the more correct term, implies that the voltage drop will be small and that the current must therefore be large to produce the total wattage.

We can operate the loudspeaker direct from a low-impedance source (e.g. a high-current, low-voltage transistor output stage), or from a high-impedance source (high voltage, low current, using a valve) provided a matching transformer is interposed. Such a transformer will have a large number of turns of fine wire to form the high-impedance primary winding, and a low number of turns of thicker wire to feed the loudspeaker. Transformers are often used in transistor audio output stages, but the ratio of turns is much smaller as befits the low-to-low matching.

The choice of valve or valves must reflect the amount of power required to operate the loudspeaker. A small portable set for example does not lay much claim to high power or high fidelity sound. One watt of output power is a modest demand but adequate for normal purposes. To deliver this amount is no great strain for a valve operating from say a 200V supply line, and a low-power valve such as the PCF80 performs quite well in the Thorn 1580 series (see Fig. 6), operating with a total cathode current of some 10mA.

This of course is for the pentode section of the valve. Its triode section functions as an audio amplifier, required because the small audio output signal from the ratio detector circuit is not sufficient to swing the control grid of the output pentode adequately to produce the required *variation* of its cathode current. Therefore the output of the detector, as developed across the volume control R79, is applied via the capacitor C65 to pin 9 (control grid) of the triode section, which provides voltage amplification.

It will be observed that there is no resistor in the cathode circuit of the triode to bias the valve to approximately the mid point of its operating slope. The bias in fact consists of the voltage developed across the 10MΩ resistor R82. This keeps the coupling capacitor C65 negatively charged (10MΩ is a high value, and prevents the capacitor fully discharging after it has been charged by the signal voltage from the volume control). Thus the control grid is biased whenever a signal is being received.

Once this has been understood it's easy to see how distortion can be introduced at this early point in the audio circuit. If the capacitor is leaky there will be no bias and the current flow from the cathode to the anode will be heavy (comparatively), causing a large voltage drop across the 220kΩ anode load resistor R83. Whatever signal swings are applied to the grid through the faulty capacitor will have little effect, and the anode voltage at pin 1 will be very low indeed. This is the clue as to what is happening. If the anode voltage at pin 1 is very low, one of two likely faults are present. One is that the capacitor is indeed leaky, but far more likely is that the trouble will be found to be due to the anode load resistor R83 rising in value into the MΩ range. If the anode voltage is non-existent therefore, check the value of the resistor first (red red yellow).

Alternatively, it may be found that the anode voltage is high. This is certainly not due to R83 falling in value. It's due either to the valve being defective or to the 10MΩ resistor R82 becoming open-circuit, leaving the grid biased right off.

These faults are rare however in comparison to the more frequently met ones of no h.t. supply to the pentode section due to R134 (8·2kΩ) being open-circuit, or the PCF80 itself being defective. The rule is to check the voltages at pins 3, 6 and 7. A full 215V should be present at pin 6, with 220V at pin 3. The voltage at pin 7 indicates the current being drawn, and this should result in a 3V volts drop across R90.

Ah, you may say. What if there is no voltage at pin 1 and the 220kΩ resistor is in order? Ah, we would reply. If there is no supply to R83 there will be no supply to the field oscillator either in this set, so the first and most obvious symptom would be field collapse as evidenced by a white line across the centre of the screen. Ah.

Higher Power Circuit

To obtain a greater movement of the loudspeaker voice coil more current is required to drive it. This demands a valve or other device capable of supplying such an increased current.

For example, the big brother of the 1580 series is the 1500 chassis, which has appeared in many guises, from semiportables to 24in. solid wood monsters. This uses a PCL82 triode-pentode audio valve, and it's well worthwhile spending a few moments on this circuit for two reasons. First because almost anyone connected with TV servicing will encounter this chassis and an audio fault in it, secondly because the faults that do arise can be misleading to the uninitiated (and sometimes to those well versed in our craft).

It will be seen (Fig. 7) that the h.t. supply is derived from the wirewound resistor R96. In later versions of the chassis this is a safety item which springs open when overheated, thus cutting off the supply. In earlier chassis R96 was a plain wirewound which could cook up happily (or unhappily) if the current was heavy until the mains fuse failed or R96 became open-circuit. It could also become open-circuit for no good reason. One has to approach the problem with an open mind therefore. The approach depends upon the complaint – no sound, intermittent sound or distorted sound.

Intermittent Sound

Very common, and this applies to a lot of sets which employ a PCL86 audio output valve instead, is intermittent sound. Tapping the valve may restore or remove the sound, and the simple solution is to replace the PCL82, PCL84 or PCL86 (depending on the set).

At the same time, a wise precaution is to check the condition of the cathode bias resistor of the pentode section, as this has a profound effect on the current drawn by the (new) valve. If its specified value has fallen (as it often does, particularly in the Philips 210-300 series) the new valve will have a very short life as the bias is then low and the current drawn is therefore high.

If the valve is not responsible for the intermittency (proved by substitution), attention must be paid to the voltage supplies. Wirewound resistors have the disconcerting habit of occasionally becoming intermittently open-circuit, sealing themselves up on a change of

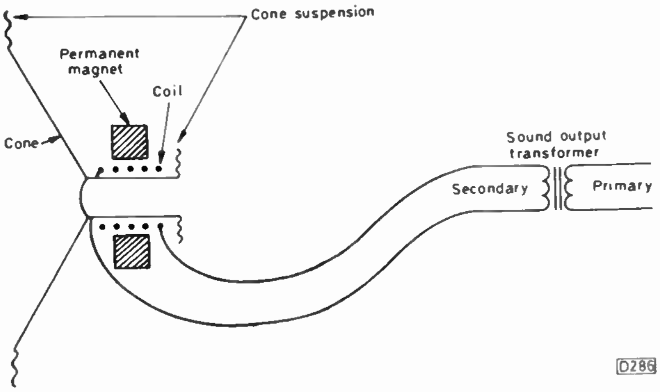


Fig. 5: Operation of a moving-coil loudspeaker.

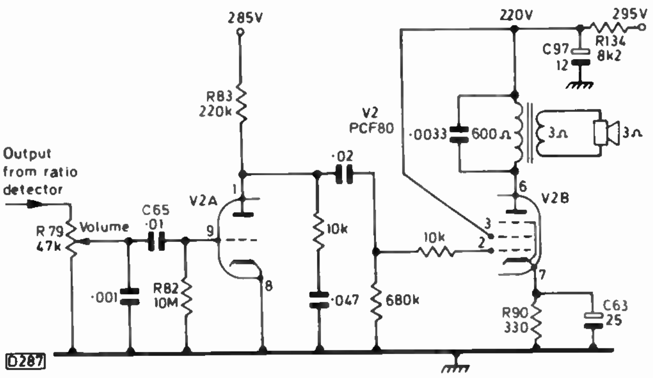


Fig. 6: Audio circuit used in the Thorn 1580 chassis.

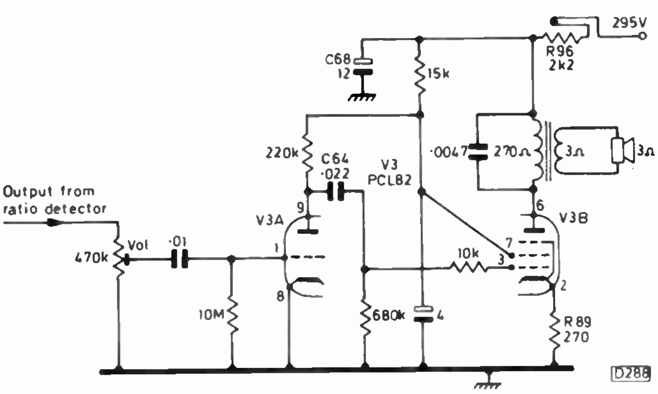


Fig. 7: Audio circuit used in the Thorn 1500 chassis.

temperature. This possibility must not be overlooked. Voltage checks will quickly reveal this sort of caper, and we need not dwell on it.

No Sound

Far more often the complaint is no sound at all. This again can be due to the valve itself, but if the supply is absent some caution is required when restoring it (e.g. attending to R96).

If R96 overheats there are several possibilities. C68 could be leaky, and often is. Therefore a resistance check on the circuit before R96 is restored is necessary. With R96 out of the circuit there should be a very high reading with the positive probe connected to chassis and the negative probe to the capacitor, once the capacitor charging swing has taken place.

Quite often the reading is acceptable and there is no h.t. leakage. Restoring R96 may still result in it overheating however, because the valve is drawing excess current.

The valve may be faulty, R89 may be low in value, or C64 may be leaky. Perhaps all three. This is not at all uncommon. The trouble starts with C64 becoming leaky, thus joining the d.c. at pin 9 to the control grid circuit of pin 3. This causes the valve to draw excessive current, probably suffering permanent damage. The same fate awaits the cathode resistor R89 which bears the full brunt of the current in common with R96 but, being a carbon resistor, R89 can quickly fall in value from its specified 270Ω and will thus constitute a threat to future operation if it is not replaced. Thus the small capacitor C64 must be considered as a most likely but often overlooked cause of trouble in this circuit.

The lesson then is that there may be more than one cause of a fairly obvious effect, and it pays to dig deeper rather than merely to replace any damaged items. If a valve has been passing excessive current, check for a positive voltage at its control grid. If one is present, remove the valve. If the voltage increases, replace or at least check the coupling capacitor.

All this was based on the 1500 chassis. A quick note next to illustrate the differences in "stock faults" between two similar circuits. The PCL82 used in the Philips 210-300 series seems to design its own doom. It overheats, damaging its 470Ω cathode resistor (and probably the associated 80μF decoupling electrolytic as well), also the 1kΩ screen grid and audio amplifier feed resistor situated on the main electrolytic block. We've never known the coupling capacitor to be leaky to cause this however. There's always the first time of course.

Many receivers use the PCL86 audio output valve. It's very often the cause of complete loss of sound, intermittent sound, or distorted sound. Generally replacement is the only action required, with a precautionary check on the cathode resistor to ensure that it hasn't changed value. The value by the way is a lot less than that used with a PCL82 – usually in the region of 120 to 180Ω.

Distorted Sound

The unwary can be fooled by the common fault sound distortion however. We've already made the point that misalignment of a 6MHz coil core (particularly the quadrature coil) can cause distortion. Many a valve has been replaced only to find that the distortion remains and that the only action necessary is slight adjustment of a core in the final sound i.f. coil can. This is particularly so in the case of the GEC series One range of single-standard monochrome sets.

We've stressed the importance of checking the output valve's cathode bias resistor. When there's distortion a resistor which is often overlooked is the anode load resistor in the triode circuit. Whilst the value of this is often say 220kΩ, when the supply is from the normal h.t. line, in some earlier receivers the value is much higher than this with the supply source the much higher boosted h.t. line. Typical h.t. line say 200V, typical boost line say 900V. Whilst this arrangement was used in many earlier Philips designs, it's very rarely encountered now. The more common value of 220kΩ will usually be found. These resistors can go high however, and their value should be checked.

Transistor Audio Circuits

Whilst it's common to operate audio output transistors from a fairly low-voltage supply line, with a low-impedance output coupling, this is by no means universal. For example, some monochrome receivers (e.g. the Decca MS2000/2400 series) use a single high-voltage audio output transistor of

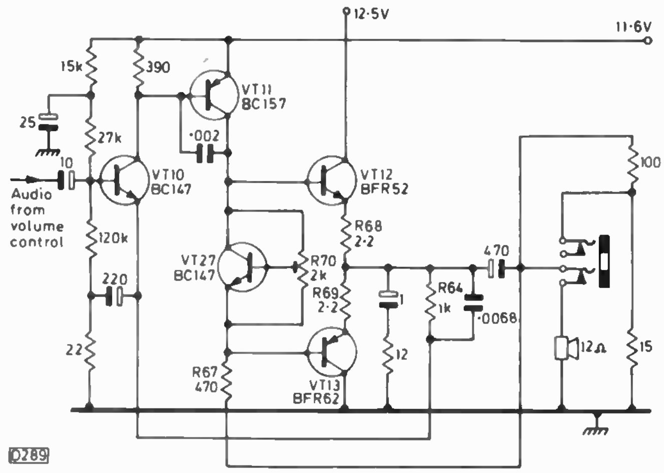


Fig. 8: Typical transistor audio circuit.

the MJE340 type, with a transformer in the collector circuit to match down to the loudspeaker. A similar arrangement is found in some Thorn colour sets, for example the Thorn 8000 series. Not much needs to be said about this type of output stage. Apart from the transistor breaking down completely, it can also be responsible for noise of the "dry-joints" type more usually associated with a poor soldered joint. This occurs when an internal connection fails to make proper contact.

Far more common is the matched audio output pair of npn and pnp transistors which are turned on alternately by a driver or drivers fed from an audio amplifier stage (voltage amplifier). Since the average TV receiver is not called upon to deliver ear-splitting power the heat generated in such circuits is not high and they are reasonably trouble free.

In some receivers both output transistors are npn types and they may be driven directly from an i.c., as for example in the Philips 320 monochrome series and the G8 colour chassis.

When trouble is encountered the rule is start from the loudspeaker and work back. Very often the loudspeaker itself is responsible for distortion or no sound, so it's essential to check this item first. In the Thorn 1590 series, for example, the majority of complaints about the sound end up with loudspeaker replacement (speech coil rubbing in the polepiece instead of floating). The effect of a rubbing speech coil is difficult to describe. It's far more evident on low volume output than it is at high output.

If the distortion is more severe, or if there is no sound at all, the next check after the loudspeaker (a meter on the low ohms range should read the loudspeaker impedance directly if there is no output transformer) should be on any earphone socket that may be fitted (most portables) as there may be poor contact here. The output stage proper may then have to be tackled.

The method of checking transistors with an ohmmeter has been explained in previous parts, and it should be necessary to add only that the presence of a driver transistor must be taken into account when in-circuit readings in the output stage seem right but subsequent voltage readings seem all wrong. If there's doubt, remove the solder from the base contact and take the ohmmeter reading from the isolated lead. Any diodes in the circuit should be checked similarly.

The current in the output circuit is often set and adjusted by a preset control working on the base of a regulating transistor (see later Thorn 1590 circuit, Fig. 8). This transistor (VT27) should not be omitted from the checks. The failure of this transistor will often cause overheating in the output pair, and perhaps failure of one or both of them. If there is any doubt, connect a 22Ω resistor between the bases of the output pair until the cause of the trouble has been located and cleared.

Fault tracing in a transistor audio amplifier is often difficult because the d.c. operating conditions of the first audio amplifier stage determine the conduction of the driver and thus the output pair, while correct operation of the latter determines the voltage applied to the first stage via the d.c. feedback (R64 in Fig. 8) loop. Thus there's room for confusion, and each transistor should be separately tested in such a case. It's essential to tackle this sort of circuit logically, and to understand this type of circuit is to understand many types of transistor field timebase circuits which operate on similar lines.

If the transistors cannot be faulted and there is no sign of overheated resistors (e.g. R68, R69) in the output stage, the next components to come under suspicion are any electrolytic capacitors which may be present in the circuit. These can suffer from one of two basic defects, as has been previously described, i.e. they can dry up and thus fail to couple one part of a circuit to another, or they can leak to upset the operating conditions of the whole audio circuit. Whilst in the latter case a suspect should be removed for testing or the voltage conditions of the circuit checked with it out, in the former case (dried up) an electrolytic capacitor can be rapidly checked simply by shunting a capacitor of similar value across it, observing the polarity markings.

We have pointed out that a loudspeaker is a current-operated device, and that this often involves the dissipation of a certain amount of heat. Transistors and integrated circuits are heat conscious. If they are subjected to increased temperature they will tend to pass more current and in doing so will generate further heat. Under such conditions a transistor can rapidly burn itself out (thermal runaway), and to avoid this possibility any heat generated in the device must be conducted away as efficiently as possible.

To this end some transistors are bolted to the metalwork, which absorbs the heat. Mica washers may be fitted to isolate the transistor electrically. Other transistors may have metal fins clipped to them or may be encased in some sort of housing. It's absolutely essential to preserve this heat conduction when refitting or replacing these items.

Audio ICs

Whilst the majority of sets requiring service at present will have valves or transistors in the audio stages, a fair and ever increasing number will have i.c.s performing most functions including the audio output. The best test for such devices is substitution, which means having the right ones at the right time if delay is to be avoided.

Checks involve taking voltage readings as supplied by the makers, but it's a fair bet that if the supply line is correct and the obvious "software" (loudspeaker, sockets, plugs etc.) is in order the i.c. is suspect.

Whilst some i.c.s nestle in holders and are easily removed, most are soldered to a panel. A certain degree of art is required to remove all the solder neatly and to make the subsequent resoldering good. Many makers' surplus panels are offered by advertisers at attractively low prices. These can be used for more than one purpose, and can provide a good practice ground for a hot iron, a desoldering tool and a steady hand.

It may be thought that we've devoted an undue amount of space to the sound circuits in relation to the TV set as a whole. It's hoped however that these notes will be of help when servicing other equipment which may be of interest to the reader.

Transistors in TV Circuits

Part 5

S.W. Amos, C.Eng., B.Sc., M.I.E.E.

In this series of articles reviewing the applications of transistors in TV circuits we have proceeded in order of operating frequency. We have now reached frequencies of tens of MHz, where the bandwidth occupied by the signal is a fraction of the centre frequency. At such frequencies, *LC* circuits are commonly used as transistor loads or for inter-transistor coupling. This contrasts with most of the linear applications described so far, which have consisted of wideband amplifiers with a response extending almost to zero frequency, where the transistor loads or coupling elements have been substantially aperiodic, i.e. predominantly resistive.

Sound IF Amplifiers

It's normal design practice for transistor i.f. amplifiers in television receivers to have synchronously-tuned input and output circuits. If an attempt is made to secure high gain from such a stage, feedback via the collector-base capacitance will usually be sufficient to cause instability and oscillation. One way of avoiding this is to limit the gain of the stage to a value at which the feedback is ineffective. Fig. 1 shows an example of a sound i.f. amplifier stage in which this principle is used. The centre frequency is 6MHz, and the overall passband of the amplifier about 200kHz.

TR1 is a common-emitter amplifier. It's not automatic-gain controlled, and the mean emitter current is stabilised by the potential divider R3, R4 and the emitter resistor R5.

One of the significant features of the circuit is the use of the capacitance divider C2, C3. C3 has ten times the capacitance of C2, so the divider has an 11:1 voltage step-down ratio. This reduces the gain of the stage to a value at which the collector-base capacitance of TR1 is innocuous. It also avoids the heavy i.f. transformer secondary winding damping that would occur if the transistor was directly connected across it. By virtue of the step-down ratio, the resistance effectively connected across the secondary winding by the transistor input circuit is 11^2, i.e. 121 times, the transistor's input resistance. This probably exceeds the value of the 22kΩ resistor R2, so that the connection of the transistor has little effect on the tuning and Q value of the transformer.

Another interesting point about the circuit is that the input to the transistor (generated across C3) is applied directly between the base and emitter. Thus R5 could not introduce negative feedback even if it was not decoupled In fact R5 is decoupled by C4 but this is necessary to provide a low-impedance path for the output of the transistor. The output is generated between the collector and emitter of course. The collector is directly connected to one terminal of the output transformer primary winding, and the emitter is provided with a low-impedance path to the other terminal via the two decoupling capacitors C4 and C5.

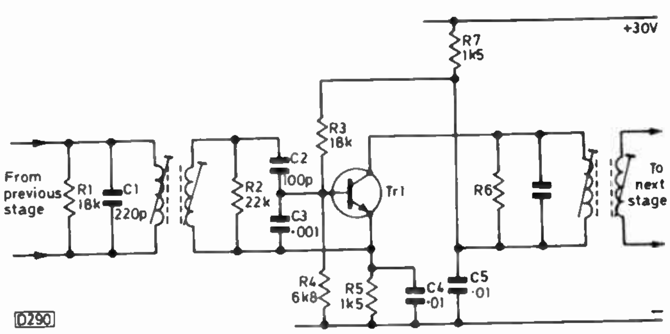


Fig. 1: Typical sound i.f. amplifier stage.

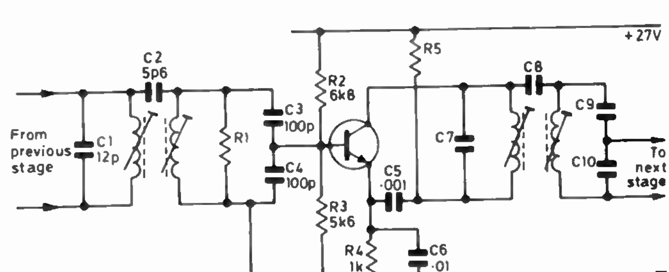


Fig. 2: Vision i.f. amplifier stage.

Vision IF Amplifiers

Fig. 2 shows the circuit of a common-emitter stage of vision i.f. amplification. Stability of mean emitter current is achieved by the usual base potential divider R2, R3 and emitter resistor R4. This circuit differs from that shown in Fig. 1 chiefly in the means adopted to achieve the much wider passband necessary in a vision i.f. amplifier: the standard centre frequency is 36.5MHz and the passband (to include the sound channel also) is 6MHz.

A capacitive divider is again used at the input, but the step-down ratio is only 2:1 so that the secondary winding is effectively damped by a resistance equal to only four times the transistor's input resistance. Heavy damping is thus obtained, and this is one of the means adopted to achieve the required passband. The other means is by choosing a suitably-tight degree of coupling between the windings of the i.f. transformers. Series-capacitance coupling is employed, the capacitors concerned being C2 and C8. As an approximate guide to the values required for C2 and C8, we can say that they should be one sixth the value of the average tuning capacitance for the primary and secondary windings. (One sixth is roughly the ratio of the passband to the centre frequency.) Thus for the input i.f. transformer the average capacitance is (50 + 12)/2 i.e. 31pF. So the coupling capacitor should be approximately 5pF: in fact it's 5.6pF.

Neutralised IF Stages

Stability in the i.f. amplifiers of some older transistor televison receivers was achieved by neutralising the effects

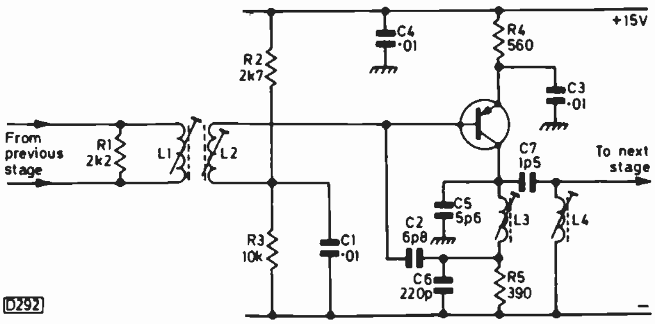
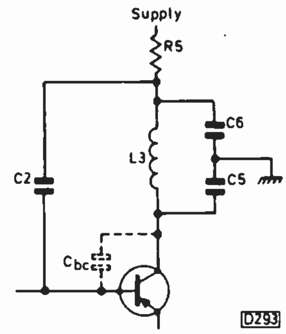


Fig. 3 (left): I.F. amplifier stage with neutralisation.

Fig. 4 (right): The essential features of the neutralising arrangement used in the circuit shown in Fig. 3.

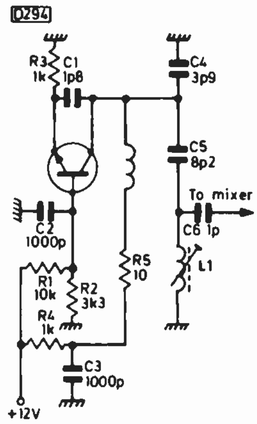


of the collector-base capacitance. The circuit shown in Fig. 3 gives a simplified example.

Again it's basically a common-emitter amplifier with stabilisation of the mean emitter current by use of the base potential divider R2, R3 and emitter resistor R4. The significant components however are the collector decoupling capacitor, C6, which is smaller than might be expected, and the neutralising capacitor C2.

The way in which neutralisation is achieved is best appreciated by redrawing the essential features of the circuit as in Fig. 4. C5 and C6 form a virtual earth point near the upper end of the tuning inductor L3. Provided *C*bc and C2 are in the same ratio as C5 and C6 the base of the transistor will also be at virtual earth potential. Thus signals generated at the output of the transistor will not be transferred to its input. The condition for perfect neutralisation is thus:

$$C2 = Cbc \times (C6/C5).$$



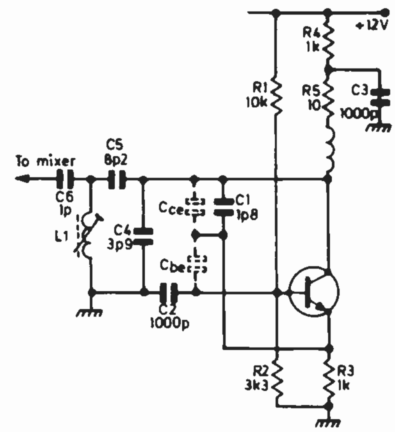


Fig. 5 (left): V.H.F. oscillator circuit as shown in the manufacturer's service manual.

Fig. 6 (right): The oscillator circuit shown in Fig. 5 redrawn to show how the transistor's internal capacitances are used as the feedback components in a Colpitts oscillator circuit.

VHF Oscillators

It's a common technique for v.h.f. oscillators to make use of the internal capacitances of a bipolar transistor as the two fundamental capacitors in a Colpitts oscillator circuit. The collector-emitter capacitance is usually much smaller than the base-emitter capacitance, and is therefore supplemented by an externally-connected component. Because the internal capacitances are not usually shown the circuit is often unrecognisable as that of an oscillator. Fig. 5 gives an example of such a circuit: this is a simplified version of a manufacturer's diagram, but the layout of the component symbols is similar. From the redrawn version of the diagram shown in Fig. 6 it's clear that the circuit is basically a common-emitter stage stabilised by the base potential divider R1, R2 and emitter resistor R3. The circuit operates as a Colpitts oscillator, the two fundamental capacitors being the collector-emitter capacitance *C*ce (supplemented by C1) and the base-emitter capacitance *C*be. Tuning is effected by variation of the inductor L1.

RF Mixers

Some mixer circuits rely for their operation on the curvature of the input-output characteristic of a transistor. The circuit can consist of a common-base amplifier, with the mean emitter current stabilised by the usual base potential divider and emitter resistor as shown in the simplified circuit in Fig. 7. The r.f. signal and the oscillator signal are both applied to the emitter. If the transistor's characteristic was linear, both signals would be amplified independently and the output would contain only components at the two input frequencies. But if, as in practice, the characteristic is curved, the signals will interact and the output will contain a wealth of different frequencies. It's the output at the difference of the two input frequencies that's normally required for feeding to the i.f. amplifier, and the design of the mixer is concentrated on maximising this particular output signal. In achieving this, the value of the bias is all important. This should be chosen, by adjustment of the emitter resistor's value, to give maximum i.f. output for a weak r.f. input, the input from the oscillator being assumed to be constant. This circuit is an example of an additive mixer.

It's possible to persuade the mixer itself to oscillate, thus avoiding the need for a separate oscillator, but the bias for a self-oscillating mixer is more critical than for a simple mixer. Clearly the transistor must be biased near cut off to achieve the non-linearity of input-output characteristic essential for successful mixing, but there must be sufficient collector current to permit oscillation. In spite of this limitation, self-oscillating mixers are widely used and are capable of conversion gains not far short of that obtainable from a mixer with a separate oscillator. Circuits are similar to those of separate oscillators, with provision for injecting the r.f. signals and for abstracting the i.f. output.

A simplified example of a u.h.f. self-oscillating mixer circuit is shown in Fig. 8. The mean current through the transistor is stabilised by the base potential divider R1, R2 and the emitter resistor R3. The transistor operates in the common-base mode, the base being decoupled to chassis by C1. The input tuned circuit of the mixer consists of a half-wave length of transmission line X1, tuned by the capacitance diode D1 and fed from the r.f. amplifier in the next compartment via the coupling loop X4. X1 is coupled to the emitter by the coupling loop X3. The oscillator circuit consists of a length of line X2 which is tuned by capacitance diode D2 and the trimmer C3 and coupled to the collector by C2. The coupling loop X3 is extended into the oscillator-

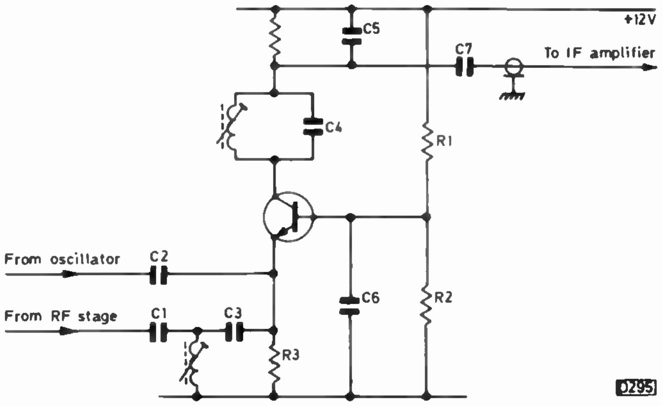


Fig. 7: Simplified additive mixer circuit.

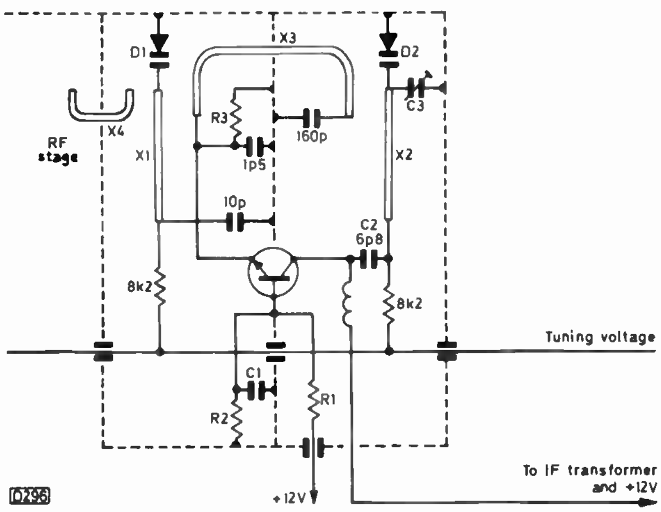


Fig. 8: Self-oscillating u.h.f. mixer circuit.

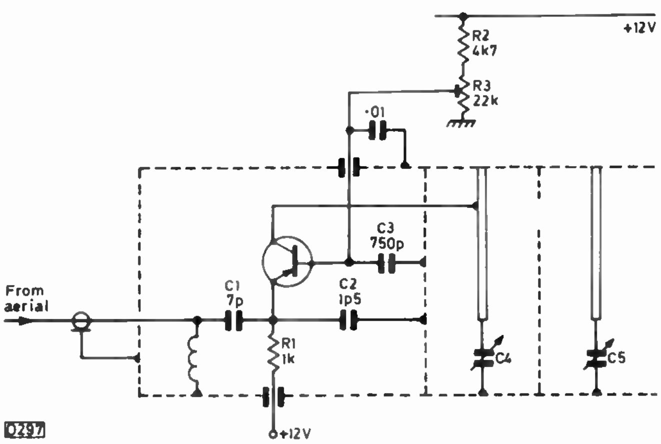


Fig. 9: U.H.F. r.f. amplifier circuit.

circuit compartment so as to couple with X2, in this way providing the positive feedback essential for oscillation.

Multiplicative Mixers

It's possible to derive a difference-frequency output from a transistor even if it has a strictly linear input-output characteristic. To achieve this, the transistor must have two input terminals and the output current must be dependent on the product of the signals applied to the two inputs. If the r.f. input is applied to one input and the oscillator input to the other, the output will contain a difference-frequency component. There is no need for non-linearity in this form of mixer, because the difference-frequency output arises from the fact that the two input signals are effectively multiplied together. One example of a transistor which can be used as such a multiplicative mixer is the dual-gate field-effect transistor.

RF Amplifiers

Fig. 9 shows the circuit of a common-base amplifier used as an r.f. stage in a u.h.f. tuner. The mean emitter current of the pnp transistor is determined by the potential divider R2, R3 which feeds the base and R1 in the emitter circuit. The interesting feature of this circuit however is that R3 is a preset component enabling the potential applied to the transistor's base to be adjusted. This in turn controls the mean emitter current which determines the mutual conductance of the transistor and hence its gain. Thus R3 acts as a preset gain control, enabling the gain to be set to a low value for reception of strong signals and at high values for receiving weaker signals. Such a control is probably labelled on the receiver as a local-distant control.

The emitter circuit is untuned, and the capacitors C1 and C2 are chosen to secure a good match between the aerial impedance and the emitter input resistance of the transistor. The output (collector) tuned circuit is a length of transmission line slightly less than a quarter wave in length. It therefore appears inductive, and is tuned to resonance by C4. This line is coupled to a similar line in the next compartment of the tuner to form a bandpass filter. Coupling is achieved via an aperture in the wall between the compartments, the capacitance between the lines providing the required degree of signal transfer.

Acknowledgement

In conclusion the author would like to record his thanks to the television receiver manufacturers, particularly Thorn Consumer Electronics and Rank Radio International, for permission to use their circuit diagrams to illustrate this series of articles. ■

Your PROBLEMS solved

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ASA CT6000A

There was a flashover and the picture collapsed to half height, with hum bars. The 2·7Ω, 7W resistor Rg45 glows red hot. Before this fault there was slight loss of height, even at the top and bottom.

The 28·6V supply for the field driver and output stages is derived from the input coil in the thyristor line output stage, and passes via Rg45. The fact that this resistor is glowing red suggests that the field output stage is drawing excessive current, though we have known of instances where this resistor, oddly enough, has increased in value. It then dissipates a disproportionate part of the supply, overheating and depriving the field driver and output stages of their normal supply and giving the symptoms quoted. There should be 32V at one side of the resistor and 28·6V at the other. Such a low resistance value is hard to measure accurately, so it would be better to fit a replacement or a few resistors to make up the value and wattage. Make sure that the associated smoothing capacitor Cg22 (2,200μF) is not leaky. If the field timebase is taking excessive current, first check for any signs of overheating components, replacing any discoloured resistors, and make sure that diodes Dg5-7 are in order – these set the bias at the bases of the two field driver transistors and thus the conditions in the output stage as well. Also check that the field scan coupling capacitor Cg20 (3,300μF) is in order.

HITACHI CEP180

The trouble with this set is no colour. The waveform at the secondary of the burst discriminator driver transformer was scoped and found to be correct but of low amplitude. The signal panel was swapped with one from another set of the same type, restoring colour, so we decided to see whether the fault on the original panel could be located. The two ident amplifier transistors TR26 and TR27, the burst gate/amplifier transistor TR20, the reference oscillator transistor TR21 and the chroma/burst amplifier transistor TR19 have all been replaced, as have the burst discriminator diodes CR8/9 and the 4·43MHz crystal X501, but the fault is still present. The voltages at the emitter of TR19 and at the collector of the a.c.c. detector transistor TR24 are both low, and the colour killer voltage is absent, i.e. no 4V at the collector of TR28.

This is a bit of a chicken-and-egg problem. The burst ripple is fed to the two ident transistors, the output from the second driving the colour-killer transistor TR28 and the a.c.c. detector transistor TR24. Clearly there's low output at some point in this feedback loop, and we suspect the ident amplifier stages TR26 and TR27. First check the tuning of TR27's output transformer T503, also the tuning of TR26's output coil L508. Then make sure that the decoupling electrolytics in the emitter circuits of these two transistors have not dried up – C535 and C538, both 22μF, 16V. Make sure that C561 which decouples the collector of the colour-killer transistor is in order. This is another 22μF, 16V electrolytic. There could be other faults, but the first priority should be to ensure that maximum output is obtained from the ident amplifier stages.

PYE 697 CHASSIS

When this set was obtained there was no field output and the tuning was unstable. Replacing the field output transistors and the 33V tuning line stabilising diode D5 cured these faults. Two faults remain. First, just after the picture comes up, a confetti-like line, wavering and shimmering, appears from top to bottom about two-thirds of the way across the screen. At its most intense it causes hum on sound. The shimmering line and hum disappear within a few minutes, and do not reappear until the set is next switched on. Disconnecting the degaussing coils has no effect on this symptom. The second fault is a tendency for every second line in strong red or yellow areas to have no or wrong colour – this condition appears to be intermittent.

The symptoms during warm up could well be caused by corona, due to dust around the e.h.t. parts, or to a poor aquadag or chassis connection. The other trouble is Hanoverian blinds and usually means that the delay phase adjustment coil L32A in front of the chrominance delay line is misadjusted.

THORN 980 CHASSIS

There is an intermittent fault on this set. Usually there's a good picture and reasonable sound, then without warning the sound drops and the picture becomes unstable, sometimes breaking up. The sound and picture return to normal without the set being touched. Alternatively, sometimes the reduced sound is accompanied by a picture which is not too clear.

Since this is a 405-line only set, the trouble must be in the tuner or the common vision and sound i.f. stage. Assuming that the aerial is o.k., we suggest you clean the tuner biscuits and check the two valves in the tuner, also the oscillator's feed resistor R206 (5·6kΩ). If the fault persists, check that the EF183 common i.f. valve's holder is tight, the valve itself, its screen grid feed components (R7/R8/C3) and the joints on the i.f. lead to the i.f. strip.

HITACHI CNP190

This set detunes itself intermittently. Sometimes the colour is lost, sometimes the complete signal, necessitating retuning. This happens most on the weakest station, though sometimes on the strongest one.

The set's fitted with a varicap tuner unit and the usual causes of this trouble are either a defective zener diode in the tuning supply or a defective tuner. The zener diode is CR110, type ZTK33H. The most likely tuner fault is one of the tuning voltage feedthrough capacitors C123 or C125 (0·001μF), though it's best to replace the tuner unit. Check whether the detuning occurs on all four channel selectors: this unit could also be faulty. There are a couple of other diodes (CR111 and CR112) in series with the supply to the push-button unit, and it's just possible that these could be defective.

PYE 169 CHASSIS

On switching on, three pictures appeared across the screen. Adjusting the line hold control was tried, but the pictures just rolled to the right or left. New timebase valves were fitted, giving a steady, upright display, but there are still two pictures instead of one, while the last part on the right-hand side is blank.

The line oscillator coil's core could be cracked, or it could be the wrong type if it's been replaced. If this is not so, check the 820pF oscillator feedback capacitor C67 and the 40μF electrolytic C66 in the cathode circuit of the reactance section of the line oscillator.

THORN 1400 CHASSIS

A wavy line running from the bottom to the top of the screen on the right-hand side appears whenever the picture is mainly white. The line is accompanied by a loud buzzing noise.

We suggest you check the a.g.c. clamp diode W1 and, if the set is used on 625 lines only, remove the v.h.f. vision detector diode W4 altogether. If necessary, check the i.f. valves V3 (EF183) and V4 (30PL14) and the video output valve V5 (6F28) by substitution. Make sure that V5's screen grid feed resistor R36 is the later value – 8·2kΩ instead of 3kΩ.

DECCA 30 CHASSIS

The picture is o.k. for the first few minutes, during which the channel can be changed without ill effect. Once the set has warmed up however channel change, adjustment of the tuning, severe ignition interference or even switching a radiogram on/off etc. results in line lock being lost.

There's a sure-fire drill for this symptom, which is due to line oscillator drift. Replace the PCF802 line oscillator valve, the two flywheel sync discriminator diodes D402/3 (types 1N914 or 1N4148 are suitable), and the three electrolytics in the line oscillator circuit (C419, C423 and C425). Then short TP400 and TP401 and adjust the line oscillator coil L401 for vertical floating lines. Finally remove the short.

THORN 1500 CHASSIS

We were plagued by intermittent field collapse on one of these sets. The picture could be momentarily restored by increasing the voltage at the anode of the field oscillator, with the back removed. A new PCL805 was fitted, the boost feed/height circuit components checked, and the oscillator feedback components examined, all to no avail. It was eventually found that the output pentode's cathode bias resistor R103 was defective when hot!

Many thanks for this tip.

BUSH TV161 SERIES

There's an unusual fault on this set – the voltage on the a.g.c. line rises and falls, giving results akin to aircraft flutter. The trouble can be stopped by advancing or retarding the contrast control, but returns when the control is at the correct setting. The two transistors in the a.g.c. circuit, the conditions in the video circuit and the voltages in the i.f. strip have all been checked. Everything is in order except for voltage fluctuations caused by the a.g.c. line variations.

The following components are suspect for a.g.c. bounce: the a.g.c. reservoir capacitor 2C79 (8μF), the two delay diodes 2MR1 and 2MR2, and the decouplers 2C3 and 2C12 (both 0·01μF). If necessary, check the 2[illegible]V supply reservoir capacitor 2C49 (1,500μF) and the 8μF smoothing capacitor 2C80.

THORN 1400 CHASSIS

The screen gradually darkened, but the set was used until the raster and sound went. The h.t. rectifier was found to be short-circuit, but on replacement a 405-line picture with sound were obtained but there was neither picture nor sound on 625 lines. The video output valve was changed and the voltages in this stage checked. They were roughly right, up a bit. Then the screen darkened, with a darker area in the centre. The raster in fact is visible only at maximum brightness, though operating the brightness control varies the voltage at the c.r.t.'s cathode. Maybe the c.r.t. has an internal short?

If the screen can be illuminated by advancing the brightness control we would not suspect that the c.r.t. has an internal short. Replacing the h.t. rectifier would be necessary to restore the h.t., but would not be the cause of the original and present trouble. The darkened area in the centre of the screen suggests that the e.h.t. is low. So, if the picture is of the correct width, check by replacement the e.h.t. tripler which is clipped to the side of the line output transformer, but if the width is insufficient with low brightness check the line output valve, the width control and the resistors in the width circuit. The lack of signals on 625 lines could be due to defective contacts on the system switch.

DECCA CTV25

The fault is lack of width, with the picture ballooning unless the brightness and contrast controls are kept very low, when the picture is too dim. The line output stage valves have been renewed and the 10MΩ resistor in the width circuit checked, and there's –65V at the control grid of the line output valve. The d.c. feed coil L408 also seems to be o.k.

If possible, the 625-line third harmonic tuning coil L405 should be checked and set up as specified in the manual. If the voltage at the anode (pin 8) of the boost diode is less than 240V, check the h.t. reservoir/smoothing capacitor C702 in the power pack. If these two steps give no joy, the line output transformer is suspect for shorting turns.

THORN 981 CHASSIS

The first problem was reduced width, about 1½in. at each side, with the width control having no effect. Later the mains fuse blew, and on replacing this it was noticed that the PY801 boost diode was not alight. This was changed, but still without results, while the PL81A line output valve's screen grid feed resistor was observed to be overheating badly.

The line output valve's screen grid feed resistor will overheat if the PY801 is not operating, since the anode of the PL81A will be without an h.t. supply and its entire cathode current will be flowing through the screen grid resistor. If the PY801 does not light up but the other valves do, either the valve's glass envelope is cracked or there's a short between pins 4 and 5 of the base. When that's been sorted out, check the resistors in the width circuit, R109 (330kΩ) in series with the width control (it's probably gone high value), the control itself, and the two high-value (2·2MΩ) resistors R107 and R106 between the slider of the width control and the PL81A's control grid.

DECCA CTV25

There's a colour fault on this set. When the left-hand side of the screen is pale blue the red gun is triggered, causing bands of mauve across the whole width of the screen. Any faces in line with these bands turn to green. The fault is present only when the start of the scan is pale blue. There's also a 50Hz sound hum that's defied all attempts at curing it despite changing all the smoothing capacitors.

The colour fault is typical of mistiming of the burst gate pulse. This pulse comes from TR201 on the luminance panel, and occurs when the associated coil L200 rings. An oscilloscope will be essential to check the timing of the pulse at L200 – it should coincide with the burst signal of course. Possible culprits are the coil itself or the 2μF coupling electrolytic C203 between the coil and the transistor. For the hum on sound, check the earthing of the braid to the volume control. We assume that your smoothing capacitor checks included both the h.t. and l.t. line decouplers.

THORN 1400 CHASSIS

The picture is stretched both vertically and horizontally, with a dark shadow in the centre of the screen and lack of brilliance.

These are the classic symptoms of low e.h.t. Try a new e.h.t. tripler tray, quoting the chassis number when ordering. In the unlikely event that the trouble persists, fit a new PL504 line output valve.

TEST CASE

189

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.

A Sobell 1040 hybrid colour set (GEC chassis) was working fine on the signal side, but suffered from the disconcerting effect of small, intermittent fluctuations in height. The chassis uses an ECC82 double-triode multivibrator field oscillator and a PL508 output pentode.

When the height control on these sets has been left in one position for a long time a poor contact spot sometimes develops on the track. This can cause the symptom, but in this case cleaning the control and rotating it a number of times made no difference. Another possibility is an ECC82 fault, which can often be brought to light by tapping the valve's envelope with the handle of a screwdriver while observing the effect on the screen. The valve appeared to be all right on this test, but by wriggling it in its holder the scan could be made to fluctuate slightly. The pins were cleaned, but the intermittent effect remained.

Both the ECC82 and the PL508 were temporarily replaced, after which the symptom appeared to have cleared. Not for very long though, for after running for an hour or so it was back again! The 32μF electrolytic which decouples the PL508's cathode looked a little worse for wear and was changed, but to no avail. There's the usual voltage-dependent resistor (VDR) in the field-charging circuit to help stabilise the field scan with changes in supply load. Having had trouble with VDRs before, the technician changed this component. Still no luck.

The ECC82's anode voltages were measured with a 1,000Ω/V meter, and although the readings appeared to remain steady even when the symptom was present, it was observed that when the meter was connected between the anode of the second triode and chassis the field scan fluctuations became more vigorous and less intermittent, with an accompanying reduction in scan amplitude. The resistors in this area were measured in-circuit with a high-reading ohmmeter, and appeared to have approximately correct values. The multivibrator cross-coupling capacitors were also changed, but the intermittent symptom remained.

In view of these facts, what was the most likely cause of the trouble? See next month for the solution and for a further item in the series.

SOLUTION TO TEST CASE 188

– Page 552 last month –

The incorrect voltages in the red channel indicated that the cause of the red tinge on the screen of a Bush Model CTV1126 (A823A chassis) lay in this area. The resistors and capacitors in the feedback clamp circuit were found to be in order, but the key component here is the clamp diode whose cathode is connected to the output transistor's collector. Positive-going pulses from the line output stage are fed to the anode of the clamp diode, and its conduction produces a negative voltage across the pulse coupling capacitor. This voltage is filtered and applied to the base of the first transistor in the circuit to adjust the bias at this point so that the correct black level is obtained. In the case in question the diode (type BA157) was found to be open-circuit, with the result that there was excessive positive bias at the base of the first transistor. The resultant low output transistor collector voltage was responsible for the excessive red on the screen. It's interesting to note that leakage in the diode would have the same effect, as would an open-circuit feedback resistor or pulse coupling capacitor.

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TELEVISION SEPT 1978

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AA119 Diode	0.11
OA47 Diode	0.08
OA79 Diode	0.08
OA81 Diode	0.08
OA85 Diode	0.08
OA90 Diode	0.08
OA91 Diode	0.08
OA95 Diode	0.08
OA202 Diode	0.12
BA100 Diode	0.12
BA102 Diode	0.07
BA130 Diode	0.10
BA145 Diode	0.20
BA148 Diode	0.20
BA154 Diode	0.06
BA155 Diode	0.09
BA164 Diode	0.09
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IN4003 Rectifier	0.09
IN4004 Rectifier	0.09
IN4005 Rectifier	0.10
IN4006 Rectifier	0.10
IN4007 Rectifier	0.11
BY142 Rectifier	0.10
BR100	0.30
BR101	0.35
BRY39	0.35
BT116	1.70
BT119	2.00
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TV106	1.40
2N4443	1.00
BT100A/02	1.50
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BYX55/350	0.60
BYX55/600	0.60
BYX71/600	0.60
2N4444 Thyristor	1.27
BT109 Thyristor	1.27

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AC128 Transistor	0.20
AC128/01 Transistor	0.30
AC141 Transistor	0.20
AC141K Transistor	0.30
AC142 Transistor	0.27
AC142K Transistor	0.45
AC153 Transistor	0.45
AC176 Transistor	0.30
AC176/01 Transistor	0.45
AC186 Transistor	0.30
AC187 Transistor	0.30
AC187K Transistor	0.45
AC188 Transistor	0.30
AC188K Transistor	0.45
AC193K Transistor	0.45
AC194K Transistor	0.45
AD140 Transistor	1.50
AD142 Transistor	1.50
AD143 Transistor	1.50
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AD161 Transistor	0.50
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AD262 Transistor	1.20
AF114 Transistor	0.45
AF115 Transistor	0.45
AF116 Transistor	0.45
AF117 Transistor	0.45
AF118 Transistor	0.45
AF121 Transistor	0.45
AF124 Transistor	0.45
AF125 Transistor	0.45
AF126 Transistor	0.45
AF127 Transistor	0.45
AF139 Transistor	0.45
AF239 Transistor	0.60
AL102 Transistor	2.70
AU107 Transistor	2.70
AU110 Transistor	2.70
AU113 Transistor	2.70
BC107 Transistor	0.15
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BC184LC Transistor	0.12
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BC187 Transistor	0.18
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BC214L Transistor	0.10
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BC238 Transistor	0.10
BC251A Transistor	0.10
BC301 Transistor	0.30
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BC307 Transistor	0.10
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BC328 Transistor	0.11
BC337 Transistor	0.11
BC338 Transistor	0.11
BC547 Transistor	0.11
BD115 Transistor	0.35
BD116 Transistor	0.80
BD124P Transistor	1.80
BD131 Transistor	0.45
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BD144 Transistor	2.50
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BD177 Transistor	0.60
BD183 Transistor	0.60
BD187 Transistor	0.60
BD210 Transistor	1.24
BD235 Transistor	0.54
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BD238 Transistor	0.54
BD239 Transistor	0.54
BD380 Transistor	0.54
BD437 Transistor	0.54
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BD535 Transistor	0.54
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BD538 Transistor	0.54
BDX73 Transistor	0.60
BDY201 Transistor	2.10
BF115 Transistor	0.45
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BF121 Transistor	0.60
BF152 Transistor	0.30
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BF200 Transistor	0.10
BF224 Transistor	0.10
BF240 Transistor	0.12
BF241 Transistor	0.12
BF256LC Transistor	0.36
BF257 Transistor	0.36
BF258 Transistor	0.37
BF271 Transistor	0.45
BF273 Transistor	0.15
BF274 Transistor	0.18
BF336 Transistor	0.37
BF337 Transistor	0.37
BF338 Transistor	0.39
BF355 Transistor	0.63
BF458 Transistor	0.15
BF459 Transistor	0.15
BFT43 Transistor	0.39
BFX29 Transistor	0.35
BFX84 Transistor	0.33
BFX85 Transistor	0.33
BFX88 Transistor	0.33
BFX89 Transistor	0.33
BFY50 Transistor	0.33
BFY51 Transistor	0.33
BFY52 Transistor	0.33
BFY90 Transistor	0.90
BDX32 Transistor	2.40
BU105 Transistor	1.50
BU105/01 Transistor	2.40
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BU105/04 Transistor	2.40
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BU204 Transistor	1.50
BU205 Transistor	1.50
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BU208 Transistor	2.40
BU208/02 Transistor	2.40
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BU406D Transistor	2.66
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R2009 Transistor	2.25
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ME0412 Transistor	0.15
ME4003 Transistor	0.10
ME6002 Transistor	0.15
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MJE520 Transistor	0.60
MJE2955 Transistor	0.96
MJE3055 Transistor	0.87
MJ2955 Transistor	1.20
MJ3055 Transistor	1.20
MPB113 Transistor	0.75
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MPSU55 Transistor	0.90
TIP31A Transistor	0.48
TIP32A Transistor	0.48
TIP41A Transistor	0.75
TIP42A Transistor	0.75
TIP2995 Transistor	0.96
TIP3055 Transistor	0.96
TIS91M Transistor	0.21
2N2904 Transistor	0.33
2N2905A Transistor	0.36
2N2905 Transistor	0.36
2N3053 Transistor	0.36
2N3055 Transistor	0.88
2N3703 Transistor	0.12
2N3705 Transistor	0.12
2N3710 Transistor	0.12
2N5296 Transistor	0.57
2N5298 Transistor	0.57
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2N6180 Transistor	0.90

INTEGRATED CIRCUITS

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TBA530Q Int Circuit	2.40
TBA540 Int Circuit	2.60
TBA540Q Int Circuit	2.60
TBA550 Int Circuit	3.15
TBA550Q Int Circuit	3.15
TBA560C Int Circuit	3.15
TBA560CQ Int Circuit	3.48
TBA570 Int Circuit	1.62
TBA570Q Int Circuit	1.74
TBA641 BX1 Int Circuit	2.61
TBA641 B11 Int Circuit	3.18
TBA651 Int Circuit	1.75
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TBA720AQ Int Circuit	2.60
TBA730 Int Circuit	0.50
TBA750 Int Circuit	2.25
TBA750Q Int Circuit	2.40
TBA800 Int Circuit	1.30
TBA810S Int Circuit	1.50
TBA820 Int Circuit	1.05
TBA920 Int Circuit	3.66
TBA920Q Int Circuit	3.75
TBA990 Int Circuit	3.75
TBA990Q Int Circuit	3.66
TCA270Q Int Circuit	2.00
TCA900 Int Circuit	0.87
TCA940 Int Circuit	2.25
TDA1170 Int Circuit	2.60
TDA1200 Int Circuit	2.25
TDA1270 Int Circuit	2.60
TDA1412 Int Circuit	0.90
TDA2020 Int Circuit	3.80
MC1307P Int Circuit	1.60
MC1310P Int Circuit	1.60
MC1327P Int Circuit	2.10
MC1327PQ Int Circuit	2.10
MC1330P Int Circuit	1.35
MC1351P Int Circuit	1.74
MC1352P Int Circuit	1.30
MC1358PQ Int Circuit	1.40
SN76003N Int Circuit	3.10
SN76003ND Int Circuit	2.60
SN76013N Int Circuit	2.20
SN76013N07 Int Circuit	2.20
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SN76131N Int Circuit	1.90
SN76226DN Int Circuit	1.30
SN76227N Int Circuit	0.50
SN76532N Int Circuit	1.50
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ECC81 Valve	1.20
ECC82 Valve	1.02
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ECC84 Valve	1.35
ECC85 Valve	1.75
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ECF82 Valve	0.65
ECF86 Valve	1.10
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ECL83 Valve	1.10
ECL84 Valve	0.90
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EF80 Valve	1.20
EF83 Valve	1.70
EF83 Valve	1.70
EF85 Valve	1.20
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EF89 Valve	2.45
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EF183 Valve	1.10
EF184 Valve	1.10
EH90 Valve	1.90
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EL36 Valve	0.90
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PCC85 Valve	1.50
PCC89 Valve	2.00
PCC189 Valve	2.00
PCC806 Valve	2.50
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UCL83 Valve	0.75
UF41 Valve	0.75
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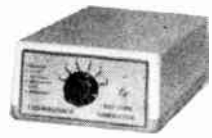

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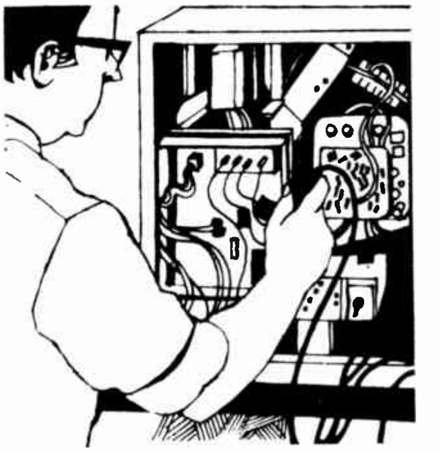

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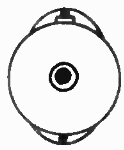

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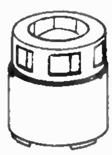

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220M 25v	470M 25v
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